Household Labor Search, Spousal Insurance, and Health Care Reform*

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Abstract

Health insurance in the United States for the working age population has traditionally been provided in the form of employer-sponsored health insurance (ESHI). If employers offered ESHI to their employees, they also typically extended coverage to their spouse and dependents. Provisions in the Affordable Care Act (ACA) significantly alter the incentive for firms to offer insurance to the spouses of employees. We evaluate the long-run impact of the ACA on firms' insurance offerings and on household outcomes by developing and estimating an equilibrium job search model in which multiple household members are searching for jobs. The distribution of job offers is determined endogenously, with compensation packages consisting of a wage and menu of insurance offerings (premiums and coverage) that workers select from. Using our estimated model we find that households' valuation of employer-sponsored spousal health insurance is significantly reduced under the ACA, and with an "employee-only" health insurance contract emerging among low productivity firms. We relate these outcomes to the specific provisions in the ACA.

Keywords: Health, Health Insurance, Labor Market Equilibrium, Household Search.

JEL Classification Numbers: G22, I11, I13, J32.

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1 Introduction

Employer-sponsored health insurance (ESHI) is the most important source of health insurance coverage for the working age population in the United States. An under-explored aspect of this system is that employers typically offer health insurance not only to their own employees, but also to the spouses (and dependents) of their employees. Indeed, spousal health insurance benefits are heavily used by married couples,[1] and these features create important links between health, health insurance, the household, and the labor market.

We re-examine these interactions in the context of the Patient Protection and Affordable Care Act of 2010 (hereafter, ACA), which comprises multiple provisions that seek, amongst other things, to improve the health insurance coverage of Americans. Most of the major components of the ACA took effect in 2014, and include a combination of individual and firm mandates, health insurance exchanges, and subsidies. First, the *individual mandate* stipulates that all individuals be covered by a qualified health insurance plan or face an income-contingent tax penalty.[2] Second, the *employer mandate* requires that firms with 50 or more full-time employees provide health insurance to workers and their dependents or pay a fine.[3] Third, the establishment of state-based *health insurance exchanges* allows individuals without ESHI options to purchase community-rated health insurance. Fourth, individuals who do not have access to employer-sponsored health insurance, either from their own or their spouses' employers, are eligible for income-contingent *premium subsidies* that can be applied to the purchase of insurance from the exchanges.

Such a significant reform to the US health insurance system is likely to have important equilibrium effects on the labor market in many dimensions. In particular, the provisions in the ACA significantly alter employers' incentives to offer health insurance benefits to the spouses of employees for several reasons. First, the definition of "dependents" under ACA, as is relevant for the employer mandate, includes children up to age 26 but does *not* include an employee's spouse. This means that firms (even large firms) will not face any tax penalty if they were not to offer spousal health insurance. Second, and as noted above, households are categorically ineligible to receive subsidies for the purchase of health insurance from their state's exchange if

[1] To the best of our understanding, the spousal health insurance benefit was and is still not required by any existing law. Based on the 2004 Panel of the Survey of Income and Program Participation, which comprises the pre-ACA data in our empirical application, we find that if both spouses are employed and offered health insurance by their employers, about 55 percent of spouses choose to obtain insurance from *one* of the employers, and only about 23 percent choose to obtain insurance from their employers separately. Furthermore, if only one spouse is employed and offered health insurance, over 90 percent of the insured couples obtain health insurance offered by the employer of the employed spouse. Identical patterns are observed in the Medical Expenditure Panel Survey data.

[2] In 2014 and 2015, the individual mandate penalties were partially implemented: in 2014, the penalty was 1 percent of family income or $95; in 2015, it was 2 percent or $325, whichever is higher. Between 2016 and 2018, the penalty is 2.5 percent of family income or $695, whichever is higher. The Tax Cut and Jobs Act of 2017 would eliminate the individual mandate penalty from 2019, though the Act did not change the legal requirement to hold minimum essential health insurance coverage.

[3] The implementation of the employer mandate was delayed till January 1, 2015, and was partially enforced until 2016. It is fully enforced since 2017.

they have access to employer-sponsored health insurance, either from their own or their spouses' employers. Thus, lower income households may prefer employers not to offer spousal insurance benefits, and the same could also be true for the employees themselves. Third, the availability of health insurance from a regulated health insurance exchange reduces households' valuation of spousal insurance. As a consequence, providing spousal health insurance benefits becomes a less effective instrument in the hiring and retention of workers than it was prior to the ACA, when the individual private insurance market was dysfunctional due to adverse selection. And while firms benefit from improving the health of their employees because healthy workers are more productive, they do not directly benefit from the improved health of the spouses of their employees, especially if the mobility decisions of their employees are now less dependent on whether spousal health insurance benefits are offered or not.

To explore the role of spousal health insurance, and how it is affected by the ACA, we develop a model based on the canonical framework of Burdett and Mortensen (1998) in which non-employed and employed workers search for jobs, and firms commit to wage offers to all potential and current employees. This frictional labor market setting provides a coherent notion of firm size, and can reproduce many well-documented relationships between firm sizes, wages, health insurance offerings, and worker turnover. Moreover, it allows us to examine outcomes including how the ACA changes the link between employer-provided health insurance and labor market mobility. For our purpose, we therefore integrate a multi-person household search model (e.g., Dey and Flinn, 2008 and Guler, Guvenen and Violante, 2012) into such an equilibrium framework. A key outcome of interest in our later analysis is the extent to which various provisions in the ACA affect whether firms offer health insurance to their employees, and if such health insurance coverage would also be extended to the spouses and dependents of the employees. To this end, we characterise jobs by an endogenously determined wage and *menu* of health insurance contracts, with the menu specifying the level of coverage (none, employee-only, employee and spouse) and the associated premiums. Upon accepting an offer, households then select a particular health insurance coverage option from those available.[4] Importantly, any job acceptance and insurance take-up decision will depend upon the labor market status of all household members. Health insurance is valuable to households, who are risk averse and ex-ante heterogeneous with respect to their marital status, presence of children, and valuations of leisure, because it insures them against medical expenditure risk and affects the dynamics of health. Similarly, health insurance is valuable to firms as it improves both hiring and retention prospects, and through its beneficial impact on workers' health, it also acts as a productivity factor. In addition, we incorporate many detailed institutional features, including the tax exemption of ESHI premiums, and the qualifying event restrictions on households' choice of health insurance.

[4]Specifying jobs in this way contrasts with other studies (e.g., Dizioli and Pinheiro, 2016, Aizawa and Fang, 2018, Aizawa, 2019) that incorporate employer-provided health insurance in extended Burdett and Mortensen (1998) frameworks. In these papers firms either offer insurance or do not, and there is no household insurance take-up decision.

We develop a multi-step estimation procedure that extends the approach pioneered by Bontemps, Robin and Van den Berg (1999, 2000), and empirically implement our model using data from the Survey of Income and Program Participation, the Medical Expenditure Panel Survey, the Kaiser Family Foundation Survey, and the Commonwealth Fund Biennial Health Insurance Survey. We show that our estimated model is able to replicate important joint household outcomes from the data, including that a large fraction of both working and non-working individuals are insured through their spouses' employers. Further, we are able to reproduce salient patterns concerning labor market and health dynamics, wages, medical expenditure, and the insurance distributions of employer sizes. We proceed to incorporate detailed institutional features of the ACA in our framework, and use our estimated model to evaluate the long-run equilibrium labor market responses to the ACA.

Consistent with early survey evidence, our simulations imply that while the provisions in the ACA are successful in reducing the uninsured rate and improving health outcomes, there are significant changes in firms' insurance offering decisions.[5] First, we find that the overall health insurance offering rate of firms declines. Second, an "employee-only" health insurance contract, which is largely impertinent in the pre-ACA equilibrium, emerges amongst low productivity firms. We show that these equilibrium responses are closely related to the availability of non-employer sponsored insurance from the marketplace exchange, and the specific eligibility rules of the associated premium subsidies. Indeed, if individuals' access to health insurance through their spouses' employers did not render households categorically ineligible for the premium subsidies, then the incidence of employee-only insurance is considerably muted. We further use our model to examine how the ACA affects job mobility, and show it to reduce the extent to which job transition events depend upon the insurance coverage status of an individual and their spouse. We also use our model to calculate households' valuation of spousal health insurance both before and after the ACA reform, and we show that the ACA considerably reduces this value.

Related literature. Our paper firstly relates to the literature, surveyed by Currie and Madrian (1999), Gruber (2000), and Gruber and Madrian (2004), which examines the interactions between health, health insurance, and labor market outcomes. The structural empirical literature that has examined these joint phenomenon is much smaller, with contributions including Rust and Phelan (1997) and De Nardi, French and Jones (2016). Equilibrium analysis, that seeks to understand the determinants of wages and the provision of health insurance, is presented in Dey and Flinn (2005), Aizawa and Fang (2018) and Aizawa (2019). As in our study, these papers develop models

[5] A survey conducted by Towers Watson National Business Group on Health (*Employer Survey on Purchasing Value in Health Care*, 2013) suggests important changes in spousal insurance benefits: 18% of surveyed firms stated that they either have already or are planning to require spouses to purchase health insurance through their employer plan before enrolling in their health plan; 12% of the respondent firms either have already or are planning to exclude spouses from enrolling in their health plan when similar coverage is available through their own employer; and 5% are planning to completely eliminate spousal coverage.

that are cast in equilibrium labor market search environments. Such an environment provides a coherent framework to jointly study job mobility, wage formation, wage dynamics, and the sorting patterns between firms and workers. The empirical analyses in Aizawa and Fang (2018) and Aizawa (2019) center on the labor market impact of the ACA, but as they consider single agent models, they are limited in their ability to examine issues related to household labor supply and spousal health insurance, as we focus upon in this paper.

