

Local Market Equilibrium and the Design of Public Health Insurance System^{*†}

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Abstract

We study the design of public health insurance system and its equilibrium impacts on the labor market and the health insurance market. We develop an equilibrium model with rich heterogeneities across local markets, workers and firms; and estimate it exploiting variations across states and policy environments before and after the Affordable Care Act. The estimated model closely matches the distribution of insurance and employment status before and after the ACA. With the estimated model, we study the impacts of programs in the form of the newly proposed Medicaid block granting, which allows for state-specific Medicaid eligibility and coverage rules.

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1 Introduction

Re-designing the public health insurance system has been one of the most debated policy issues under the Trump administration, which would bring major changes to policies under the 2010 Affordable Care Act (ACA). One proposal, known as “block granting,” would cap federal spending on Medicaid in the form of lump sum transfers to each state, and leave each state in charge of its own policy on Medicaid eligibility and coverage. This policy could directly affect the current 75 million Medicaid beneficiaries, especially the millions made eligible by the ACA Medicaid expansion.¹ Indirectly, its impact could spread to the rest of the economy via its equilibrium impacts on the labor market and the insurance market. This paper examines the potential impacts of such policies and provides information necessary for optimal designs of the public health insurance system.

To achieve this goal, one has to account for several complications. First, an informative study of a policy such as Medicaid block granting should put it in the context with other related health insurance policies, because these policies interact with one another and because multiple changes to the public health system are being considered. For example, policies driving the recent increase in Medicaid enrollment include not only the expansion of Medicaid but also components like the individual mandate, which is also proposed to be changed or eliminated. Understanding how different policy components jointly increased Medicaid enrollment provides the basis for predicting counterfactual enrollment patterns should one or more of these components be changed. Second, the impact of these policies can be highly heterogeneous across individuals and across local markets. Giving states more autonomy in health care policies may potentially improve efficiency, but one has to first understand the distribution of these impacts under counterfactual policy environments. Third, health insurance policies, even if targeted at a sub-population, can lead to major equilibrium impacts. For example, changes in Medicaid eligibility may change the risk pool in the private insurance market, as well as the demand for and the provision of employer sponsored health insurance (ESHI).

We develop a local market equilibrium model that incorporates the above factors into a coherent framework. In the model, each local (i.e., state) market consists of a market-specific distribution of firms and households. Markets are subject to sets of policies including health insurance regulations, which may vary across states and policy eras. Households differ in their family structures, needs for health insurance, human capital levels and values of non-market time. A household chooses, for each adult member, among the options of full-time jobs with

¹According to the Department of Health & Human Services, between 2013 and 2015, Medicaid enrollment increased by 10.3 million or 17.6%, mostly (9.1 million) among enrollees made eligible by the ACA Medicaid expansion. Meanwhile, government expenditure on Medicaid also increased by 21% to a total of \$554.3 billion.

and without ESHI, part-time jobs with and without ESHI, and non-employment. It also makes decisions on Medicaid enrollment (if eligible) and on private health insurance participation. Firms differ in their total productivity and the substitutability between full time and part time labor. A firm chooses the number of workers to hire from each (skill, full/part time) category and whether or not to offer ESHI. Wages are determined competitively on the labor market. The insurance market is subject to an adverse selection problem, the severity of which may vary with public insurance policies, such as Medicaid eligibility. In equilibrium, health insurance premium satisfies the zero profit condition.

To estimate such a model, which allows for unobserved heterogeneity across households, firms and states, one needs data with rich variations. We utilize the opportunity provided by ACA, exploiting its comprehensive design of various policy components, its differential implementation across states, and its significant impacts across the nation. In particular, ACA created rich variation in the policy environment across time by introducing five major policies that interact with one another, i.e., individual mandate, employer mandate, health insurance exchanges (HIX), HIX premium subsidies, and Medicaid expansion, and across states because Medicaid was expanded in some but not all states. We exploit these detailed variations in our model to identify policy-invariant parameters such as the state-specific distribution of household preferences and production technologies. We estimate the model using four data sources: the American Community Survey, the Current Population Survey, Medical Expenditure Panel Survey (MEPS), and the Kaiser Family Employer Health Insurance Benefit Survey (Kaiser). The first three are individual-level data sets on labor market (employment status, job status, wage), health, health insurance, and medical expenditure, while the fourth is a cross-sectional firm-level data set containing information about firms' characteristics, health insurance coverage and states they belong to. We estimate the model using indirect inference, where we explore the different policy environments across states and across policy eras.

For the purpose of model validation, we deliberately leave the post-ACA data for a non-random sample of states out of the estimation. The estimated model well matches the patterns in the data, including the hold-out sample, across demographic groups and states before and after the ACA.

Using the estimated model, we first examine how various health care policy components interact and affect the equilibrium, through the lens of ACA. We investigate the contribution of each of the five major ACA components in generating the total ACA impact on the distribution of market outcomes and the distribution of household welfare. Then, we use the model to study the impacts of programs similar to Medicaid block granting, which allows for state-specific Medicaid eligibility and coverage rules.

To shed light on policy designs with relatively less restrictive modeling assumptions for identification, our paper combines the strengths of two strands of the literature on the link between health insurance systems and labor markets, one relying on experiments or quasi-experiments and the other on structural models.² One subset of the first strand of literature studies health care policies using random experiments; for example, Finkelstein, Taubman, Wright, Bernstein, Gruber, Newhouse, Allen, Baicker, and the Oregon Health Study Group (2012) and Baicker, Finkelstein, Song, and Taubman (2013) on the impact of Medicaid on health and labor supply using the Oregon Medicaid experiment. A second and larger subset of the first strand of literature often utilizes policy variations via a difference in differences (DD) approach to study the impact of health reforms. For example, Kolstad and Kowalski (2010) and Kolstad and Kowalski (2012) on the Massachusetts health care reform, Garthwaite, Gross, and Notowidigdo (2013) on the Tennessee Medicaid reform, and Kaestner, Garrett, Gangopadhyaya, and Fleming (2015), Gooptu, Moriya, Simon, and Sommers (2016) and Leung and Mas (2016) on the early impact of the ACA. In particular, the last three papers utilize the same policy variation as we do in this paper, i.e., the cross-state variation in Medicaid expansion policies under the ACA. They find that Medicaid expansion lowers the uninsured rate but has insignificant impacts on labor market outcomes. Frean, Gruber, and Sommers (2016) employ a difference-in-difference-in-difference estimation strategy that relies on variation across income groups, areas, and years to study the ACA impacts on insurance coverage. In particular, they assess the relative contributions to insurance changes of the subsidized premiums for Marketplace coverage, the individual mandate, and the expanded Medicaid eligibility.

The second strand of literature takes a structural approach.³ Using a microeconomic approach, Aizawa and Fang (2013), Aizawa (2016) and Fang and Shephard (2015) incorporate the existence of health insurance markets into search models. They estimate the models using pre-ACA data and then evaluate the potential impact of the ACA through counterfactual experiments.⁴ Hackmann, Kolstad, and Kowalski (2014), Handel, Hendel, and Whinston (2015), and Tebaldi (2016) estimate equilibrium models of HIX. Other examples that use a calibration approach to study macroeconomic impacts of the ACA include Ozkan (2011), Cole, Kim, and Krueger (2012), Hansen, Hsu, and Lee (2012), Pashchenko and Porapakkarm (2013) and Nakajima and Tuzemen (2015). Our paper well complements these earlier papers. First, by exploiting policy variations across states before and after ACA, we are able to study counterfac-

²See Currie and Madrian (1999) and Gruber (2000) for reviews of earlier work in this literature.

³We restrict our review to studies on the ACA. See Dey and Flinn (2005) for an example of earlier structural papers in this literature, who estimate a search model with endogenous ESHI to evaluate the extent to which ESHI reduces job mobility and efficiency.

⁴Pohl (2015) models geographical heterogeneity of the pre-ACA Medicaid in a static single agent labor supply model.

tual policies with relatively less dependence on model structures.⁵ Second, designed to study the distribution of policy impacts and to provide information on the design of state-specific health care policies, our model incorporates rich heterogeneity across local markets, labor supply decisions at both the extensive and the intensive margins by heterogeneous households, and choices of heterogeneous labor inputs by firms with different production technologies.

2 Background Information

We study the interaction of various health policy components via the lens of the Affordable Care Act, which consists mainly of five components. First, all individuals are required to have health insurance or pay a penalty (individual mandate); second, all firms with more than 50 full time employees are required to offer health insurance or pay a penalty (employer mandate); third, *state-based* health insurance exchanges (HIX) are established where individuals can purchase health insurance at a modified community-rated premium; fourth, the individuals purchasing health insurance from HIX can obtain income-based subsidies; fifth, free public insurance through Medicaid is available if income is low enough. We provide more details of each component below.

Individual Mandate From 2014, individuals are required to be covered by a health insurance plan which meets minimum standards or pay a tax penalty. The amount of tax penalty depends on household income and household size. The penalty is scheduled to increase between 2014 and 2016: in 2016, the penalty will be the greater of (a) 2.5% of household income in excess of the 2015 income tax filing thresholds and (b) \$695 per adult plus \$347.50 per child, up to a maximum of \$2,085 for the family.⁶

Employer Mandate From 2015, every employers with more than 50 *full-time-equivalent* employees are required to provide a health insurance plan meeting minimum standards to those full time employees and their dependent children or to pay a tax penalty. The full time equivalent employee is defined as an employee working on averages at least 30 hours per week. Tax penalty is \$2,000 (indexed for future years) for each full-time employee, with the first 30

⁵One exception is Kowalski (2014), who uses variations before and after ACA in regulations on individual health insurance markets to study inefficiency in individual health insurance markets.