Second, the paper relates to the literature on household labor supply in a frictional labor market. Burdett and Mortensen (1978) were the first to develop and analyze a two-person household search model. Guler, Guvenen and Violante (2012) provide a theoretical characterisation of the joint search problem of couples in an otherwise standard sequential job search model. They show that if the household utility function is linear in income, then the spouses' reservation wages in the joint search problem coincide with those of an individual search problem. However, if the couples are risk averse, then the behavioral (reservation wage) implications of the single-agent and joint search models are no longer equivalent, and richer household dynamics (such as the breadwinner cycle) emerge. Empirical household search models are developed and estimated in Dey and Flinn (2008), Gemici (2011), and Flabbi and Mabli (2018). Importantly, all these household search papers are partial equilibrium models, in which the distribution of job offers is exogenous. We extend these models to an environment where the distribution of job offers is endogenous, thereby allowing us to study potentially important equilibrium effects following large reforms such as the ACA.[6] Most closely related to our study is Dey and Flinn (2008), which considers a model where jobs are characterized by a wage and whether health insurance is offered. They highlight the potential dependence of couples' labor market decisions in the context of health benefits,[7] but several modelling choices in their paper are not desirable to analyze the potential impact of the ACA on firms' decisions regarding whether to offer health insurance, and whether to extend coverage to employees' spouses. Firstly, as noted above, it is a partial equilibrium model which immediately limits the scope of the model for evaluating large-scale policy reforms; second, they assume that any insurance offered automatically covers employees and spouses; third, they do not model workers' health status and health expenditures.

Thirdly, by introducing the household in an empirical equilibrium search environment, we also relate to the existing literature that has developed and estimated (single agent) equilibrium labor market search models with wage posting. This literature also includes van den Berg and Ridder (1998), Bontemps, Robin and Van den Berg (1999, 2000), Meghir, Narita and Robin (2015),

[6] Common with the aforementioned household search papers, we do not consider household formation decisions. In recent work, Flabbi, Flinn and Salazar-Sáenz (2019) and Pilossoph and Wee (2019*a*) consider household search models with marriage and pre-market schooling investments. In Flabbi, Flinn and Salazar-Sáenz (2019) there is simultaneous search in the marriage and labor market, with household decisions made non-cooperatively. In contrast, Pilossoph and Wee (2019*a*) present a model where marriage matching occurs in an initial (frictionless) stage.

[7] See also, Wellington and Cobb-Clark (2000), whose empirical estimates suggest that a husband having health insurance coverage in his job reduces his wife's employment probability by around 20%.

and Shephard (2017). Indeed, we demonstrate how many of the common solution and estimation techniques that have helped make these models popular in empirical work, can be suitably extended to account for the multi-searcher households, as we consider here.

Fourth, we relate to the broader literature that has studied the impact of the ACA. This includes descriptive analysis that has examined the impact that the ACA has on insurance coverage (e.g., Long et al., 2014, and Courtemanche, Marton and Yelowitz, 2016), and the analysis of specific provisions in the ACA, such as the dependent coverage mandate that took effect in late 2010 (e.g., Dillender, Heinrich and Houseman, 2016). The implications that the ACA has for labor market incentives is detailed in Mulligan (2015*a*,*b*), while Heim, Lurie and Simon (2015) and Duggan, Goda and Jackson (2019) provide an early assessment of the labor market impacts. Meanwhile, quantitative macroeconomic evaluations of the labor market impact include Pashchenko and Porapakkarm (2013) and Nakajima and Tüzemen (2017). Also related is the literature that analysed the preceding the Massachusetts Health Reform of 2006, which shares features with the ACA (see, Kolstad and Kowalski, 2012, 2016, Courtemanche and Zapata, 2014, and Hackmann, Kolstad and Kowalski, 2015).

Outline. The remainder of the paper is structured as follows. In Section 2 we present the details of our theoretical model. In Section 3 we proceed to describe the empirical implementation of our model, including our data, identification, estimation procedure, and estimation results. In Section 4 we describe how we incorporate the main components of the ACA in our theoretical model, while in Section 5 we present results from our counterfactual experiments, and show how a range of outcomes, including firms' health insurance offering decision and the value of employer-sponsored spousal health insurance, is affected by provisions in the ACA. In Section 6 we conclude and discuss directions for future research.

2 The Model

We begin by presenting the model under the pre-ACA economic environment. The economy consists of a continuum of stable households with a population size that we denote by N. Time is continuous, and all households are infinitely lived with the common discount rate $\rho > 0$. Households differ in a number of dimensions. First, they differ in terms of their observable characteristics $\mathbf{x}$, which include the presence of children and marital status. Second, as in Albrecht and Axell (1984), households also differ in their unobserved value of leisure $\boldsymbol{\alpha}$, which is continuous on its support. Both $\mathbf{x}$ and $\boldsymbol{\alpha}$ are considered persistent household characteristics,[8]

[8]The ACA affects the incentives for marriage in two main ways. Firstly, many of the components of the ACA are based on household income which therefore acts to introduce an implicit marriage penalty. Secondly, since most employers do not extend health insurance coverage to unmarried partners, the availability of non-employer provided health insurance reduces an important economic benefit from marriage. Both of these considerations suggest that

with the joint cumulative distribution function of household types denoted by $\mathcal{B}(\boldsymbol{\alpha}, \mathbf{x})$.[9] Second, households differ in terms of the health status $\mathbf{h}$ of its members, which evolves according to a law of motion that we describe below.

The economy consists of both married couple households and single individual households. The single households' problem is relatively standard and can be incorporated as a special case of the couple's problem (see Section 2.6). For conciseness, we focus our description of the household problem on couple households, which comprise two household members, who have preferences represented by a household utility function. In such households, members are indexed by $j \in \{1, 2\}$, with the convention that adult 1 is the male, and adult 2 is the female. Individuals may be in the state of non-employment or employment, with jobs characterized by a wage rate w, and a *menu* of health insurance offerings I. We consider a frictional labor market, with workers sequentially sampling job offers from $F(w, I)$ at rate $\lambda_u^j(\mathbf{x})$ when non-employed and rate $\lambda_e^j(\mathbf{x})$ when employed. Upon accepting an offer, workers select a particular health insurance coverage option $i \in I$, with each option associated with a distinct insurance premium $r(i; w, I)$. The purchase of health insurance protects individuals against medical expenditure risk. Firms offer one of three different types of insurance:

1. *No health insurance* ($I = 0$). Workers receive pre-tax monetary compensation equal to the wage w. Such a worker may still be insured if they are covered by their spouse's insurance.

2. *Employee only insurance* ($I = 1$). Insurance is offered, but it does not extend coverage to spouses. Workers decide whether to decline insurance ($i = 0$) and receive pre-tax monetary compensation w (since $r(0; w, I) = 0$), or to purchase insurance ($i = 1$) at the premium $r(1; w, 1)$, which is a pre-tax deduction.

3. *Employee and spouse insurance* ($I = 2$). Insurance is offered, and made available to both the employee and their spouse. Again, workers decide whether to decline insurance ($i = 0$) and receive w, to purchase insurance for the employee only ($i = 1$) at premium $r(1; w, 2)$, or to purchase insurance for the employee and their spouse ($i = 2$) at premium $r(2; w, 2)$.

For convenience, we will often refer to the insurance contract offering decision of the firm I to be the *sector* of the firm, with the set of possible sectors choice denoted $\mathcal{I} = \{0, 1, 2\}$.[10] The conditional, or *sector-specific*, wage offer distributions are denoted $F_I(w)$. For single person households,

the ACA may reduce the economic incentives for marriage and a full quantitative assessment of this impact is left for future work. See Abramowitz (2016) and Barkowski and McLaughlin (2018) for evidence on how specific ACA provisions have affected marriage rates.

[9]The same heterogeneity structure is considered in Shephard (2017) in a single agent model. Heterogeneity in leisure flows enriches the model's ability to capture diverse labor market histories. As we discuss later, it also provides a way to smooth the labor supply function faced by the firms, where it would otherwise exhibit discontinuities.

[10]Most families in the U.S. receive health insurance for their children through employer sponsored plans. We assume that if firms provide any form of health insurance ($I = 1, 2$) then they also extend coverage to the dependent children of their employees, and that employees who purchase insurance always purchase for their children. While we omit these details from the presentation of our model, in our empirical implementation we explicitly model a distribution

individual insurance *choice* and individual insurance *coverage* are synonyms. This is not true in couple households, since individuals may be insured through their spouse. In what follows we use $q_j(\mathbf{i})$ to denote the indicator function for spouse j being insured, given the insurance choices of both adults $\mathbf{i} = (i_1, i_2)$. We set $i_j = 0$ if spouse j is non-employed.

Employees are not able to change insurance coverage options freely during a job spell. In particular, workers are not allowed to change coverage in response to changes in health status. There are two ways that coverage may be changed. Firstly, it may be changed in response to a *qualifying event*, which given the absence of family transitions in our model, is associated with either adult starting a new job, or entering the non-employment pool.[11] Secondly, coverage may be changed when an open enrollment event occurs. We model an open enrollment event by assuming it takes place at some exogenous rate $\eta > 0$, which then allows the household to re-optimize over the set of available insurance options.[12]

Employed individuals face a constant risk of entering non-employment, with *exogenous* job destruction events occurring at rate $\delta_j(\mathbf{x})$. As we explain below, there may also be *endogenous* transitions to non-employment following changes in health status, or in the labor market position of their spouse.

2.1 Preferences

For couples, we consider a *unitary* model of the household, with preferences assumed constant absolute risk aversion (CARA)

$$U(c, P_1, P_2; \boldsymbol{\alpha}, \mathbf{x}) = \alpha_1(1 - P_1) + \alpha_2(1 - P_2) - \exp(-\psi(\mathbf{x}) \cdot c), \tag{1}$$

where $\psi(\mathbf{x}) > 0$ is the coefficient of absolute risk aversion, c is household consumption, and P_j is spouse j's employment indicator. Households are taxed on total family earnings; and given the absence of any saving or borrowing technology, they consume their net income, less any

of medical expenditure for children (parametrized the same way as for adults, as detailed in Section 2.3) but do not incorporate child health status as a state variable. Given the absence of variation in child medical expenditure risks across firms, the child coverage premium is also necessarily constant across all firms and so households will also be indifferent with respect to the source of any employer provided child coverage.

[11] Termination of employment for any reason (voluntary or involuntary) other than gross misconduct is a qualifying event. See, e.g., http://www.dol.gov/ebsa/faqs/faq-consumer-cobra.html. Our treatment of what constitutes a qualifying event is a slight simplification as we do not consider whether there is an associated loss of coverage.

[12] Modelling open enrollment as a stochastic process allows us to capture the idea that workers have the ability to change their coverage absent a qualifying event by waiting, in a tractable way that does not require explicit non-stationarities to be introduced. We calibrate η so that an open enrollment event occurs, on average, every year.

out-of-pocket medical expenditure costs.[13] The couple's budget constraint is therefore given by

$$c = y\left(P_1(w_1 - r_1(i_1; w_1, I_1)) + P_2(w_2 - r_2(i_2; w_2, I_2)) + (2 - P_1 - P_2)b_{UI}; \mathbf{x}\right) \\ - o(m_1|q_1(\mathbf{i})) - o(m_2|q_2(\mathbf{i})), \tag{2}$$

where $y(\cdot; \mathbf{x})$ is the after-tax income function that subsumes the tax schedule, b_{UI} is unemployment insurance, and $o(m_j|q_j)$ gives the out-of-pocket expenditure given medical cost m_j, and individual insurance coverage q_j. Note that the after-tax income function depends upon the demographic conditioning vector $\mathbf{x}$. This reflects the differential treatment of single and married households in the U.S. tax system, together with any variation caused by the presence of dependent children.

2.2 Health

Current health status is measured by the scalar h. There are H discrete health statuses, ordered $h^1 < h^2 < \ldots < h^H$, with the maximal value h^H corresponding to most healthy. Health status is dynamic and evolves stochastically. We denote spouse j's health status by h_j. The Poisson rate at which spouse j with insurance status q_j experiences a change in health status from h_j to h_j' is given by $\nu_j(h_j'|h_j, q_j, \mathbf{x})$. The total rate at which health status changes is given by $\overline{\nu}_j(h_j, q_j, \mathbf{x}) = \sum_{h_j' \neq h_j} \nu_j(h_j'|h_j, q_j, \mathbf{x})$. Following any health shock, either (or both) individual may decide to exit employment, in which case the couple may re-optimize over any available health insurance options. Health insurance is valuable to couples both because it insures household members against medical expenditure shocks, and because health insurance, via both preventative and curative care, influences the health transition function $\nu_j(h_j'|h_j, q_j, \mathbf{x})$.

2.3 Medical expenditure

Individuals are subject to a new health expenditure shock whenever they experience a change in either their health status or insurance coverage. The distribution of medical expenditure is modelled as a mixture distribution.[14] There is a probability mass at zero expenditure, with this probability given by $M_j^0(h_j, q_j, \mathbf{x})$. Conditional on a positive medical expenditure realization, the cumulative distribution function of medical expenditures is $M_j^+(\cdot|h_j, q_j, \mathbf{x})$. Note that both current health h_j, and individual health insurance status, q_j, may affect the distribution of medical expenditure. Let the resultant unconditional distribution be denoted $M_j(\cdot|h_j, q_j, \mathbf{x})$.

An important simplifying assumption in our analysis, is that medical expenditure *realizations* are unobserved to the household (at least, currently) and so are not state variables. This implies

[13] See García-Pérez and Rendon (2016) and Wang (2019) for non-equilibrium household search models with savings.

[14] The use of mixture distributions is a common way to parametrically approximate the empirical medical expenditure distributions, which are typically both positively skewed, and with a mass at zero expenditure. See, for example, Einav et al. (2013).

that the flow benefit to the household comprises expected flow utility, where the expectation is over the distribution of family medical expenditure shocks conditional on current household health status and insurance coverage. Given our flow utility specification in equation (1) we obtain convenient forms for expected utility. Consider the case where adult 1 is uninsured so that $o(m_1|q_1 = 0) = m_1$, while adult 2 is fully insured with $o(m_2|q_2 = 1) = 0$. In this case, expected flow utility is given by

$$\begin{aligned} &\iint U(y - o(m_1|q_1) - o(m_2|q_2), P_1, P_2; \boldsymbol{\alpha}, \mathbf{x}) \, \mathrm{d}M_1(m_1|h_1, q_1, \mathbf{x}) \, \mathrm{d}M_2(m_2|h_2, q_2, \mathbf{x}) \\ &\quad = \alpha_1(1 - P_1) + \alpha_2(1 - P_2) - \exp(-\psi(\mathbf{x})y) \\ &\quad \times \underbrace{\left[M_1^0(h_1, 0, \mathbf{x}) + (1 - M_1^0(h_1, 0, \mathbf{x})) \cdot \int \exp(\psi(\mathbf{x})m_1) \, \mathrm{d}M_1^+(m_1|h_1, 0, \mathbf{x}) \right]}_{\equiv R_1(\psi(\mathbf{x}), h_1, 0, M_1(\cdot|h_1, 0, \mathbf{x}))}, \end{aligned} \tag{3}$$

where $R_j(\psi, h_j, q_j, M_j)$ is the *risk adjustment* factor for spouse j, given risk aversion ψ, health status h_j, insurance coverage q_j, and expenditure distribution M_j. In our empirical application we impose distributional assumptions on $M_j^+(\cdot|h_j, q_j, \mathbf{x})$ that imply that this risk adjustment factor both exists and may be analytically characterized. See Section 3.2.

2.4 Worker value functions

We formalize our description of the household labor market and health insurance choice problem using value functions. We denote the value in the joint non-employment state as $\mathcal{V}_{uu}(\mathbf{h}; \boldsymbol{\alpha}, \mathbf{x})$. When only adult 1 (the male) is employed, the value function conditional on the current insurance choice i_1 (and other household state variables) is denoted by $\mathcal{V}_{eu}(w_1, i_1, I_1, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x})$, while the *maximal* value over the set of all available insurance choices is defined as $\overline{\mathcal{V}}_{eu}(w_1, I_1, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) = \max\{\mathcal{V}_{eu}(w_1, i_1, I_1, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) : i_1 \in I_1\}$. It is necessary to define both of these value functions, as restrictions in the ability of the household to change insurance coverage mean that the current insurance choice i_1 is not necessarily the most preferred from the set I_1. Similarly, we define $\mathcal{V}_{ue}(w_2, i_2, I_2, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x})$ and $\overline{\mathcal{V}}_{ue}(w_2, I_2, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x})$ to be the value functions when only the female is employed, and with $\mathcal{V}_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x})$ and $\overline{\mathcal{V}}_{ee}(\mathbf{w}, \mathbf{I}, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x})$ defining the respective value functions in the joint employment state.