⁶In 2014, it is the maximum of (a) 1% of household income; (b) \$95 per adul, up to the maximum \$695. More detailed can be found, for example, <http://files.kff.org/attachment/issue-brief-the-cost-of-the-individual-mandate-penalty-for-the-remaining-uninsured>

employees excluded from the calculation.⁷

Health Insurance Exchanges The *state-based* health insurance exchanges (HIX), or simply marketplace, are established since 2014. In each marketplace, an individual can purchase a health insurance plan from insurers *only in his/her state*. The design of health insurance plans are government-regulated and categorized into four plans with different levels of generosity: bronze, silver, gold, and platinum. Importantly, insurers need to offer the same plan to every consumer and insurance premium per individual is subject to modified community rating: premium can vary *only* based on age and smoking status, with the degree of variations set by the government.⁸

Income-Based Subsidies for Plans from HIX Individuals may obtain both premium and coinsurance subsidies from the government if they purchase health insurance from HIX. Individuals are eligible for the subsidies if (1) they are unable to get affordable coverage through an eligible employer plan that provides the minimum value;⁹ (2) they are not eligible for any other government health insurance program (e.g., Medicaid); (3) their household income is below 400% of Federal Poverty Line (FPL). The amount of subsidies varies by income, family size and states. In general, individuals and families whose household income for the year is between 100% and 400% of FPL for their family size may be eligible for the premium tax credit, and the subsidies decrease with income. If the household income is around 100% of the FPL, subsidies are designed such that the maximum premium contribution of the household is equal to 2% of household income; If the income is around 400% of the FPL, it is 9% of the household income.¹⁰ In addition, individuals purchasing the silver plan can obtain income-based tax credit, which serves as cost-sharing subsidies.

Medicaid The ACA specifies that Medicaid should expand to cover uninsured individuals with household income below 133% of FPL. However, it is *not* a legal requirement that states shall expand Medicaid. In 2015, 32 states (including Washington DC) expanded Medicaid to

⁷The more detail be can found: <https://www.irs.gov/Affordable-Care-Act/Employers/Employer-Shared-Responsibility-Provisions>

⁸The regulations are set by the federal government, based on which state governments can set further restrictions. For example, the maximum premium ratio between the youngest and the oldest cannot exceed more than a factor of 3.

⁹ESHI plan is affordable if the annual premium for self-only coverage does not exceed 9.5% of household income.

¹⁰If states offer Medicaid to individuals whose income below 133%, then they are not eligible to those subsidies. See additional details about premium subsidies, e.g., :<https://www.irs.gov/Affordable-Care-Act/Individuals-and-Families/Questions-and-Answers-on-the-Premium-Tax-Credit>

cover the sub-population as ACA specifies. In particular, most states in the northeast expanded Medicaid, while half of the states in the south did not expand Medicaid. Importantly, the eligibility and generosity of Medicaid under the ACA are specified by the federal government, which must be uniform across states.

3 Data

Our household-side data come from three sources: the American Community Survey (ACS), the March Current Population Survey (March CPS) and the Medical Expenditure Panel Survey (MEPS). We focus on the population of age 22 to 65. The ACS and CPS both provide information on households' health insurance, labor market status, demographics and residential states. Given the inconsistency in the health insurance information in the CPS arising from the re-design of relevant questions (Pascalle, 2015), we rely mainly on ACS and complement it with the CPS, which contains information on household members' health status.

MEPS is a set of large-scale surveys of families and individuals, their medical providers, and employers across the United States. We use its Household Component (HC), a panel survey that features several rounds of interviewing covering two full calendar years. Key to our analyses, MEPS collects detailed information for each person in the household on demographic characteristics, health conditions, health status, use of medical services, charges and source of payments, health insurance coverage, income, and employment. We use the restricted MEPS geocode data, which identifies 30 states with the remaining 20 states encrypted.

For the firm side, we use the Kaiser Family Employer Health Benefit Survey, a cross-sectional survey of firms representative of those with at least three workers. We focus on private-sector employers. Crucial to our analyses, it contains information on firm size, health insurance provision, as well as employee composition in terms of age, wage levels and full versus part time status.

3.1 Impacts of the ACA: Suggestive Evidence

We present suggestive evidence from the data on ACA's early impacts on health insurance status and labor market outcomes, which will serve as part of the auxiliary models we use to estimate our structural model.

3.1.1 Time Series Patterns

Figure 1 shows the aggregate uninsured rate between 2007 and 2015. Due to the financial crisis and the associated loss of jobs with ESHI, the uninsured rate rose between years 2009 and 2013 and peaked at 23% in 2010, while this fraction was below 20% in 2008. It dropped in 2014 to below 19% further down to around 15% in 2015, the former (latter) coincides with the start of the individual (employer) mandate. Figure 2 shows that the aggregate uninsured rate trend separately for states that have expanded Medicaid under the ACA and those that have not. The over-time changes exhibit very similar patterns across these two types of states, with lower uninsured rates in Medicaid-expanding states in all years.

Figures 3-8 show the corresponding patterns for Medicaid coverage, ESHI coverage, and individual health insurance coverage. The fraction of people enrolled in Medicaid has been rising over the years especially since 2014: it was 7% in 2007, and doubled in 2015. Relative to their counterpart, Medicaid-expanding states have had higher Medicaid enrollment rate throughout and much steeper increase since 2014. The fraction of individuals covered by ESHI dropped sharply since 2009 from a peak of over 69% to below 65% between 2010 and 2014. In the first year of employer mandate (2015), this rate rose to over 65%. Although Medicaid-expanding states have had a higher ESHI rate throughout, the fraction dropped in 2014, while the opposite is true in non-expanding states. Furthermore, the non-expanding states experienced a sharper increase in ESHI rate than the expanding states in 2015. The fraction of individuals covered by individual health insurance also doubled during this period of time, with around 10% coverage in 2015. Unlike the other coverage patterns, the difference between the expanding and non-expanding states is much less obvious: the former states had a slightly lower fraction before 2014 and equal fraction in 2015.

Figures 9-12 show patterns for labor market outcomes. We focus on the non-employed rate and the fraction of part-time workers among the employed. The non-employment rate peaked in 2010 at 26% and has been decreasing since 2011 and down to 23% by 2015. The fraction of part-time workers among those employed has been declining since 2010 from over 12% to around 10%. In Medicaid-expanding states, non-employment rate and part-time rate were higher over all years; the post-recession decrease of non-employment rate started in 2012 and continued until 2014, with a slight increase in 2015. In non-expanding states, the decrease of non-employment rate started in 2011 and continued into 2015, with a stagnant period between 2013 and 2014. Medicaid-expanding states also experienced a steeper decrease in part-time rate between 2014 and 2015.

3.1.2 Regression Results

We present further data evidence via regressions. Given the observed and unobserved differences across local labor markets, the policy impacts are likely to differ as well. To illustrate this point, we combine the ACS data for a year before the ACA (2013) and a year after (2015) to run regressions of the following form

$$y_{ist} = X_{ist}\alpha_1 + d_s + \sum_{g=1,G} I(s \in g, t = 2015)X_{ist} [MEP_s\alpha_{2g} + (1 - MEP_s)\alpha_{3g}] + \epsilon_{ist}. \quad (1)$$

y_{ist} is an outcome variable for individual i in state s and year t , whose characteristics are given by X_{ist} . d_s is a state fixed effect. The next terms in the regression capture the policy era impacts ($t = 2015$) that are allowed to differ across state groups $g = 1, \dots, G$, where states are grouped based on low. Furthermore, the policy era impacts are allowed to differ across states within a group based on Medicaid expansion status in that state $MEP_s \in \{0, 1\}$. Within each group, the state-group-specific vector of parameters α_{2g} (α_{3g}) summarizes the suggestive evidence of ACA's impacts on different demographic groups (X) in states that did (did not) expand Medicaid under the ACA. ϵ_{ist} is an i.i.d. error term.

The results are shown in Tables 1-3. Although they are included in the regressions, the coefficients associated with X and its interactions X with year fixed effects are not reported to save space. Table 1 shows the result on one being uninsured. Consistent with the time series figures, the year fixed effects show a significant decline of the uninsured rate in 2015 relative to 2013. The coefficient associated with ACA's Medicaid expansion (α_1) is small and insignificant for the default individual group (middle education, married with child). It is significantly negative for the lowest education group and for singles, yet significantly positive for the highest education group and for those without children.

The three columns in Table 2 report, respectively, outcomes of whether or not one is covered by Medicaid, by individual insurance, and by ESHI. Unsurprisingly, year fixed effects of 2014 and 2015 on coverage by Medicaid and individual health insurance are significantly positive and larger than previous years. Compared to their counterpart, those exposed to Medicaid expansion experienced significantly higher coverage by Medicaid except for the highest education group and those with children; however, they were less likely to be covered by individual health insurance except for the lowest-educated group and for singles. For ESHI, the pattern is somewhat different. Compared to 2011-2013, ESHI increased in 2014 but decreased again in 2015. The difference by Medicaid expansion status is insignificant for most groups, except that singles and those without children were more likely to be covered by ESHI under Medicaid expansion.

Table 3 shows results on labor market outcomes. Those exposed to Medicaid expansion were slightly more likely to be non-employed, an effect that was similar across all demographic groups. Conditional on being employed, the probability that one worked part time was similar across Medicaid expansion status except for the highest-education group who were less likely to work part time under Medicaid expansion.

The regression results suggest rich heterogeneity in the impacts of the ACA. Within the same region, the impacts differ, qualitatively and quantitatively, across different demographic groups. For the same demographic group, the policy impacts differ across regions. For example, associated with the expansion of Medicaid, individuals with low education are more likely to be non-employed in the South, while less likely to be non-employed in other regions. In addition, with the expansion of Medicaid, they are much more likely to be insured, and in particular via Medicaid, in the South than in other regions.

4 Model

4.1 Environment

There are M labor markets defined by state and policy era (pre-ACA and ACA), each treated as a closed economy. In each market m , there is a distribution of heterogeneous firms and a continuum of heterogeneous households. Firms produce homogenous goods using labor inputs, but with production technologies that differ in both the overall productivity of and the substitutability across various labor inputs. Each household is characterized by $(x, \mathbf{s}, \boldsymbol{\chi}, \epsilon)$, where x is a vector of observable characteristics of the household.¹¹ $\mathbf{s} = [s, s']$ is a two-dimensional vector that denote the levels of human capital of the workers in the household, with $\mathbf{s} \in \{1, \dots, S\}^2$ for coupled households and $\mathbf{s} \in \{1, \dots, S\} \times \{0\}$ for single households. Similarly, $\boldsymbol{\chi} \in \{1, 2\}^2$ denotes the couple's types and $\boldsymbol{\chi} \in \{1, 2\} \times \{0\}$ denote a single's type. Types capture further unobserved heterogeneity across workers even conditional on their human capital levels. We use s as the index/level of human capital, while k_s as the amount of human capital at the level s .