Here, for conciseness, we only describe the value functions in the male single-earner (*eu*) state, with the recursive definitions of all other value functions provided in Appendix A. To proceed we define the expected flow utility when only the male is working as $\overline{u}_{eu}(w_1, i_1, I_1, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x})$.[15] In describing the value function we note that the following events may happen. First, either adult may experience a health transition, which occurs at rate $\overline{\nu}_j(h_j, q_j)$ for spouse j. In this event,

[15]This is obtained by integrating the flow utility function (equation (1)) over the distribution of all medical expenditure shocks. We obtain an analytical characterisation for the expected utility, using the risk adjustment factors that we derive and present in Appendix D.

either the husband continues to be employed, or he endogenously quits to non-employment. Note that health transitions themselves do not allow individuals to re-optimize over the set of insurance offerings by their employers. Second, either adult may receive a job offer (at rate $\lambda_e^1(\mathbf{x})$ for the husband, and at rate $\lambda_u^2(\mathbf{x})$ for the wife). If the non-employed wife were to accept a job, then the husband may either remain employed or endogenously exit to non-employment.[16] The latter is possible since the reservation wage of any adult, as detailed in Dey and Flinn (2008), Guler, Guvenen and Violante (2012), and Flabbi and Mabli (2018), is in general a function of their spouse's state. In both cases, optimization over the set of insurance options is permitted. Third, there may be an exogenous job destruction event for the husband, occurring at rate $\delta_1(\mathbf{x})$. Fourth, at rate η there is an open enrollment event which allows re-optimization over the set of insurance options, absent a job change, and therefore allows value $\overline{\mathcal{V}}_{eu}(w_1, I_1, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x})$ to be attained. Suppressing the conditioning of both the value functions and worker parameters on leisure values and the vector of demographic characteristics ($\boldsymbol{\alpha}$ and $\mathbf{x}$), it then follows that the Bellman (1957) equation is given by

$$\begin{aligned}
\mathcal{D}_{eu}(i_1, \mathbf{h})\mathcal{V}_{eu}(w_1, i_1, I_1, \mathbf{h}) = {}& \overline{u}_{eu}(w_1, i_1, I_1, \mathbf{h}) \\
& + \textstyle\sum_{h_1'} \nu_1(h_1'|h_1, q_1(i_1)) \max\{\mathcal{V}_{eu}(w_1, i_1, I_1, h_1', h_2), \mathcal{V}_{uu}(h_1', h_2)\} \\
& + \textstyle\sum_{h_2'} \nu_2(h_2'|h_2, q_2(i_1)) \max\{\mathcal{V}_{eu}(w_1, i_1, I_1, h_1, h_2'), \mathcal{V}_{uu}(h_1, h_2')\} \\
& + \lambda_e^1 \int \max\{\overline{\mathcal{V}}_{eu}(w_1', I_1', \mathbf{h}), \mathcal{V}_{eu}(w_1, i_1, I_1, \mathbf{h})\}\, \mathrm{d}F(w_1', I_1') \\
& + \lambda_u^2 \int \max\{\overline{\mathcal{V}}_{ee}(\mathbf{w}, \mathbf{I}, \mathbf{h}), \overline{\mathcal{V}}_{ue}(w_2, I_2, \mathbf{h}), \mathcal{V}_{eu}(w_1, i_1, I_1, \mathbf{h})\}\, \mathrm{d}F(w_2, I_2) \\
& + \delta_1 \mathcal{V}_{uu}(\mathbf{h}) + \eta \overline{\mathcal{V}}_{eu}(w_1, I_1, \mathbf{h}),
\end{aligned}$$

where $\mathcal{D}_{eu}(i_1, \mathbf{h}) \equiv \rho + \overline{\nu}_1(h_1, q_1(i_1)) + \overline{\nu}_2(h_2, q_2(i_1)) + \lambda_e^1 + \lambda_u^2 + \delta_1 + \eta$.

2.5 Steady state flows

We consider the steady state of the labor market. In describing this steady state we derive flow equations for all the joint labor market states. These equations embody a rich set of dynamics, and are also necessary to characterize the subsequent decision problem of the firm. As in the above, our discussion here considers the single earner state, where adult 1 (the male) is employed, and adult 2 (the female) is not, and we denote the corresponding measure of households as $g_{eu}(w_1, i_1, I_1, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x})$. This state will be exited if: i) adult 1 experiences an exogenous job de-

[16] We do not allow for job acceptance decisions that are only used to trigger qualifying events and would be followed by an immediate quit. For example, suppose that the employed husband is uninsured at a firm that offers ESHI, but would prefer to be insured. In this case, the wife would always be willing to accept *any* job offer if instantaneous quits are allowed as this would allow the household to re-optimize over the husband's available insurance options at no cost.

struction event; ii) either adult experiences a health transition; iii) adult 1 accepts a higher value job; iv) adult 2 accepts a job (since we are characterizing the joint states, this is true regardless of whether adult 1 endogenously quits his job or not); v) there is an open enrollment event.[17] Again suppressing the conditioning on the persistent household characteristics $(\boldsymbol{\alpha}, \mathbf{x})$, the total outflows from this state are therefore given by

$$g_{eu}(w_1, i_1, I_1, \mathbf{h}) \cdot \left[\delta_1 + \overline{v}_1(h_1|q_1(i_1)) + \overline{v}_2(h_2|q_2(i_1)) + \lambda_e^1 \int_{\boldsymbol{\Omega}_{eu}^{1-}(w_1,i_1,I_1,\mathbf{h})} \mathrm{d}F(w_1', I_1') + \lambda_u^2 \int_{\boldsymbol{\Omega}_{eu}^{2-}(w_1,i_1,I_1,\mathbf{h})} \mathrm{d}F(w_2', I_2') + \eta \right], \quad (4)$$

with the conditional outflow set for adult 1's job offers defined as $\boldsymbol{\Omega}_{eu}^{1-}(w_1, i_1, I_1, \mathbf{h}) = \{(w_1', I_1') : \overline{\mathcal{V}}_{eu}(w_1', I_1', \mathbf{h}) > \mathcal{V}_{eu}(w_1, i_1, I_1, \mathbf{h})\}$ and with the corresponding set for adult 2's offers given by $\boldsymbol{\Omega}_{eu}^{2-}(w_1, i_1, I_1, \mathbf{h}) = \{(w_2', I_2') : \max\{\overline{\mathcal{V}}_{ee}(w_1, w_2', I_1, I_2', \mathbf{h}), \overline{\mathcal{V}}_{ue}(w_2', I_2', \mathbf{h})\} > \mathcal{V}_{eu}(w_1, i_1, I_1, \mathbf{h})\}$.

Now consider the inflows into this state (conditional on $\mathcal{V}_{eu}(w_1, i_1, I_1, \mathbf{h}) > \mathcal{V}_{uu}(\mathbf{h})$), and let $v_{eu}^*(w, i, I, \mathbf{h}) = \mathbb{1}[V_{eu}(w, i, I, \mathbf{h}) = \overline{V}_{eu}(w, I, \mathbf{h})]$ denote the indicator function for the insurance choice $i \in I$ being optimal. Firstly, consider those inflows that result from a male job acceptance event. This could be from an initial state of joint non-employment, from a lower value job in the *eu* state, from the *ue* state (with adult 2 endogenously quitting upon job acceptance), or from the joint employment *ee* state (again, with adult 2 endogenously quitting). These inflows are

$$f(w_1, I_1) \cdot v_{eu}^*(w_1, i_1, I_1, \mathbf{h}) \cdot \Bigg[\underbrace{\lambda_u^1 g_{uu}(\mathbf{h})}_{\text{adult 1 accepts job from } uu} + \underbrace{\lambda_e^1 \sum_{I_1'} \sum_{i_1' \in I_1'} \int_{\boldsymbol{\Omega}_{eu}^{1+}(w_1,i_1',I_1,I_1',\mathbf{h})} g_{eu}(w_1', i_1', I_1', \mathbf{h})\, \mathrm{d}w_1'}_{\text{adult 1 accepts higher value job}}$$

$$+ \underbrace{\lambda_u^1 \sum_{I_2'} \sum_{i_2' \in I_2'} \int_{\boldsymbol{\Omega}_{ue}^{2+}(w_1,i_2',I_1,I_2',\mathbf{h})} g_{ue}(w_2', i_2', I_2', \mathbf{h})\, \mathrm{d}w_2'}_{\text{adult 1 accepts job, adult 2 quits from } ue} + \underbrace{\lambda_e^1 \sum_{\mathbf{I}'} \sum_{\mathbf{i}' \in \mathbf{I}'} \int_{\boldsymbol{\Omega}_{ue}^{3+}(w_1,\mathbf{i}',I_1,\mathbf{I}',\mathbf{h})} g_{ee}(\mathbf{w}', \mathbf{i}', \mathbf{I}', \mathbf{h})\, \mathrm{d}\mathbf{w}'}_{\text{adult 1 accepts job, adult 2 quits from } ee} \Bigg], \quad (5)$$

where we use the same notational convention when defining the measures for the alternative joint states, and where the inflow set $\boldsymbol{\Omega}_{eu}^{1+}(w_1, i_1', I_1, I_1', \mathbf{h}) = \{w_1' : \overline{\mathcal{V}}_{eu}(w_1, I_1, \mathbf{h}) > \mathcal{V}_{eu}(w_1', i_1', I_1', \mathbf{h})\}$ defines the set of wages that the currently employed (single earner) male would quit his job from, $\boldsymbol{\Omega}_{ue}^{2+}(w_1, i_2', I_1, I_2', \mathbf{h}) = \{w_2' : \overline{\mathcal{V}}_{eu}(w_1, I_1, \mathbf{h}) > \max\{\overline{\mathcal{V}}_{ee}(w_1, w_2', I_1, I_2', \mathbf{h}), \mathcal{V}_{ue}(w_2', i_2', I_2', \mathbf{h})\}\}$ gives the wages that the currently employed (single earner) female would quit her job from with the male accepting (w_1, I_1), and finally the set $\boldsymbol{\Omega}_{ue}^{3+}(w_1, \mathbf{i}', I_1, \mathbf{I}', \mathbf{h}) = \{\mathbf{w}' : \overline{\mathcal{V}}_{eu}(w_1, I_1, \mathbf{h}) > \max\{\overline{\mathcal{V}}_{ee}(w_1, w_2', I_1, I_2', \mathbf{h}), \mathcal{V}_{ee}(\mathbf{w}', \mathbf{i}', \mathbf{I}', \mathbf{h})\}\}$ defines the male and female wages that is dominated by the single earner state $(w_1, I_1, \mathbf{h})$.

Second, we have a job destruction induced inflow from the joint employment state, with

[17] Our formulation allows for an outflow at an open enrollment event even when current choice $i_1 \in I_1$ is optimal given $(w_1, I_1, \mathbf{h})$. However, the outflow will be completely offset by an accompanying inflow that we detail below.

adult 1 employed at a type-(w_1, I_1) job, and when adult 2 exogenously loses her job at rate δ_2. The measure of such inflows is given by

$$\delta_2 \cdot v^*_{eu}(w_1, i_1, I_1, \mathbf{h}) \cdot \sum_{I'_2} \sum_{i'_2 \in I'_2} \sum_{i'_1 \in I_1} \int g_{ee}(w_1, w'_2, \mathbf{i}', I_1, I'_2, \mathbf{h}) \, \mathrm{d}w'_2. \tag{6}$$

Third, we have inflows due to health transitions from either adult. These could be from an initial single earner state, where total health induced inflows are given by

$$\sum_{h'_1} \nu_1(h_1 | h'_1, q_1(i_1)) g_{eu}(w_1, i_1, I_1, h'_1, h_2) + \sum_{h'_2} \nu_2(h_2 | h'_2, q_2(i_1)) g_{eu}(w_1, i_1, I_1, h_1, h'_2). \tag{7}$$

Note that the health inflows above are not multiplied by the indicator $v^*_{eu}(w_1, i_1, I_1, \mathbf{h})$ since changes in health by itself do not constitute a qualifying event. Inflows may also arise from a joint employment state where the health transition (of either adult) induces adult 2 to endogenously enter the non-employment pool. Here the endogenous quit triggers a qualifying event so that inflows are given by

$$v^*_{eu}(w_1, i_1, I_1, \mathbf{h}) \cdot \Bigg[\underbrace{\sum_{h'_1} \sum_{I'_2} \sum_{i'_2 \in I'_2} \sum_{i'_1 \in I_1} \int_{\boldsymbol{\Omega}^{5+}_{eu}(w_1, \mathbf{i}', I_1, I'_2, \mathbf{h})} \nu_1(h_1 | h'_1, q_1(\mathbf{i}')) g_{ee}(w_1, w'_2, \mathbf{i}', I_1, I'_2, h'_1, h_2) \, \mathrm{d}w'_2}_{\text{adult 1 health transition from } ee\text{, adult 2 quits}}$$
$$+ \underbrace{\sum_{h'_2} \sum_{I'_2} \sum_{i'_2 \in I'_2} \sum_{i'_1 \in I_1} \int_{\boldsymbol{\Omega}^{5+}_{eu}(w_1, \mathbf{i}', I_1, I'_2, \mathbf{h})} \nu_2(h_2 | h'_2, q_2(\mathbf{i}')) g_{ee}(w_1, w'_2, \mathbf{i}', I_1, I'_2, h_1, h'_2) \, \mathrm{d}w'_2}_{\text{adult 2 health transition from } ee\text{, adult 2 quits}} \Bigg], \tag{8}$$

and with the inflow set in equation (8) given by $\boldsymbol{\Omega}^{5+}_{eu}(w_1, \mathbf{i}', I_1, I'_2, \mathbf{h}) = \{w'_2 : \overline{\mathcal{V}}_{eu}(w_1, I_1, \mathbf{h}) > \max\{\mathcal{V}_{ee}(w_1, w'_2, \mathbf{i}', I_1, I'_2, \mathbf{h}), \overline{\mathcal{V}}_{ue}(w'_2, I'_2, \mathbf{h})\}\}$.

Finally, we also have inflows when an open enrollment event occurs (at rate η) and with the insurance choice $i_1 \in I_1$ optimal. The measure of open enrollment inflows is

$$v^*_{eu}(w_1, i_1, I_1, \mathbf{h}) \cdot \eta \cdot \sum_{i'_1 \in I_1} g_{eu}(w_1, i'_1, I_1, \mathbf{h}). \tag{9}$$

The steady state requirement can therefore be stated as (4) = (5) + (6) + (7) + (8) + (9). The flow equations in the single earner state when adult 2 (the female) is employed is symmetric to the above and may be similarly derived. Flow equations for the other joint states are presented in Appendix B.

2.6 Single households

We have described the worker side of the economy for households that comprise two adults. In our application, we consider a labor market that is composed of both single and couple households, with family status a persistent characteristic and contained in our demographic conditioning vector $\mathbf{x}$. The decision problem for single households is, unsurprisingly, much simpler. To simplify our exposition of the firm side as much as possible, we note that formally the single person household model can be considered as a special case of the general two person model presented here where the arrival rate of spousal job offers and the value of spousal leisure is restricted to be zero. This allows us to consistently maintain the joint state notation, with differences in worker parameters, as well as differences in the tax treatment of singles and couples, all incorporated through the demographic conditioning vector.

2.7 Firms

Firms are risk neutral and are heterogeneous with respect to their productivity p, and their fixed cost of providing health insurance. The underlying distribution of productivity in the population of firms is given by the cumulative distribution function $\Gamma(\cdot)$, with the corresponding PDF $\gamma(\cdot)$, on the support $[\underline{p}, \overline{p}] \subset (0, \infty)$. We allow health to directly affect the productivity of the worker (as in Dey and Flinn, 2005, Fang and Gavazza, 2011, Dizioli and Pinheiro, 2016, and Aizawa and Fang, 2018, amongst others), with firm productivity here corresponding to the flow marginal product of a worker with maximal health status h^H. The marginal product of a worker with health status h is then given by $p \times a(h) \leq p$, where $a(h) \leq 1$ captures the impact of health on worker productivity.

We assume that there is *compensation package* posting: employers post a contract (w, I) that specifies a wage and the type of insurance offering prior to forming matches with potential employees, who can then either accept or reject the offer.[18] Associated with each insurance choice $i \in I$ is the insurance premium $r(i; w, I)$. We restrict the contract space of firms by the requirement that within each choice, insurance premiums are equal to the expected medical expenditure as faced by the firm. In particular, this assumption rules out any cross-subsidization within the firm, and conditional on the insurance provision decision I, restricts the problem of the firm to be one-dimensional (i.e. the choice of a wage). Note that there are several reasons why firms may wish to provide health insurance benefits. First, absent the availability of non-employer sponsored insurance, the risk aversion of households and risk neutrality of firms introduces a

[18] Note that these contracts do not depends upon the household type $(\boldsymbol{\alpha}, \mathbf{x})$ or spousal state. An alternative empirical framework would be a model with bargaining, as in the Diamond-Mortensen-Pissarides framework, for example. Our choice of the BM framework is motivated by its coherent notion of firm size (as is relevant for the ACA employer mandate), and because the bargained wage in a bargaining framework would depend on household characteristics including marital status, and spousal wage/employment outcomes, which is unlawful under various anti-discrimination laws, such as the Equal Pay Act.

risk sharing motive. Second, health insurance plan premiums are a pre-tax deduction.[19] Third, health is a productivity factor, whose transition is affected by the provision of health insurance. While the first two points imply a direct incentive to provide insurance to both employees and their spouses, the latter point only concerns firms' employees.

The decision problem of the firm is the choice of compensation package (w, I) to maximize profits, taking the optimal strategies of workers (job acceptance, mobility, and selection from the insurance offerings), and the aggregate compensation distribution $F(w, I)$ as given. We now describe this problem.

2.7.1 Firm size

To characterize firm size it is first necessary to derive the objects related to firm size in the steady state of the labor market using the worker flows that we presented in Section 2.5 and Appendix B. As an intermediate step, we first note that the measure of male workers from a type-$(\boldsymbol{\alpha}, \mathbf{x})$ household that is working in a firm with wage w, insurance choice i, insurance offerings I, and joint family health status $\mathbf{h}$ is given by

$$\ell_1(w, i, I, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) = \frac{1}{f(w, I)} \left[g_{eu}(w, i, I, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) + \sum_{I_2'} \sum_{i_2' \in I_2'} \int g_{ee}(w, w_2', i, i_2', I, I_2', \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \, \mathrm{d}w_2' \right]. \quad (10)$$

The analogous object for female workers $\ell_2(w, i, I, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x})$ is defined symmetrically. The total measure of gender j workers in a firm with compensation package (w, I), who self-select into contract $i \in I$, and with family health status $\mathbf{h}$ is obtained by integrating over the distribution of family types

$$\ell_j(w, i, I, \mathbf{h}) = \int \ell_j(w, i, I, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \, \mathrm{d}B(\boldsymbol{\alpha}, \mathbf{x}), \quad (11)$$

so that the total firm size for a firm with compensation package (w, I) is given by

$$\ell(w, I) = \sum_{\mathbf{h}} \sum_{i \in I} [\ell_1(w, i, I, \mathbf{h}) + \ell_2(w, i, I, \mathbf{h})]. \quad (12)$$

2.7.2 Average worker productivity

Recall that health is a productivity factor, with the flow marginal product of a worker with health status h at a productivity p firm given by $p \times a(h)$. The expected flow marginal product at a productivity p firm with compensating package (w, I) is given by $A(w, I; p) = p \times \widetilde{A}(w, I)$,

[19] The tax exclusion for employer-sponsored health insurance premium was authorized by Congress in 1954. See IRS Section 106(a) of the Internal Revenue Code.

where we define

$$\widetilde{A}(w, I) = \frac{1}{\ell(w, I)} \times \left[\sum_{\mathbf{h}} \sum_{i \in I} \left[a(h_1) \cdot \ell_1(w, i, I, \mathbf{h}) + a(h_2) \cdot \ell_2(w, i, I, \mathbf{h}) \right] \right], \tag{13}$$

and with $\ell_j(w, i, I, \mathbf{h})$ and $\ell(w, I)$ as given in equations (11) and (12).