Each market m is perfectly competitive with a vector of market wages $\{w_{shz}^m\}$ for each worker-job category, where a category is characterized by human capital level s , part time or full time $h \in \{P, F\}$ and employer insurance coverage $z \in \{0, 1\}$. A firm makes decisions on the quantities of different labor inputs and the provision of health insurance. A household makes joint decisions on labor supply and health insurance status. Each worker's health insurance

¹¹In particular, x includes marital status, numbers of children under age 6 and under age 18, and the following characteristics of each spouse: gender, age, education and health status.

status is described by a vector $INS \in \{0,1\}^4$, where $INS_1 = I(\text{ESHI})$, $INS_2 = I(\text{insured via spouse's ESHI})$, $INS_3 = I(\text{insured via Medicaid})$, $INS_4 = I(\text{insured via health insurance exchanges})$. We assume that all four statuses are mutually exclusive, i.e., $\sum_s INS_s \in \{0,1\}$ and $\sum_s INS_s = 0$ means no insurance. Let $\mathbf{INS}$ be the 4×2 matrix of health insurance status of the couple.

4.1.1 Out-of-Pocket Health Expense

The out-of-pocket expense for health insurance is governed by a function

$$OOP(x, \mathbf{INS}, r, m, \zeta_{mi}).$$

That is, the expense depends on household characteristics x , health insurance status $\mathbf{INS}$, private health insurance premium schedule r and the market m it lives in; and it is subject to a shock ζ_{mi} .¹² The shock ζ_{mi} is assumed to be i.i.d. across markets and households, realized after the household's decisions.¹³ An important role of health insurance in the model is that it insures medical expenditure risks, with the coverage varies with health insurance status $\mathbf{INS}$, e.g., ESHI covers more than HIX. Regardless of $\mathbf{INS}$, we assume that households are guaranteed a minimum consumption level $\underline{c}$, which is particularly important for the uninsured.

4.1.2 Household Preference

A household's utility depends on joint consumption C , leisure and health insurance status, given by

$$u(C, \mathbf{h}, \mathbf{INS}; x, \boldsymbol{\chi}).$$

where $\mathbf{h} = [h, h']$ is the vector of labor supply status of the household. We allow households with different characteristics $(x, \boldsymbol{\chi})$ to view the trade-offs between consumption, leisure and health insurance status differently. In addition, we also allow for the possibility that health insurance status may directly affect one's utility beyond financial reasons. For example, households may prefer employer-provided insurance over Medicaid for non-financial reasons.

4.1.3 Production Function

Let n_{jsh} be the number of employees hired by Firm j with human capital level s and working status h . Let l_{jsh} be the Type- (s, h) labor input in firm j , which is the total amount of k_s

¹²The expense varies with r directly only when one is insured via private insurance plans. Conditional on r and x , the expense may vary across markets with different policy environments.

¹³The model allows different markets to have different health insurance premium and Medicaid coverage etc.

possessed by the n_{jsh} employees. Firm j 's production is governed by the following CES function

$$Y_j = T_j \left(\sum_{h \in \{F, P\}} \sum_{s=1}^S A_{sh} l_{jsh}^{\rho_j} \right)^{\theta/\rho_j}, \quad (2)$$

where $l_{jsh} = k_s n_{jsh}$.

Firms differ in (T_j, ρ_j) , where T_j denotes firm j 's TFP, ρ_j governs the substitutability between various labor inputs. The parameter vector $\{A_{sh}\}_{sh}$ is common across firms, with $A_{sh} > 0$ and $\sum_{h \in \{F, P\}} \sum_{s=1}^S A_{sh} = 1$.

4.2 Household's Problem

In the following, we present the problem for a coupled household. The problem is simpler for singles because the size of the choice set is smaller: $h' = z' = 0$ by definition.

4.2.1 The Link Between Labor Supply and Health Insurance Status

The labor supply status of each worker in a household can be not working or working in one of the job categories, i.e., $((h, z), (h', z')) \in \{(0, 0), \{P, F\} \times \{0, 1\}\}^2$. Household labor supply choice directly governs INS_1 , because $INS_1 = z$ and one's spouse can be covered by one's employer only when $z = 1$, that is, $INS'_2 = 0$ if $z = 0$. If $INS_1 = INS'_1 = 0$ for both spouses, the household may be eligible for Medicaid governed by the eligibility function $MC(x, y, m)$, which depends on household characteristics x , household income y and the market m one lives in. Therefore, a household's labor supply decision indirectly governs INS_3 and INS'_3 via income. If INS_m and INS'_m are all zeros for $m = 1, 2, 3$, the household can decide whether or not to purchase health insurance (INS_4, INS'_4) .

Let $\mathbf{INS} = [INS, INS']$ be the matrix of a couple's health insurance status, we impose the following restrictions on $\mathbf{INS}$, which are in line with the data facts for a vast majority of households and simplifies out analyses.

- 1) *Conditional on choosing* $(z, z') = 0$, if a household is eligible for Medicaid, it will choose between using it, i.e., $INS_3 = INS'_3 = MC(x, y, m)$ or stay uninsured, i.e., $\mathbf{INS} = \mathbf{0}$. This is consistent with the data facts where almost no household in such cases opt for private insurance.
- 2) If only one spouse works on a job with employer provided insurance, his/her spousal and children will be covered, e.g., $\mathbf{z} = [1, 0]$ implies $INS'_2 = 1$.
- 3) If both spouses are covered by employers, they are indifferent between whose employer will cover their children. As such, in expectation, the burden of child health insurance will be split

evenly between the two employers.

4) $INS_4 = INS'_4$, so that private health insurance purchase is made for the whole household.

4.2.2 Optimal Choice

The household problem can be solved in two steps. First, a household chooses its labor supply status $(\mathbf{h}, \mathbf{z})$. Second, it chooses its health insurance status **INS** among the options associated with its choice $(\mathbf{h}, \mathbf{z})$, as specified in the previous subsection. For a household with characteristics $(x, m, \boldsymbol{\chi}, \mathbf{s})$, its problem is given by

$$\begin{aligned} & \max_{(\mathbf{h}, \mathbf{z}) \in \{(0,0), \{P,F\} \times \{0,1\}\}^2} \{V(x, m, \boldsymbol{\chi}, \mathbf{s}, \mathbf{h}, \mathbf{z}) + \epsilon_{\mathbf{h}, \mathbf{z}}\}, \\ \text{s.t. } & (h', z') = (0, 0) \text{ if single,} \\ & h \in \{P, F\} \text{ if } z=1 \text{ and } h' \in \{P, F\} \text{ if } z'=1. \end{aligned} \quad (3)$$

where $V(\cdot, \mathbf{h}, \mathbf{z})$ is the value function associated with the choice $(\mathbf{h}, \mathbf{z})$, as we specify below. The last constraint reflects the fact that one has to be employed if $z = 1$. The last term, $\epsilon_{\mathbf{h}, \mathbf{z}}$, is household's taste associated with choice $(\mathbf{h}, \mathbf{z})$, assumed to be drawn from a Type-1 extreme value distribution. Let $(\mathbf{h}^*, \mathbf{z}^*)_{(x, m, \boldsymbol{\chi}, \mathbf{s})}$ be the solution to (3).

4.2.3 Value Function $V(\cdot, \mathbf{h}, \mathbf{z})$

Each $V(\cdot, \mathbf{h}, \mathbf{z})$ involves the optimal **INS** choice given $(\mathbf{h}, \mathbf{z})$, such that

$$\begin{aligned} V(x, m, \boldsymbol{\chi}, \mathbf{s}, \mathbf{h}, \mathbf{z}) &= \max_{\mathbf{INS}} E_{\zeta_{mi}} [u(C, \mathbf{h}, \mathbf{INS}; x, \boldsymbol{\chi})] \\ \text{s.t. } & C = \max \{y - OOP(x, \mathbf{INS}, r, m, \zeta_{mi}), \underline{c}\} \\ & y = w_{shz}^m + w_{s'h'z'}^m + b(x, m, r, w_{shz}^m + w_{s'h'z'}^m, \mathbf{h}, \mathbf{INS}) \\ & \mathbf{INS} \in \Omega(x, y, m, \mathbf{z}) \end{aligned} \quad (4)$$

where $b(\cdot)$ is the net government transfer for household with characteristics x on market m , income $(w_{shz}^m + w_{s'h'z'}^m)$ and working status $\mathbf{h}$. In addition, via insurance premium subsidies and individual insurance mandate, $b(\cdot)$ may also depend on premium r and insurance status **INS**.¹⁴

The link between labor supply and health insurance status is reflected in the fact that one can choose **INS** only from $\Omega(x, y, m, \mathbf{z})$, the set of feasible health status given $(x, y, m, \mathbf{z})$. In particular, if $\mathbf{z} = [0, 0]$, i.e., neither spouse works on a job with coverage. The feasible choice is further governed by whether or not one is eligible for Medicaid, governed by the market-specific

¹⁴ $w_{s0z}^m = 0$ for all (m, s, z) , i.e., labor income is zero when $h = 0$.

rule $MC(x, y, m)$. One can choose to participate in Medicaid if eligible, otherwise, one needs to decide whether or not to buy health insurance from health insurance exchanges. That is,

$$\Omega(x, y, m, \mathbf{z}=[0, 0]) = \begin{cases} \{[0, 0, 1, 0]^2, [0, 0, 0, 0]^2\} & \text{if } MC(x, y, m) = 1, \\ \{[0, 0, 0, 1]^2, [0, 0, 0, 0]^2\} & \text{if } MC(x, y, m) = 0. \end{cases}$$

When at least one spouse works on a job with insurance, the insurance status is fully determined, such that

$$\begin{aligned} \Omega(x, y, m, \mathbf{z}=[1, 0]) &= \{([0, 0, 1, 0], [0, 1, 0, 0])\}, \\ \Omega(x, y, m, \mathbf{z}=[0, 1]) &= \{([0, 1, 0, 0], [0, 0, 1, 0])\}, \\ \Omega(x, y, m, \mathbf{z}=[1, 1]) &= \{[1, 0, 0, 0]^2\}. \end{aligned}$$

In our specification, we allow for asymmetry between the couple, e.g., the household may have higher preference for wife working part-time and husband working full-time than the other way round. Similarly, the household may have asymmetric preferences between $\mathbf{z} = [0, 1]$ and $\mathbf{z} = [1, 0]$.

4.3 Firm's Problem

Firm j choose the number of employees for each (s, h) category $\{n_{jsh}\}$, and whether or not to provide its employees with health insurance. For simplicity, we assume that a firm's health insurance provision is the same for all of its employees with the same working status h . In the pre-ACA era, firm j solves the following problem, taking as given the market wage levels $\{w_{shz}^m\}$

$$\pi_j^* = \max_{\{z_{jh}, \{n_{jsh}\}_s\}_h} \left\{ Y_j - \sum_{h \in \{F, P\}} \sum_{s=1}^S n_{jsh} (w_{shz}^m + q^m z_{jh} \kappa_{sh}^m) + \eta_{z_j} \right\}, \quad (6)$$

where Y_j is given by the production technology (2), q^m is the price of employer-provided health insurance in market m , η_{z_j} is the an i.i.d. Type-1 extreme-value distributed shock to each choice of $z_j = \{z_{jh}\}_h \in \{(1, 1), (1, 0), (0, 0)\}$. κ_{sh}^m denotes the expected demand for health insurance from a worker with skill s at job h who chooses a (h, z) -type job. Given that a firm cannot discriminate workers within the same (s, h) category, it needs to take into account that households have different demands for health insurance and to infer the expected cost of providing health insurance to a worker with (s, h) . That is, conditional on $z_{jh} = 1$, the expected

insurance cost is given by $q_h^m \kappa_{sh}^m$ for each worker with (s, h) . In particular, κ_{sh}^m is given by

$$\kappa_{sh}^m = \int \kappa(x, m, \chi, s, s') dG\left(x, \chi, s' | s, m, (h^*, z^*)_{(x, m, \chi, s)} = (h, z)\right), \quad (7)$$

where $\kappa(x, m, \chi, s, s')$ is the adult-equivalent measure of the unit of health insurance demand from a household with characteristics (x, m, χ, s, s') , which depends on $(\mathbf{h}^*, \mathbf{z}^*)_{(x, m, \chi, s)}$ and the number of dependent children in the household (part of x). A firm needs to integrate out the worker's household characteristics (x, χ, s') conditional on the fact that the worker is of skill level s and one part of the optimal decision of the household $(\mathbf{h}^*, \mathbf{z}^*)_{(x, m, \chi, s)}$ is such that $(h^*, z^*)_{(x, m, \chi, s)} = (h, z)$.

Firm j 's optimal decision $\left\{z_{jh}^*, \{n_{jsh}^*\}_s\right\}_h$ can be derived in two steps. First, given a particular vector of z , Firm j chooses its optimal demand for each type of workers $\{n_{sh}^*(z)\}_{sh}$, which gives the maximum profit $\pi_j^*(z)$ conditional on z . Second, Firm j chooses the z associated with the highest profit. For a researcher, who has no information about η_{z_j} , the probability that a particular z is chosen follows

$$\Pr(z_j = z') = \frac{\exp(\pi_j^*(z'))}{\sum_{z \in \{(0,0), (1,0), (1,1)\}} \exp(\pi_j^*(z))}.$$

4.3.1 With Employer Mandate

With ACA employer mandate, a firm with over n^{cut} full-time equivalent workers has to either provide ESHI to full time workers or pay a penalty $G(n)$ as a function of the vector of a firm's employment choice. The mandate will be binding if the unconstrained choice under $z = (0, 0)$, $\{n_{sh}^*(0)\}_{sh}$, features over n^{cut} full-time equivalent employees. In this case and only in this case, the previous solution to the firm's problem needs to be modified. In particular, such a firm needs to compare the profit $\pi_j^*(0)$ net of the mandate penalty with that from the following constrained optimization problem

$$\begin{aligned} \pi_j^c(z^c = 0) &= \max_{\{(n_{jsF}, n_{jsP})\}_{s=1}^S} \left\{ Y_j - \sum_{h \in \{F, P\}} \sum_{s=1}^S n_{jsh} w_{shz}^m \right\} \\ s.t. \quad \sum_s n_{jsF} + \tau \sum_s n_{jsP} &< n^{cut}, \end{aligned} \quad (8)$$

where τ is the full-time equivalent discount rate of a part-time worker. Denote by $\{n_{sh}^c(z)\}_{sh}$ the optimal solution to (8).

If $\pi_j^c > \pi_j^*(0) - G(n_j^*(0))$,

$$\Pr(z_j = z') = \frac{\exp(\pi_j^*(z'))}{\pi_j^c(z=0) + \sum_{z \in \{(1,0),(1,1)\}} \exp(\pi_j^*(z))} \text{ for } z' = (1,0) \text{ or } (1,1)$$

$$\Pr(z_j = z^c) = \frac{\exp(\pi_j^c(z^c=0))}{\pi_j^c(z^c=0) + \sum_{z \in \{(1,0),(1,1)\}} \exp(\pi_j^*(z))}.$$

Otherwise

$$\Pr(z_j = z') = \frac{\exp(\pi_j^*(z') - I(z=0)G(n_j^*(z')))}{\sum_{z \in \{(0,0),(1,0),(1,1)\}} \exp(\pi_j^*(z) - I(z=0)G(n_j^*(z)))}.$$

4.4 Private Insurance Premium

The private health insurance premium structure was much more complex on the pre-ACA market than it is on the post-ACA exchange market (HIX). We use the pre-ACA data only as part of the information to estimate the model, which is then used to conduct counterfactual experiments given the premium structure under the ACA. For this purpose, it suffices to take the observed pre-ACA equilibrium insurance premium as given. However, our counterfactual experiments are likely to change the distribution of buyers on the private health insurance market, and hence the health insurance premium. Although it would be infeasible to incorporate a full-blown health insurance market into our model, we endogenize the post-ACA private insurance premium in a way that captures the key features of the HIX, i.e., premiums can differ based only on age and that premiums are set according to a standard age-rating curve.¹⁵

In particular, we assume that in each market m , HIX is perfectly competitive, as in Handel, Hendel, and Whinston (2015), and offers a single product, as in Hackmann, Kolstad, and Kowalski (2014). Let r_b^m be the base premium in market m , and $g(\cdot)$ be the exogenous age-rating curve, the premium structure is given by

$$r^m(x) = r^m(\text{age}) = g(r_b^m, \text{age}).$$

Premiums differ across markets as the base premium adjusts to satisfy the break-even condition in each market, i.e., among those insured via HIX, their total insurance premium equals their total health expenditure net of reimbursement.

¹⁵We abstract from the premium variation based on smoking history, which we do not have information on. See Orsini and Tebaldi (2015) for a study on premium variations across areas with different consumer age compositions.

4.5 Equilibrium

Definition 1 *An equilibrium in local market m is a tuple*

$\left\{ (\mathbf{h}^, \mathbf{z}^*)_{(x,m,\boldsymbol{\chi},\mathbf{s})}, (\{z_h^*, \{n_{sh}^*\}_s\}_h)_{(T,\rho)}, \{w_{shz}^m\}_{shz}, r^m(x) \right\}$ that satisfies*

- 1) Household optimization: Given $\{w_{shz}^m\}_{shz}$ and $r^m(x)$, $(\mathbf{h}^*, \mathbf{z}^*)_{(x,m,\boldsymbol{\chi},\mathbf{s})}$ solves household optimization problem for each $(x, m, \boldsymbol{\chi}, \mathbf{s})$.*
- 2) Firm optimization: Given $\{w_{shz}^m\}_{shz}$ and $r^m(x)$, $(\{z_h^*, \{n_{sh}^*\}_s\}_h)_{(T,\rho)}$ solves firm optimization problem for each (T, ρ) .*
- 3) Equilibrium consistency: wages $\{w_{shz}^m\}_{shz}$ equate the aggregate demand and supply for each work-job category (s, h, z) ; the health insurance premiums $r^m(x)$ satisfy the break-even condition.*

4.6 Further Empirical Specifications

4.6.1 Health Status

To complement the ACS with the health status information from the CPS, we rely on the empirical distribution $\Pr(\text{healthy}|x, \text{state})$ from the CPS. In particular, for each household with x in the ACS, we simulate its members' health status according to $\Pr(\text{healthy}|x, \text{state})$. We use state-specific conditional distribution to allow for the systematic difference across states in people's health status that may be correlated with its policy

4.6.2 Unobservable Household Characteristics

In the model, given the market wage levels, the relevant information for the exchange is a worker's human capital level s , which is observed by both the worker and the firm. The researcher does not observe one's human capital nor one's type. We assume the distribution of unobservables $(\mathbf{s}, \boldsymbol{\chi})$ differ by x and states, such that

$$\Pr((\mathbf{s}, \boldsymbol{\chi}) | x, \text{state}) = \Pr(\boldsymbol{\chi} | x, \text{state}) \Pr(\mathbf{s} | x, \boldsymbol{\chi}).$$

The probability that a couple's type is $[n, n'] \in \{1, 2\}^2$ is given by

$$\Pr(\boldsymbol{\chi} = [n, n'] | x, \text{state} = h) = \frac{\exp(x' \beta_{nn'} + \beta_{0h})}{\sum_{(l, l') \in \{1, 2\}^2} \exp(x' \beta_{ll'} + \beta_{0h})}.$$

The probability that a worker's human capital is of level s is given by the following discretization of a log-normal distribution:

$$\Pr(s|x, \chi) = \begin{cases} \Phi(\ln(k_s) - x'\lambda - \alpha_\chi) - \Phi(\ln(k_{s-1}) - x'\lambda - \alpha_\chi) & \text{for } 1 < s < S, \\ \Phi(\ln(k_s) - x'\lambda - \alpha_\chi) & \text{for } s = 1, \\ 1 - \Phi(\ln(k_{s-1}) - x'\lambda - \alpha_\chi) & \text{for } s = S, \end{cases} \quad (9)$$

where α_χ is a type-specific parameter that allows for a potential direct correlation between s and χ , with α_1 normalized to zero. The mass points of the human capital amount (k_s) are assumed to be quantiles from $\ln N(\bar{x}'\lambda, 1)$, where $\bar{x}$ is the population mean of x . The distribution of a couple's skill is given by

$$\Pr(\mathbf{s}|x, \boldsymbol{\chi}) = \Pr(s|x, \chi) \Pr(s'|x, \chi')$$

Notice that a couple's skill levels are correlated because 1) household characteristics x enter the skill distributions for both, and 2) types χ and χ' are correlated within a couple and one's type is directly correlated with s . We set the total number of skill levels $S = 5$, which leads to 20 categories of jobs defined by (s, h, z) on each market, and 10 unobserved groups of individuals defined by (s, χ) .