2.7.3 Insurance premiums

As noted above, the contract space of firms is restricted such that the insurance premium is equal to the expected medical expenditure conditional on worker insurance choice i (that is, there is no cross-subsidization within the firm by contract choice). Letting $\mathbb{E}[m_j | h, q, \mathbf{x}]$ denote the mean medical expenditure for adult j given health status h, insurance status q, and demographics $\mathbf{x}$, these insurance premiums may be written as

$$r(i; w, I) = \frac{1}{\ell(w, i, I)} \times \left[\sum_j \sum_{\mathbf{h}} \int \ell_j(w, i, I, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \right.$$
$$\left. \cdots \times \left(\widetilde{q}_{\mathrm{e}}(i) \cdot \mathbb{E}[m_j | h_j, 1, \mathbf{x}] + \widetilde{q}_{\mathrm{s}}(i) \cdot \mathbb{E}[m_{3-j} | h_{3-j}, 1, \mathbf{x}] \right) \mathrm{d}B(\boldsymbol{\alpha}, \mathbf{x}) \right], \tag{14}$$

where $\widetilde{q}_{\mathrm{e}}(i)$ is an indicator for whether the *employee* is insured *by the firm* at choice $i \in I$, and similarly $\widetilde{q}_{\mathrm{s}}(i)$ defines an indicator for whether their *spouse* is insured *by the firm* at this choice. Since individuals may potentially be insured by both their own and their spouses employer, these are distinct from the individual insurance indicator functions, $q_j(\mathbf{i})$. Note that equation (14) implies that $r(0; w, I) = 0$.

2.7.4 Firms' flow profits

Given that the reduction in wages for any insurance choice $i \in I$ is exactly offset by the expected medical expenditure, insurance premiums and medical expenditure do not *directly* enter the expression for steady state profit flows for the firm. However, they do so indirectly through the value that households place on the different employment options, and therefore upon firm size. Excluding any fixed sector specific flow costs (see below), the steady state profit flows for a productivity p firm offering compensation package (w, I) are therefore given by

$$\pi(w, I; p) = [A(w, I; p) - w] \times \ell(w, I). \tag{15}$$

Relative to existing (single agent) implementations of the Burdett and Mortensen (1998, hereafter BM) model, the main complication in extending the framework to a joint-search environment is that the labor supply function $\ell(w, I)$ is derived from a more complicated decision problem.

However, to the extent that we may characterise and solve the steady state worker flow equations (see Appendix B) we may obtain this numerically, and then extend the solution techniques employed in simpler versions of the BM model with continuous productivity. Further details are provided in Appendix E. This maximization problem yields the sector-specific *wage policy* functions $w_I(p)$. With maximized profits, conditional on insurance offerings I, given by

$$\pi_I(p) = [A(w_I(p), I; p) - w_I(p)] \times \ell(w_I(p), I). \tag{16}$$

2.7.5 Firms' insurance offering decision

The insurance offering decision (or sector) is endogenous. Firms select into whichever sector generates the highest expected flow profits. These profits consist of the sum of maximized steady state variable profit flows, as given by equation (16), and the fixed and time invariant flow cost ϵ_I associated with each insurance offering choice I. The insurance offering decision conditional on firm productivity p and the vector of fixed costs $\boldsymbol{\epsilon}$ is therefore

$$I(p; \boldsymbol{\epsilon}) = \arg\max_{I \in \mathcal{I}} \{\pi_I(p) - \epsilon_I\}. \tag{17}$$

As in Aizawa and Fang (2018), we smooth the firm offering decision by assuming that the fixed flow costs are heterogeneous across firms of a given productivity, and are of the form $\epsilon_I = \bar{\epsilon}_I - \varepsilon_I$, where $\bar{\epsilon}_I$ is common to all firms in sector I with $\bar{\epsilon}_0 = 0$ and $\bar{\epsilon}_1 = \bar{\epsilon}_2 = \bar{\epsilon}$. We extend their specification by assuming a generalized extreme value distribution for ε_I which allows us to introduce correlation in the unobserved value for providing the different types of insurance coverage. This yields the nested Logit specification for the conditional choice probabilities

$$\Delta(I; p) = \begin{cases} \dfrac{\exp[\sigma \pi_0(p)]}{\exp[\sigma \pi_0(p)] + \exp[\sigma_{\varepsilon_{12}} \cdot IV_{12}(p)]} & \text{if } I = 0 \\ \dfrac{\exp[\sigma_{\varepsilon_{12}} \cdot IV_{12}(p)]}{\exp[\sigma \pi_0(p)] + \exp[\sigma_{\varepsilon_{12}} \cdot IV_{12}(p)]} \times \dfrac{\exp[\sigma(\pi_I(p) - \bar{\epsilon})/\sigma_{\varepsilon_{12}}]}{\sum_{I'>0} \exp[\sigma(\pi_{I'}(p) - \bar{\epsilon})/\sigma_{\varepsilon_{12}}]} & \text{if } I > 0, \end{cases} \tag{18}$$

where σ is a scale parameter, $\sigma_{\varepsilon_{12}}$ measures the degree of independence in the unobserved value of providing different insurance types, and $IV_{12} = \log \sum_{I>0} \exp[\sigma(\pi_I - \bar{\epsilon})/\sigma_{\varepsilon_{12}}]$ is the *inclusive value* of offering some form of health insurance. The total sector size is then given by

$$\Delta_I = \int_{\underline{p}}^{\overline{p}} \Delta(I; p) \, \mathrm{d}\Gamma(p). \tag{19}$$

2.7.6 Market equilibrium

Definition 1 *A market equilibrium is defined by a set of wage offer distributions $F_I(w)$ in each sector $I \in \mathcal{I}$, and a sector choice probability function $\Delta(I; p)$ such that simultaneously:*

1. *The distribution of wage offers in sector I is given by*

$$F_I\left(w\right) = \frac{1}{\Delta_I} \int_{w_I(p) \leq w} \Delta\left(I; p\right) d\Gamma\left(p\right).$$

2. *The strategy of a productivity p firm, conditional on sector choice I, is the wage policy function $w_I(p)$, which maximizes equation (15) given the labor supply function $\ell(w, I)$ defined in equation (12). Given a vector of choice specific costs $\boldsymbol{\epsilon}$, the insurance offering decision of a productivity p firm solves equation (17).*

3. *Conditional on the firm productivity level p, the proportion of firms with insurance offerings I is given by $\Delta(I; p)$, as defined in equation (18).*

4. *Insurance premiums at a productivity p firm, with insurance offerings I, and wage policy $w_I(p)$, are equal to expected medical expenditure conditional upon worker choice $i \in I$, and are given by $r(i; w_I(p), I)$ as defined in equation (14).*

5. *The expected flow marginal product at a productivity p firm with wage policy $w_I(p)$, insurance offering I, and insurance premiums $\{r(i; w_I(p), I)\}_{i \in I}$ is given by equation (13).*

6. *The behaviour of type-$(\boldsymbol{\alpha}, \mathbf{x})$ households is as described by the household value functions presented in Section 2.4 and Appendix A.*

In BM workers are homogeneous, and the competition between identical firms results in a continuous, non-degenerate distribution of wage offers. These results are extended in Bontemps, Robin and Van den Berg (2000), where firms are heterogeneous with respect to their productivity. An important property of these models, which facilitates the theoretical characterization of the properties of the wage policy function, is that the job acceptance decision of a worker is completely determined by their current wage. Such a property clearly does not hold in our setting. Moreover, note that if the leisure distribution were degenerate, then there would exist several mass points in the distribution of reservation wages,[20] and by consequence, there would be discontinuities in firms' labor supply function above the lowest wage. Our approach to circumventing this issue has been to introduce a continuous distribution of heterogeneity through the leisure values, and while we do not present a formal characterization of the equilibrium properties of our model, the resulting wage offer distributions are taken to be continuous with no mass points.

[20]This results from the discreteness in state variables such as health, the different (single and married) demographic types, and through the labor market position of their spouse.