4.6.3 Unobservable Firm Characteristics

We assume that firm j 's technology (T_j, ρ_j) is correlated with its observable characteristics W_j , conditional on which T_j and ρ_j are drawn independently from log normal distributions. The *TFP* of Firm j is distributed as

$$T_j \sim \ln N(\bar{T} - 0.5\sigma_T^2, \sigma_T^2).$$

The power parameter in the CES production function follows

$$\ln\left(\frac{\rho_j}{1 - \rho_j}\right) \sim N(\bar{\rho}, \sigma_\rho^2),$$

with

$$\text{corr}\left(\exp(T_j), \ln\left(\frac{\rho_j}{1 - \rho_j}\right)\right) = v.$$

5 Estimation

Taking the realized equilibrium in the data as given, our estimation procedure does not require solving for the equilibrium. As a price taker, a household (firm) takes the equilibrium wage levels and health insurance premium as given, and makes its optimal decision. The model-predicted individual household (firm) optimal decisions should match the observed equilibrium outcomes.

5.1 Parameters to be Estimated outside of the Model

To reduce the computational burden, we parameterize the stochastic health expenditure function $OOP(\cdot)$ and government policies, and estimate these functions outside of the model.

5.1.1 Out-of-Pocket Health Expenditure

We estimate the household out-of-expenditure function $OOP(x, \mathbf{INS}, r, m, \zeta_{mi})$ using information from MEPS, in the following steps. First, we estimate each household member's gross medical cost, modeled as a random draw from a market-specific log normal distribution, the mean of which depends on household characteristics and in particular the member's own characteristics. Let tc_k be the total medical cost for member k in household with $(x, \mathbf{INS}, m)$,

$$\ln(tc_k) \sim \ln N(\Gamma(x, k, \mathbf{INS}, m), \sigma_m^2),$$

where σ_m^2 is a market-specific dispersion parameter. The mean given by

$$\Gamma(x, k, \mathbf{INS}, m) = \alpha_0^{TC}(\mathbf{INS}, gender_k, adult_k) + \alpha_1^{TC}(\mathbf{INS}, gender_k, adult_k) I(health_k = bad) + x' \beta^{TC} + \psi_m.$$

The constant term $\alpha_0^{TC}(\cdot)$ and the additional cost for unhealthy individuals $\alpha_1^{TC}(\cdot)$ are allowed to differ across insurance status, gender and whether or not Member k is an adult. β^{TC} accounts for the correlation between cost and household characteristics x , such as education and marital status. ψ_m is a state-specific parameter that accounts for geographical heterogeneity.

Then, we estimate the out-of-pocket expenditure as given by

$$\begin{aligned} OOP(\cdot) &= f(TC, \mathbf{INS}) + r(x, \mathbf{INS}, m) \\ s.t. \ TC &= \sum_k tc_k, \end{aligned}$$

where $f(\cdot)$ is the out of pocket medical expenditure given the realized total medical expenditure TC and insurance coverage $\mathbf{INS}$, and $r(\cdot)$ is the average health insurance premium among $(x, \mathbf{INS}, m)$ as observed in the data.

5.1.2 Health Care Policies and ESHI Prices

We parameterize health care policies, including those implemented under the ACA, as precisely as possible. We specify the Medicaid eligibility and coverage as a function, $MC(x, y, m)$, of market-specific function of demographic types (with or without children) and household income, where a market is defined as (state, before/after ACA). In particular, under ACA, states that expanded Medicaid need to follow eligibility rules specified by the federal government; while states that did not could have their own Medicaid eligibility rules. We parameterize these policies based on information from Kaiser Family Foundation (2013) and CMS (2014).¹⁶ We also incorporate other important ACA policy components that are uniform across the nation, i.e., individual mandates, employer mandates, and premium subsidies in HIX. The parametrization of these policies are described in the appendix.

For the government net transfer function, we assume the following functional form

$$\begin{aligned} b(x, m, r, w_{shz}^m + w_{s'h'z'}^m, \mathbf{h}, \mathbf{INS}) = & -T(x, m, w_{shz}^m + w_{s'h'z'}^m, \mathbf{h}) + WB(x, m, w_{shz}^m + w_{s'h'z'}^m, \mathbf{h}) \\ & + Sub(r, w_{shz}^m + w_{s'h'z'}^m, \mathbf{h}, \mathbf{INS}) - PE(x, m, r, w_{shz}^m + w_{s'h'z'}^m, \mathbf{h}, \mathbf{INS}) \end{aligned}$$

where T is the total income tax function, WB is welfare benefit function, Sub is HIX premium subsidy function, and PE is the tax penalty if individuals are uninsured and if individual mandates are implemented in m . Following Chan (2013) and Gayle and Shephard (2016), we parameterize the income tax schedule using NBER taxsim, and welfare eligibility using Welfare rules database from the Urban Institute.

Finally, for ESHI price in each market q^m , we use the average ESHI premium reported by firms on market m as observed in Kaiser.

5.2 Parameters to be Estimated within the Model

Our structural model can be estimated in two stages. Stage 1 estimates household-side parameter (Θ^H) and the wage levels $\{w_{shz}^m\}$ by matching households' optimal decisions to the

¹⁶We abstract from asset testing for Medicaid, which would require detailed asset information and add non-trivial complications to the model. This extra layer of complication is unlikely to add much insight to our model or to change its implications significantly, given the fact that asset testing was abolished under ACA in all states and before ACA in most states.

observed equilibrium household outcomes. Stage 2 takes households' decision rules, hence $\widehat{\Theta}^H$, as given, and estimates firm-side parameters (Θ^F) by matching firms' optimal decisions with the observed equilibrium firm outcomes.

Remark 1 *Given that $\{w_{shz}^m\}$ are known to and taken as given by individual households but unknown to the researcher (since s is not observable), we can treat $\{w_{shz}^m\}$ as parameters to be estimated in the first stage. For feasibility, we assume that wages for different skill levels can be approximated by a discretized log-normal distribution that is specific to each (market, hour, ESHI) category, and that $\{\ln(w_{shz}^m)\}_{s=1}^5$ are quintiles from the distribution $N(\bar{w}_{mhz}, \sigma_{mhz}^2)$.¹⁷*

In both stages, the estimation is via indirect inference, an approach that involves two steps: 1) compute from the data a set of “auxiliary models” that summarize the patterns in the data to be targeted for the structural estimation; and 2) repeatedly simulate data with the structural model, compute corresponding auxiliary models using the simulated data, and search for the model parameters that cause the auxiliary model estimates computed from the simulated data and from the true data to match as closely as possible. In particular, let $\bar{\beta}$ denote our chosen set of auxiliary model parameters computed from data; let $\widehat{\beta}(\Theta)$ denote the corresponding auxiliary model parameters obtained from simulating a large dataset from the model (parameterized by a particular vector Θ) and computing the same estimators. The structural parameter estimator is then the solution

$$\widehat{\Theta} = \operatorname{argmin}_{\Theta} [\widehat{\beta}(\Theta) - \bar{\beta}]' W [\widehat{\beta}(\Theta) - \bar{\beta}],$$

where W is a weighting matrix. We obtain standard errors for $\widehat{\beta}(\Theta)$ by numerically computing $\partial \widehat{\Theta} / \partial \bar{\beta}$ and applying the delta method to the variance-covariance matrix of $\bar{\beta}$.

5.3 Use of the Data

We divide the data into two parts, one for estimation and the other for model validation. The estimation sample includes the pre-ACA data of all of the G state groups, and the post-ACA data of all state groups but Group G , i.e., the highest-poverty-rate states. The post-ACA data for state Group G is held out for model validation. We use the data in this fashion for the following reasons. First, information of a state in at least one policy era is necessary to identify state-specific parameters; and information of multiple states in both policy eras is necessary to identify policy impacts without having to rely entirely on the model structure. Second, it gives

¹⁷On each market, there are 20 categories of jobs and hence 20 wage levels. It would be infeasible to estimate these market-specific wage vectors non-parameterically. In our approach, wage levels are governed by 8 parameters on each market.

us more confidence in our counterfactual policy results if the model can match the post-ACA pattern in the non-random held-out group of states.

5.4 Auxiliary Models and Identification

We choose auxiliary models to exploit the rich variation across states and policy eras, as well as the variation of policy doses conditional on household/firm characteristics. All auxiliary models we target in the estimation are calculated using the estimation sample only.

5.4.1 Stage 1

We first estimate household-side parameters (Θ^H) and wage-level parameters, the former consisting of the parameters governing 1) utility function (Θ_u^H), 2) household type distribution (Θ_x^H) and 3) skill distribution (Θ_s^H). The auxiliary models we target include:

1. From the ACS
 - (a) The regressions as specified in equation (1).
 - (b) Moments by policy era (before/after 2014), by demographics (single/coupled, with/without children), by education levels and by groups of Medicaid-expanding/non-expanding state groups.
 - i. Insurance status: uninsured, insured via ESHI, insured via Medicaid
 - ii. Job status: non-employed, employed full time
 - iii. Earnings and earnings² by insurance status, by part/full time status
 - iv. Interactions of insurance status and job status.
2. From the CPS: differences in insurance status and in job status between people with good health and bad health.

State-era-specific policies, such as Medicaid and other welfare programs, affect a household's decision by changing its budget constraints. Cross-sectional policy variations allows for comparison of decisions made by observationally equivalent households across states who face different constraints. This information can be used to identify household preferences if the distribution of household unobservables is the same across states.¹⁸ With state-specific distribution of household unobservables, one needs more than cross-sectional variation. Assuming

¹⁸Such identification strategies are pursued by Keane and Moffitt (1998) and Pohl (2015).

that the distribution of household preferences and types is constant over time, we explore the variation introduced by ACA across both time and states.¹⁹

5.4.2 Stage 2

The vector of firm side parameters (Θ^F) consists of the parameters governing 1) production function (Θ_p^F), 2) firm type distribution function (Θ_{Tp}^F). The auxiliary models we target include:

1. mean, variance, and quantiles of the following firm-side variables
 - (a) firm size,
 - (b) fraction of full time workers,
 - (c) fraction of workers earning below threshold wages w^* .
 - (d) fraction of workers earning above threshold wages w^{**} .
2. covariance of the following variables:
 - (a) firm size and fraction of full time workers,
 - (b) firm size and fraction of workers earning below threshold wages w^* ,
 - (c) firm size and fraction of workers earning above threshold wages w^{**} ,
3. moments of the following variables by region and by policy era:
 - (a) the mean of the ESHI offering
 - (b) the mean of the ESHI offering only for full time employees,
 - (c) the covariance between the ESHI offering and firm size,
 - (d) the covariance between the ESHI offering and fraction of workers earning above threshold wages w^{**} ,
4. moments from the household data based by region and by policy era.
 - (a) aggregate employment by skill types.

The identification of firm-side parameters will utilize both firm side optimization conditions and policy variations in the data. We discuss these details in Appendix. One important target is Moment (4), which imposes the equilibrium restriction that labor market should clear.

¹⁹Chan (2013) uses policy variations across states and across time for identification in his study of welfare programs.

6 Estimation Results (Preliminary)

6.1 Parameter Estimates

Table 1 reports selected estimated parameters of interests. The list of other parameter estimates are reported in the appendix. We find that Type 1 individuals have higher relative risk aversion compared with Type 2 individuals, with magnitudes of risk aversion in line with other studies. We find that the annual consumption floor is \$300, which is consistent with other findings in the literature (e.g., De Nardi et al. 2016).

Our model allows for state-specific distribution of household types, governed by $\Pr(\chi|x, m)$. The heterogeneous distribution of types across states depends on cross-state differences in observables (x) and unobservables. Although we do not take a stand on the source of the latter and we model it as a flexible state-specific constant term in $\Pr(\chi|x, m)$, after the estimation, we can examine how these state-specific type distributions are correlated with observed policy decisions, in particular, the decisions on ACA Medicaid expansion. We find that the correlation between $\Pr(\chi = 1|\bar{x}_m, state)$ and a state's Medicaid expansion choice is 0.28, where $\chi = 1$ indicates more risk averse individuals, and $\bar{x}_m$ is the average household type in each market m . Thus, Medicaid was more likely to have been expanded in states with a higher share of risk averse individuals, conditional on observables.

parameters	estimates	std.error
CRRA coeff. for type 1	2.49	()
CRRA coeff. for type 2	1.29	()
consumption floor	0.03	()

Table 1: the Selected Parameter Estimates

6.2 Model Fit

Figures 1 and 2 show that the model matches well with the data in terms of average insurance status and average employment status in 2012 and 2014. Tables 1 and 2 report the model fits of regression coefficients for insurance status and labor market status. In general, the model is able to capture the patterns well, both by whether Medicaid expansion states and by demographic types.

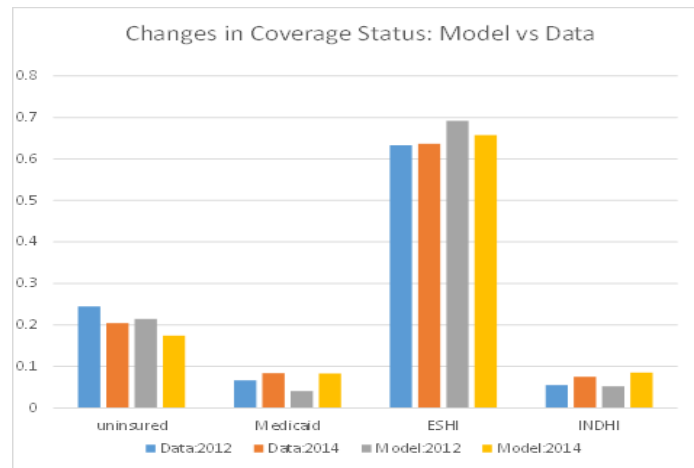


Figure 1: Figure 1

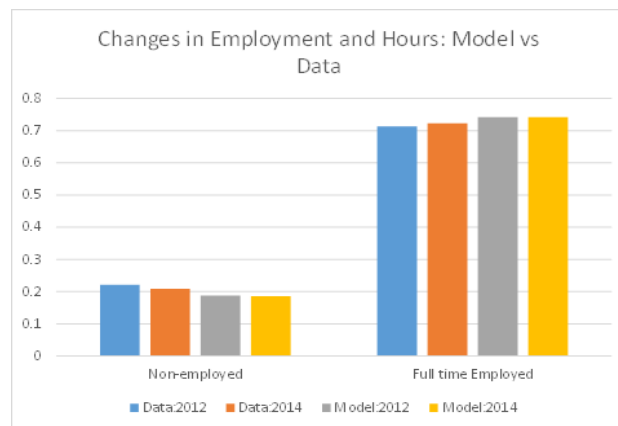


Figure 2: Figure 2

	Data		Model	
	MEP=1	MEP=0	MEP=1	MEP=0
ACA	-0.03	-0.01	-0.02	-0.01
ACA*lowE	-0.04	0.02	-0.001	0.003
ACA*highE	0.03	0.006	0.002	-0.000
ACA*single	-0.05	-0.005	-0.04	-0.002
ACA*childless	-0.01	-0.03	-0.04	-0.05

Table 2: the Model Fit for the Regression Coefficient for Uninsured

	Data		Model	
	MEP=1	MEP=0	MEP=1	MEP=0
ACA	-0.006	-0.023	-0.004	0.01
ACA*lowE	-0.006	0.026	-0.002	-0.01
ACA*highE	0.008	0.016	0.003	-0.01
ACA*single	-0.005	0.003	-0.009	-0.01
ACA*childless	-0.001	-0.001	-0.001	-0.002

Table 3: the Model Fit for the Regression Coefficient for Non-Employed

7 Counterfactual Experiments

7.1 Medicaid Grant Block

8 Conclusion

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Appendix

A1. Functional Forms

A1.1 Utility Function

We assume utility is separable in consumption, leisure and health insurance status. Let n_x be the adult equivalent measure of household x , utility function is given by

$$u(C, \mathbf{h}, \mathbf{INS}; x, \boldsymbol{\chi}) = \frac{(C/n_x)^{1-\gamma_{\boldsymbol{\chi}}}}{1-\gamma_{\boldsymbol{\chi}}} - d_0 I(INS_3 + INS'_3 \geq 1) - D(\mathbf{h}, \boldsymbol{\chi}, x).$$

The utility from consumption is assumed to be governed by a CRRA function, with household-type-specific parameter $\gamma_{\boldsymbol{\chi}}$. d_0 captures household's distaste for using Medicaid; $D(\cdot)$ is the disutility from working, taking the following form

$$D(\mathbf{h}, \boldsymbol{\chi}, x) =$$

$$\begin{cases} \sum_{l=P,F} [I(h=l)(D_h(x) + d_{\chi l})] + I(kid > 0)(d_3 I(h \neq 0) + d_4 I(h = F)) & \text{if single} \\ \sum_{n=1}^2 \left\{ \sum_{l=P,F} [I(h_n=l)(D_h(x) + d_{\chi l})] \right\} + I(kid > 0)(d_3 I(h \neq 0, h' \neq 0) + d_4 I(\mathbf{h} = [F, F])) & \text{else} \end{cases}$$

where $d_{1P} = d_{1F} = 0$ as a normalization for Type 1. $D_P(x)$, $D_F(x)$ capture the disutility of working as a function of observable characteristics, given by

$$D_l(x) = \varphi_{0l} + \sum_{e=1}^3 \varphi_{el} I(edu = e) + \varphi_{4l} I(female) + \varphi_{5l} I(age < age^*) \text{ for } l = P, F.$$

For a single with some child under age 6, she/he incurs $d_3 > 0$ as the additional disutility from working, which is increased by $d_4 > 0$ if the job is full time. For a coupled household, the disutility is summed over each spouse's private disutility ($D_h(x) + d_{\chi l}$) and the interaction of their choices in the case they have a young child: the couple incurs the cost d_3 if both are working and an additional d_4 if both are working full time.

A2. Solve Firm's problem

$$\pi_j^*(z) = \max_{\{(n_{sjF}, n_{sjP})\}_{s=1}^S} \left\{ Y_j - \sum_s n_{sjF} (w_{sF} + q_F z_{jF}) - \sum_s n_{sjP} (w_{sP} + q_P z_{jP}) \right\}$$

$$Y_j = T_j \left(\sum_{h \in \{F, P\}} \sum_{s=1}^S A_{sh} l_{jsh}^{\rho_j} \right)^{1/\rho_j}, \quad (10)$$

where $l_{jsh} = k_s n_{jsh}$.

1) Choose n

Given z_j , firm's optimal demand for Type- (s, h) worker is characterized by the following first order condition

$$\frac{Y_j}{L_j} A_{sh} k_s^{\rho_j} (n_{jsh})^{\rho_j-1} = w_{shz}^m + q_h z_h = Cost_{shz},$$

where

$$L_j = \sum_{s=1}^S A_{sF} l_{mjF}^{\rho_j} + \sum_{s=1}^S A_{sP} l_{mjP}^{\rho_j}.$$

2) Choose z

$$\max_z \left\{ \pi_j^*(z) + \eta_z \right\}.$$

so that

$$\Pr(z_j = z') = \frac{\exp(\pi_j^*(z'))}{\sum_{z \in \{0,1\} \times \{0,1\}} \exp(\pi_j^*(z))}.$$

A3. Numerical Algorithm

- Discretize (T_j, ρ_j) for $j = 1, \dots, J$.
- Guess $\{w_{shz}\}_{s,h,z}$.
- Given equilibrium price solve worker's problem and calculate the choice probability.
- Solve firm's problem. Specifically, for each firm j , we can solve the optimal labor demand which is characterized by a system of nonlinear equations for $\{(n_{sF}, n_{sP})\}_{s=1}^S$.
- Then, we can compare aggregate supply and demand for each human capital level in each sector. Specifically, for each human capital s , the optimal labor supply is:

$$LS_{shz} = \int_{s=h(x, \chi, \tilde{s})} \frac{\exp(V(x, \chi, \tilde{s}, h, z))}{\sum_{h', z'} \exp(V(x, \chi, \tilde{s}, h', z'))} dF(x, \chi)$$

where $S(x, \chi, \tilde{s})$ is the unique human capital level of individual implied from worker

characteristics $(x, \chi, \tilde{s})$. Similarly, aggregate labor demand is characterized by

$$LD_{shz} = \int n_{sh}^z dG(T_j, \rho_j).$$

we keep updating until both labor markets and insurance markets clear.