3 Data, identification and estimation

3.1 Data

Our primary data source is the 2004 Panel of the Survey of Income and Program Participation (SIPP), which interviews U.S. individuals and households every four months up to twelve times. In each interview wave SIPP collects detailed monthly information regarding individuals' demographic characteristics and labor force activity, including their earnings, measures of labor supply, and whether the individual changed jobs within an employment spell. In addition, each wave contains information on both individual health insurance coverage and the source of insurance (i.e. whether it is the individual's own or spousal employment-based insurance, a private individual insurance plan, or public insurance). The SIPP also comprises periodic topical modules. In waves 3 and 6 of the 2004 SIPP panel, a topical health module provides information that includes each individual's self-reported health status (categorized as being "poor", "fair", "good", "very good" and "excellent"),[21] and both out-of-pocket and total medical expenditures. In addition, wave 5 contains a topical module that provides detailed information about the availability and coverage of employer-sponsored health insurance.

As we describe in more detail in Section 3.3, we do not construct detailed individual event histories using SIPP, but rather rely on point-in-time sampling.[22] For each household, single or married, our main SIPP data set comprises two observations that are spaced 12 months apart. These correspond to observations from the reference month in waves 3 and 6 when health status information is available.[23] We restrict our sample to include individuals aged between 26 and 50 in our sample window, not self-employed, not employed in the public sector, and not currently serving in the military. We also exclude individuals with either public or non-employer provided health insurance. For individuals in couples, we select those households where both spouses satisfy these requirements over the sample period. Additionally, given that we do not model either marriage formation and dissolution or fertility, we exclude households that experience either a change in marital status, or changes in the presence of dependent children. We only use wage information for non-proxy respondents, and treat wages as being unobserved if in the top or bottom 1.5% percentile of the distribution. To the extent possible, we apply these same sample selection restrictions to our additional data sources.

We supplement SIPP with three additional data sources. Firstly, we use pooled data from the 2003–2006 full-year consolidated Household Component (HC) data files of the Medical Expenditure Panel Survey (MEPS). This provides information including medical expenditure, self-

[21] This same categorization is used in the supplemental data sources that contain health measures.

[22] See Dey and Flinn (2008) and Flabbi and Mabli (2018) for a similar strategy.

[23] The reference month is the month that the interview took place. The variables in the topical module correspond to the reference month.

reported health status, insurance coverage, income, and demographic characteristics.[24] Second, we use data from the 2006 Kaiser Family Foundation (KFF) Employer Health Benefit Annual Survey. KFF is an annual survey of private and public employers with three or more workers, and provides information on employer-sponsored health insurance offering (if any), plan choices, premiums, enrollment patterns, as well as firm characteristics, including firm size.[25] Third, we use the 2003 Commonwealth Fund Biennial Health Insurance Survey, a nationally representative sample of over 4,000 adults ages 19 and older living in the United States. In addition to providing information on demographics, health insurance coverage and access, it collects information on current self-reported health status and non-productive work time.[26]

3.2 Empirical specification

In our empirical analysis, there are five broad demographic groups that constitute household types: single men, single women with children, single women without children, married couples with children, and married couples without children. These comprise the elements of our demographic conditioning variable $\mathbf{x}$. We allow for two health states ($H = 2$), with the health status h^1 (which we refer to as *unhealthy*) corresponding to the poor/fair health categories, and the health status h^2 (henceforth referred to as *healthy*) corresponding to good/very good/excellent health.

We parametrize the conditional medical expenditure distribution M_j^+ as truncated Gamma-Gompertz (Bemmaor and Glady, 2012), a three parameter distribution that provides an excellent fit to empirical medical expenditure distributions.[27] As we show in Appendix D, this distributional assumption implies that $\mathbb{E}[m_j|h_j, q_j, \mathbf{x}]$ (the mean medical expenditure for adult j given health status h_j, insurance status q_j, and demographics $\mathbf{x}$), may be written in terms of the Gaus-

[24]MEPS is a set of large-scale surveys administered by the Agency for Healthcare Research and Quality. It provides nationally representative estimates of health expenditure, utilization, payment sources, health status, and health insurance coverage for the U.S. civilian non-institutionalized population. MEPS-HC, which began in 1996, collects detailed semi-annual information (for up to 5 rounds) on individual demographic characteristics, health conditions, health status, use of medical services, charges and source of payments, access to care, satisfaction with care, health insurance coverage, income, and employment. The second MEPS component is the Insurance Component (IC), which is an establishment survey of characteristics of employer sponsored health insurance. The collected data include the number and types of private insurance plans offered (if any), premiums, contributions by employers and employees, eligibility requirements, benefits associated with these plans, and employer characteristics. Unfortunately, a public use microdata sample for MEPS-IC is not available.

[25]The response rate for firms in the full KFF survey is much lower for firms that do not offer health benefits. All firms that declined to participate were asked a single question: "Does your company offer or contribute to a health insurance program as a benefit to your employees?" The response rate to this question was 72% in 2006.

[26]Information is reported on both work days missed due to both sickness and tooth problems (lost productivity), as well as time at work where individuals could not fully concentrate due to feeling unwell (partial productivity). In calculating the total number of unproductive days over the year, we apply weight 0.5 to the partially productive days. MEPS-HC also collects information on missing workdays due to illness. We use data from the Commonwealth Fund Health Insurance Survey data as it provides a broader measure. See Dizioli and Pinheiro (2016) for an analysis of the impact of health insurance on productivity using MEPS-HC data in the context of a single-agent BM model.

[27]We set the truncation point at expenditure (in annual terms in 2006 prices) equal to \$50,000. The CDF of the untruncated Gamma-Gompertz distribution is $1 - \theta_\beta^{\theta_s}/[\theta_\beta - 1 + \exp(\theta_b m)]^{\theta_s}$, where $\theta_b, \theta_s, \theta_\beta > 0$, with $m \in [0, \infty)$. The parameter θ_b is a scale parameter; θ_s and θ_β are shape parameters.

sian hypergeometric function (see Abramowitz and Stegun, 1964). In the same appendix we also demonstrate that these distributional assumptions allow us to derive an analytic characterization of the expected utility risk adjustment factor, as discussed in Section 2.3.[28]

We calculate tax schedules (defined as piecewise linear functions of household earnings) using the National Bureau of Economic Research TAXSIM calculator (see Feenberg and Coutts, 1993). Our measure of net taxes includes federal income taxes and Earned Income Tax Credit, but does not include state taxes and other non-income taxes. These taxes vary across demographic groups; and for families with dependent children, both taxes and tax credits are calculated as if there were two children. For individuals who are non-employed, we impute a value of unemployment insurance (UI) that is equal to the average UI payment in 2006, multiplied by an estimate of the UI recipiency rate. Note that while unemployment insurance is taxed, it is taxed differently from labor earnings as it is an unearned income source. We account for this differential tax treatment in our empirical implementation. The modified marginal tax rate schedule is replaced by a differentiable function using the method proposed by MaCurdy, Green and Paarsch (1990), which smoothes the tax schedule in the neighborhood of any marginal rate changes. Further details of our tax schedule implementation, and our smoothing procedure, are provided in Appendix C.

In addition to taxes, our empirical implementation allows a number of model parameters to vary with demographic characteristics. The coefficient of absolute risk aversion $\psi(\mathbf{x})$ varies with all the broad demographic groups $\mathbf{x}$ that define a household type. The job-offer arrival rates (for both employed and non-employed individuals), and job destruction rates vary with household type and gender. However, for married men, we do not allow these parameters to vary by the presence of dependent children, while for single individuals without children, they do not vary with gender.[29] The distribution of leisure flow values $\boldsymbol{\alpha}$ is assumed to be Gaussian, with the mean of the distribution a log-linear function of household demographics and gender (specifically: marital status, gender, children status and an interaction between gender and children status). In couple households, we assume that the leisure flows of the husband and the wife are statistically independent.

Health status is dynamic and evolves stochastically, and we similarly allow this transition process to be a function of demographics. The Poisson rate at which an individual health status improves from unhealthy to healthy is a log-linear function of indicator variables for marital

[28]Since we consider a truncated distribution, this risk adjustment factor is necessarily finite. If the support of the distribution is unbounded from above, then the risk adjustment term is finite whenever $\psi(\mathbf{x}) < \theta_s(h, q, \mathbf{x}) \cdot \theta_b(h, q, \mathbf{x})$, which places a restriction on how risk averse households may be. Again, see Appendix D. Note that with CARA preferences, a finite risk adjustment factor is synonymous with the existence of the moment generating function associated with a given out-of-pocket medical expenditure distribution. An alternative would be an exogenous consumption floor, which is equivalent to the truncation point (and so risk adjustment factor) being a function of household income. In practice, medical debt is most prevalent in low and moderate income households (Collins et al., 2008), and such a formulation would provide little incentive for low income households to purchase health insurance.

[29]These restrictions were informed by first estimating a more general specification.

status, gender, and insurance coverage. The Poisson rate at which an individual health status deteriorates from healthy to unhealthy is parametrized symmetrically. Similar index restrictions are used in our parametrization of the medical expenditure distributions: the probability mass at zero expenditure is a (logistic) function of health status, gender and insurance coverage; the shape and scale parameters of the (Gamma-Gompertz) conditional medical expenditure distribution are log-linear functions of these same variables. Finally, recalling that child health status is not a state variable of our model, the parameters of the child medical expenditure distribution only depend upon insurance coverage.