9 Figures and Tables

9.1 Time Series Patterns

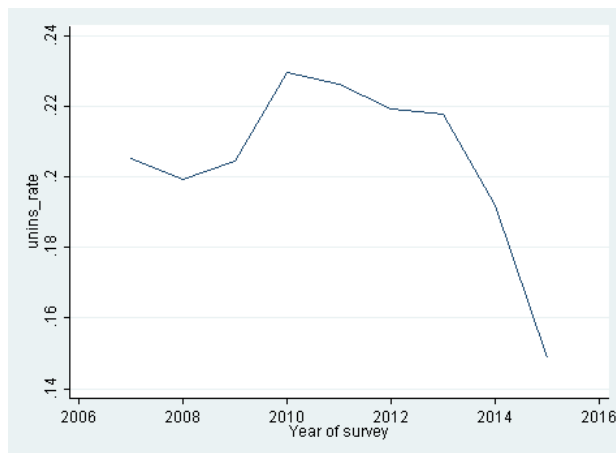


Figure 1: Uninsured rate

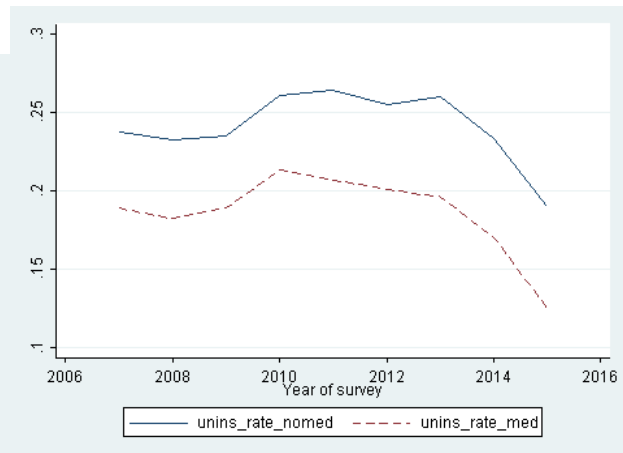


Figure 2: Uninsured rate: by Medicaid expansion

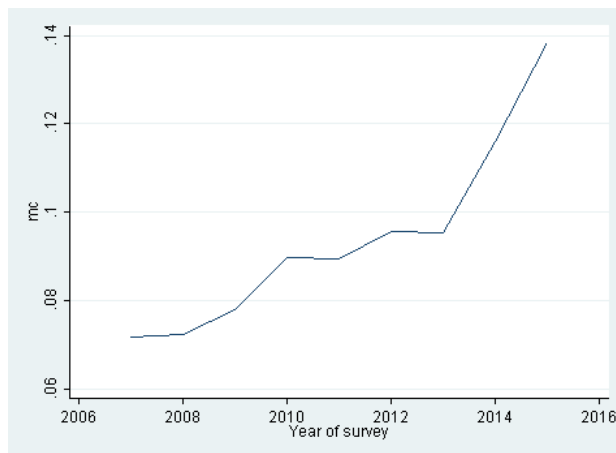


Figure 3: Medicaid Enrollment

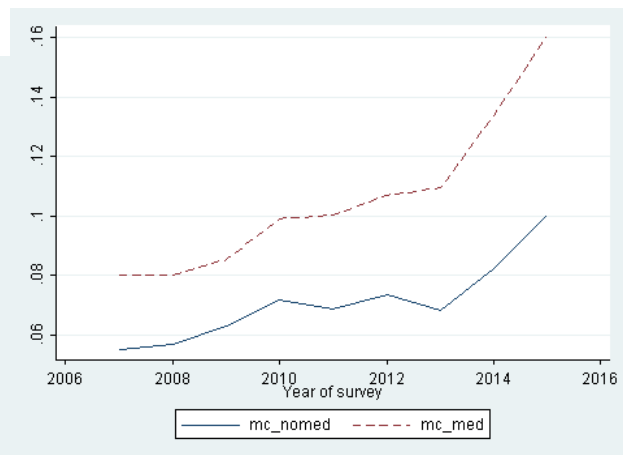


Figure 4: Medicaid Enrollment: by Medicaid expansion

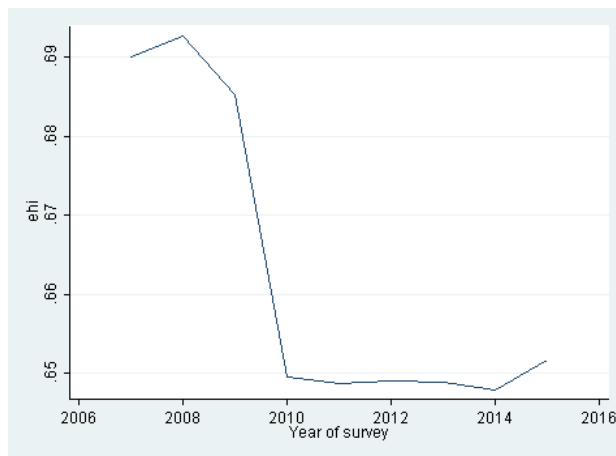


Figure 5: ESHI Coverage

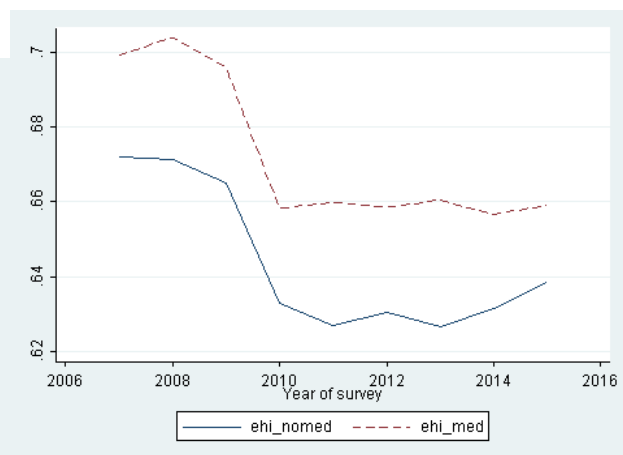


Figure 6: ESHI Coverage: by Medicaid expansion

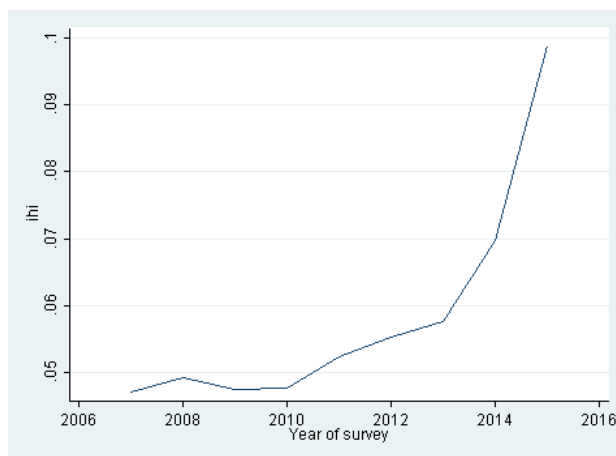


Figure 7: Individual Health Insurance Enrollment

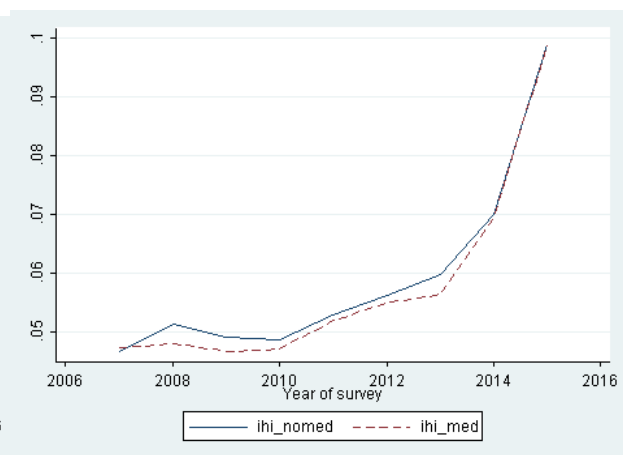


Figure 8: Individual Health Insurance Enrollment: by Medicaid expansion

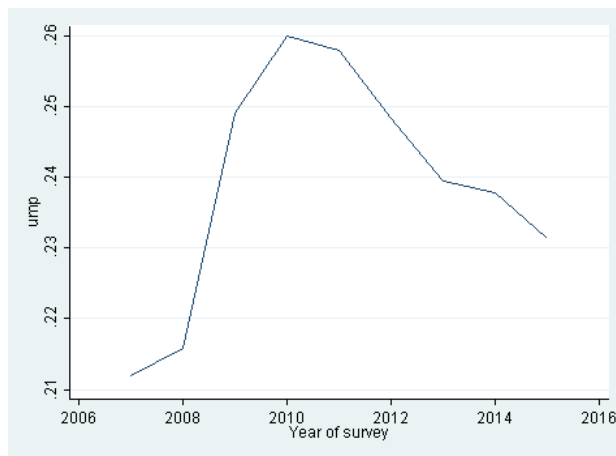


Figure 9: Non-employment

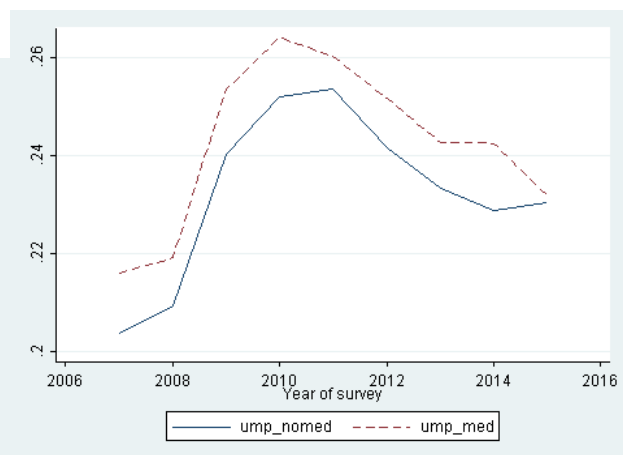


Figure 10: Non-employment: by Medicaid expansion

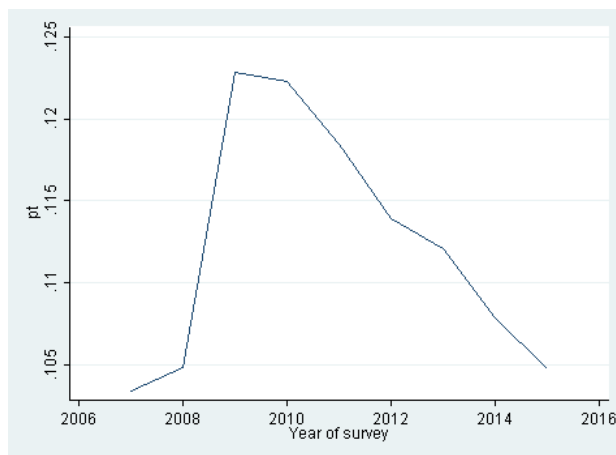


Figure 11: Part-time among employed

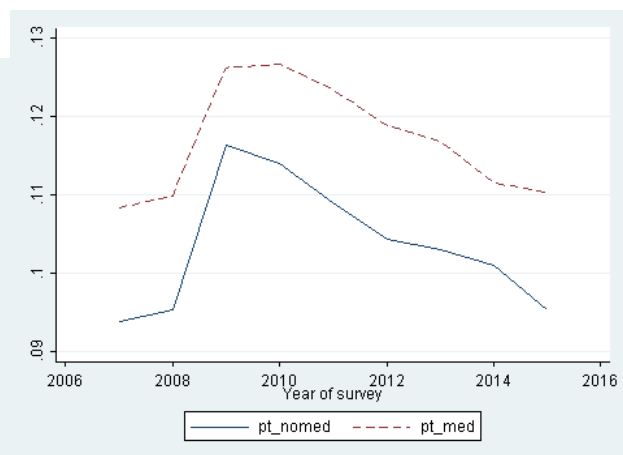


Figure 12: Part-time among employed: by Medicaid expansion

9.2 Figures: Firm Side Statistics

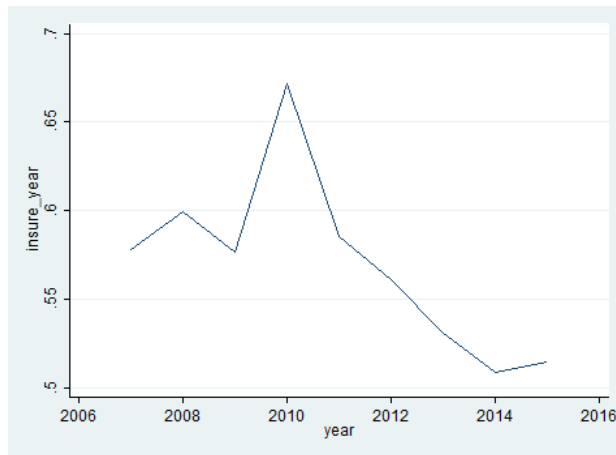


Figure 13: Health Insurance Provision

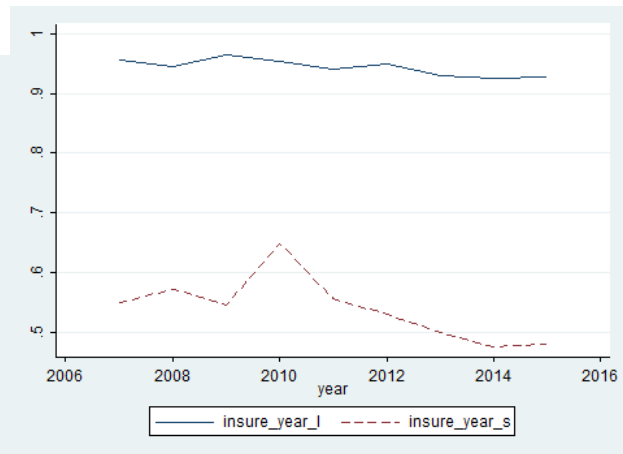


Figure 14: Health Insurance Provision by firm size (above vs below 50)

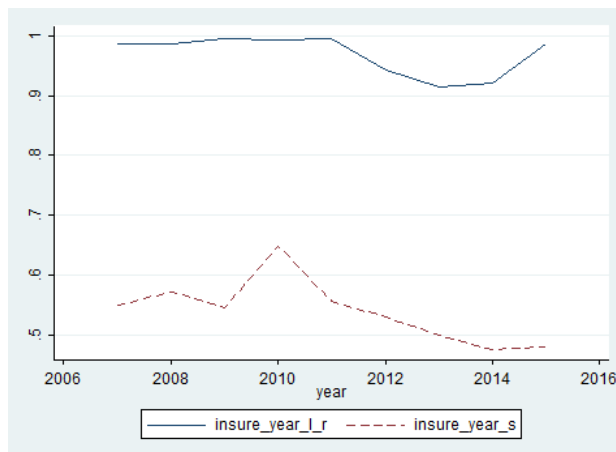


Figure 15: Health Insurance Provision by firm size: Northeast

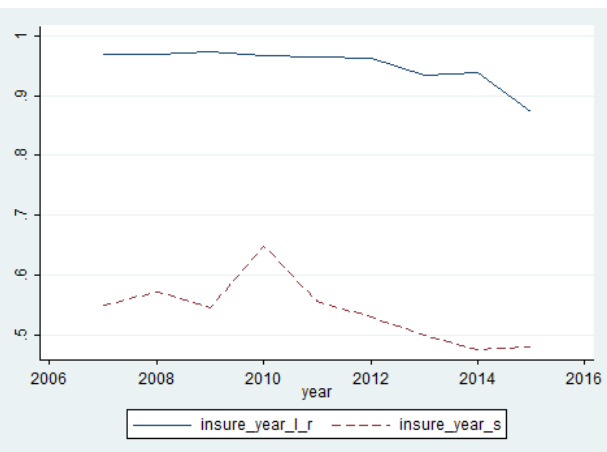


Figure 16: Health Insurance Provision by firm size: Midwest

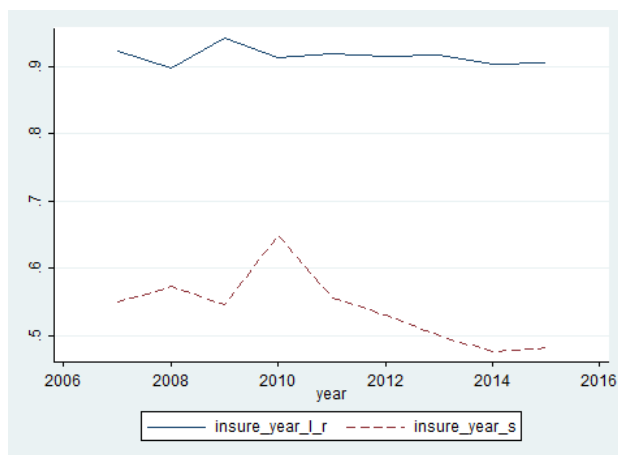


Figure 17: Health Insurance Provision by
firm size: South

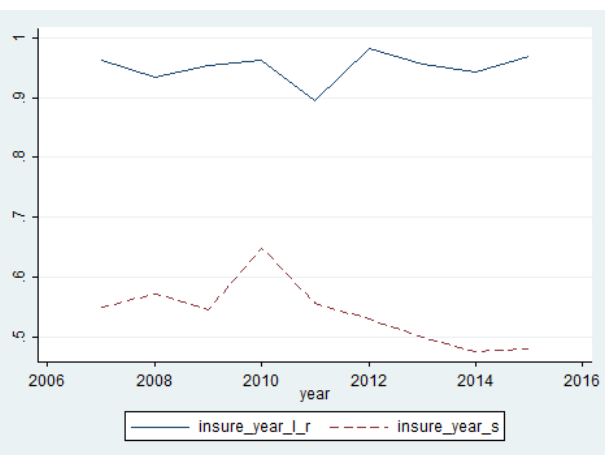


Figure 18: Health Insurance Provision by
firm size: West

9.3 Tables: Difference in Difference Estimation

Table 1: Uninsured

	Uninsured
ACAmedexp	0.004 (0.006)
ACA_medexp_ed_low	-0.028*** (0.005)
ACA_medexp_ed_high	0.020*** (0.005)
ACA_medexp_single	-0.046*** (0.004)
ACA_medexp_nochild	0.022*** (0.004)
y_2008	-0.004 (0.004)
y_2009	0.003 (0.005)
y_2010	0.022*** (0.005)
y_2011	0.037*** (0.005)
y_2012	0.041*** (0.005)
y_2013	0.033*** (0.005)
y_2014	0.012** (0.005)
y_2015	-0.020*** (0.005)
Observations	793660
Adjusted R-squared	0.125
State Fixed Effects	YES
Quadratic Trend by Medicaid Expansion	YES
="* p<0.10 ** p<0.05 *** p<0.01"	

Table 2: Other Insurance Status

	Medicaid	INDHI	ESHI
ACAmedexp	0.015*** (0.004)	-0.006* (0.003)	-0.006 (0.006)
ACA_medexp_ed_low	0.025*** (0.003)	0.010*** (0.003)	-0.008 (0.005)
ACA_medexp_ed_high	-0.029*** (0.004)	-0.000 (0.003)	0.003 (0.006)
ACA_medexp_single	0.019*** (0.003)	0.015*** (0.002)	0.012*** (0.004)
ACA_medexp_nochild	-0.032*** (0.003)	-0.007*** (0.002)	0.011** (0.005)
y_2008	-0.003 (0.003)	0.001 (0.003)	0.004 (0.005)
y_2009	0.002 (0.003)	0.002 (0.003)	-0.009* (0.005)
y_2010	0.019*** (0.003)	0.002 (0.003)	-0.043*** (0.005)
y_2011	0.017*** (0.003)	0.000 (0.003)	-0.055*** (0.005)
y_2012	0.021*** (0.003)	0.005* (0.003)	-0.066*** (0.005)
y_2013	0.013*** (0.003)	0.009*** (0.003)	-0.053*** (0.005)
y_2014	0.027*** (0.004)	0.015*** (0.003)	-0.046*** (0.006)
y_2015	0.045*** (0.004)	0.051*** (0.003)	-0.057*** (0.006)
Observations	793660	793660	793660
Adjusted R-squared	0.075	0.014	0.162
State Fixed Effects	YES	YES	YES
Quadratic Trend by Medicaid Expansion	YES	YES	YES
="* p<0.10 ** p<0.05 *** p<0.01"			

Table 3: Labor Market Outcomes		
	Non-Employed	Part Time Employed
ACAmedexp	0.011*	0.002
	(0.006)	(0.005)
ACA_medexp_ed_low	0.004	-0.005
	(0.005)	(0.005)
ACA_medexp_ed_high	-0.005	-0.013***
	(0.005)	(0.005)
ACA_medexp_single	-0.005	0.001
	(0.004)	(0.004)
ACA_medexp_nochild	-0.000	-0.006
	(0.004)	(0.004)
y_2008	0.004	-0.006
	(0.005)	(0.004)
y_2009	0.031***	0.006
	(0.005)	(0.004)
y_2010	0.040***	0.018***
	(0.005)	(0.004)
y_2011	0.041***	0.006
	(0.005)	(0.005)
y_2012	0.038***	0.013***
	(0.005)	(0.005)
y_2013	0.025***	0.002
	(0.005)	(0.005)
y_2014	0.021***	-0.004
	(0.006)	(0.005)
y_2015	0.014**	-0.004
	(0.006)	(0.005)
Observations	793660	586835
Adjusted R-squared	0.066	0.034
State Fixed Effects	YES	YES
Quadratic Trend by Medicaid Expansion	YES	YES
=** p<0.10	** p<0.05	*** p<0.01"