All households, regardless of their type, sample from the same joint compensation package distribution. The sector-specific wage offer distributions are parametrized as a non-standard Beta distribution. For each sector (defined by health insurance offering), we estimate the parameters of the support of the distribution, as well as the two shape parameters. Additionally, we specify a measurement error term for log-wages, whose variance is assumed to be common across jobs with different insurance offerings.[30]

3.3 Estimation

The estimation procedure we develop is an extension of the multi-step estimation procedure that has been used in other empirical applications of the BM model with continuous productivity distributions (Bontemps, Robin and Van den Berg, 1999, 2000; Shephard, 2017). Crucially, our procedure does not require us to solve the equilibrium of the model, and therefore offers important computational advantages. It proceeds as follows:

1. While the distributions of job offers are complicated equilibrium objects from the compensation package posting game, we nonetheless impose a parametric form on these distributions, with the (conditional) cumulative distribution functions denoted $F_I(w; \boldsymbol{\theta}_F^I)$. The parameter vectors $\boldsymbol{\theta}_F^I$ and aggregate sector sizes Δ_I are then included (along with all other parameters that are relevant for the household decision problem) in the first-step estimation parameter vector $\boldsymbol{\theta}$. The first stage of our estimation, which we detail in the following section, concerns the choice of $\boldsymbol{\theta}$ to minimize some criterion function.[31]

2. Given the first stage parameter estimates, we recover an estimate of $a(h)$ using data on non-productive time (which we obtain from the Commonwealth Fund Biennial Health Insurance Survey) and the estimated transition processes.[32] We then solve for the steady state worker

[30]We construct certain moments using a steady state transition function, which correspond to annual transitions. We assume that the measurement error terms associated with the cross-section and the transition are independent.

[31]The continuous time discount rate ρ and the open-enrollment rate η are both exogenously fixed.

[32]The impact of health on productivity is non-parametrically non-identified using worker and firm size data alone. Here we follow an approach similar to Dizioli and Pinheiro (2016) by using a direct measure of non-productive time. Since the empirical measure of subjective health is a point-in-time measure, while the productivity outcomes are

flows (as described in Section 2.5 and Appendix B) to obtain the implied firm size objects using equations (10), (11), and (12). Given $a(h)$ is known we may obtain $\widetilde{A}(w, I)$ and calculate the implied firm flow marginal product using the firms' first order conditions. That is

$$p \equiv w_I^{-1}(w) = \frac{w\ell'(w, I) + \ell(w, I)}{\widetilde{A}(w, I)\ell'(w, I) + \ell(w, I)\widetilde{A}'(w, I)}, \tag{20}$$

where all partial derivatives are evaluated with respect to the wage rate. This therefore establishes identification of the wage policy function $w_I(p)$, together with firm flow profits $\pi_I(p)$ (which we recall are defined excluding any fixed sector-specific costs).

3. The firm productivity distribution is identified by noting that the (conditional) wage offer distributions must satisfy

$$F_I(w_I(p)) = \frac{1}{\Delta_I} \int_{\underline{p}}^{p} \Delta(I; p) \, \mathrm{d}\Gamma(p). \tag{21}$$

Applying Leibniz's rule and summing over the set of alternatives $I \in \mathcal{I}$, we then achieve identification of the marginal productivity distribution

$$\gamma(p) \equiv \Gamma'(p) = \sum_I \Delta_I \times f_I(w_I(p)) \times w_I'(p),$$

since by definition $\sum_I \Delta(I; p) = 1$.

4. Non-parametric estimates of the sector choice probabilities are given by

$$\widehat{\Delta}(I; p) = \frac{\Delta_I \times f_I(w_I(p)) \times w_I'(p)}{\gamma(p)}, \tag{22}$$

where all right hand side quantities are estimated from the previous step. Without further restrictions, this does not identify the sector specific cost distribution itself. Imposing distributional assumptions, as described in Section 2.7.5, allows us to obtain estimates of the sector specific cost distributions by finding the parameter values that minimize the distance between $\widehat{\Delta}(I; p)$ and $\Delta(I; p)$ from equation (18), given steady state flow profit $\pi_I(p)$.

We note some important practical issues. Firstly, since we are using a parametric form for the

retrospective, this only provides us with a temporally aggregated measure. We recover the analogue of our theoretical measure $a(h)$ by using the transition processes implied by the estimated model. Let $\widehat{\widetilde{a}}(h)$ denote the empirical fraction of non-productive days given current health h, and let $\widetilde{v}(h'|h)$ be the fraction of time that employed individuals had health status h' over the past year, given that their *current* health status is h. We obtain this through simulation. Thus for all h we have

$$\widehat{\widetilde{a}}(h) = \sum_{h'} a(h')\widetilde{v}(h'|h),$$

which is a linear system. Once we have recovered $a(\cdot)$ we normalize the measures such that $a(\overline{h}) = 1$.

sector specific cost distribution, we are not able to exactly induce our non-parametric estimates $\widehat{\Delta}(I;p)$. This necessarily means that the equilibrium joint distribution of compensation packages will also not exactly induce those obtained from the first stage of our estimation exercise.[33] Second, an important feature of the labor market prior to the introduction of the ACA, is that if firms offer health insurance, they almost always offer it to both employees and their spouses. In performing our estimation, we will therefore be ignoring the employee-only health insurance option by restricting the corresponding sector size to be zero. We will then show that such insurance offerings are indeed "small" in equilibrium, given a suitable choice of the parameter $\sigma_{\varepsilon_{12}}$ that measures the degree of independence in the unobserved value of providing different insurance types.

3.3.1 First-step estimation

For reasons as discussed in Dey and Flinn (2008) we do not use likelihood based estimation.[34] Instead, we estimate the vector of worker-side model parameters $\boldsymbol{\theta}$ (including the parametrized wage offer distribution) using a rich set of moments computed from the stationary distribution of labor market outcomes and the associated steady state transition functions. Our first step estimation procedure is then formally described as

$$\widehat{\boldsymbol{\theta}} = \arg\min_{\boldsymbol{\theta}} [\overline{\mathbf{m}}_{\text{sim}}(\boldsymbol{\theta}) - \mathbf{m}_{\text{data}}]^{\intercal} \mathbf{W} [\overline{\mathbf{m}}_{\text{sim}}(\boldsymbol{\theta}) - \mathbf{m}_{\text{data}}],$$

where $\mathbf{m}_{\text{data}}$ is a vector of empirical moments, and $\overline{\mathbf{m}}_{\text{sim}}(\boldsymbol{\theta}) = \frac{1}{S}\sum_{s=1}^{S} \mathbf{m}^{s}_{\text{sim}}(\boldsymbol{\theta})$ is the model moment vector given $\boldsymbol{\theta}$ calculated on each of S simulated datasets, and $\mathbf{W}$ is a positive-definite weighting matrix. Given the problems associated with the use of the optimal weighting matrix (Altonji and Segal, 1996) we choose $\mathbf{W}$ to be a diagonal matrix, whose element is proportional to the inverse of the diagonal variance-covariance matrix of the empirical moments.[35]

[33] Empirical applications of the BM model which implement a multi-step estimator typically use a non-parametric estimator of the wage offer distribution. This estimator is obtained by inverting steady state flow equations that relate the unknown distribution of wage offers to the known distribution of cross-sectional earnings. Such an inversion is not feasible in our application, and the use of a parametrically specified offer distributions removes the inversion step. However, conditional on the estimate of F, this procedure is equivalent to the implementation in Bontemps, Robin and Van den Berg (1999, 2000) in the single sector case. In practice, we calculate equation (20) by first replacing both $\widetilde{A}(w,I)$ and $\ell(w,I)$ for each I by a polynomial approximation using the method described in Murray, Müller and Turlach (2016). This allows us to directly calculate the derivative of these functions with respect to wages, and to also obtain the slope of the wage policy function, $w_I'(p)$.

[34] One of the difficulties in implementing a likelihood based estimator in a continuous time multi-person sequential search model is that some events may induce simultaneous changes (e.g. the wife may voluntarily quit her job when her husband accepts a high wage offer). An alternative, also discussed by Dey and Flinn (2008), would be a discrete time framework. As they discuss, this introduces a number of conceptual and data issues, and would complicate parts of the analysis as it would be necessary to consider many simultaneous events in the decision period.

[35] We construct $S = 20$ simulated datasets. The variance matrix of our estimator is given by

$$\text{Var}(\widehat{\boldsymbol{\theta}}) = \left(\frac{S+1}{S}\right) \times \left[\mathbf{D}_{\mathbf{m}}^{\intercal}\mathbf{W}\mathbf{D}_{\mathbf{m}}\right]^{-1} \mathbf{D}_{\mathbf{m}}^{\intercal}\mathbf{W}\boldsymbol{\Sigma}\mathbf{W}^{\intercal}\mathbf{D}_{\mathbf{m}} \left[\mathbf{D}_{\mathbf{m}}^{\intercal}\mathbf{W}\mathbf{D}_{\mathbf{m}}\right]^{-1},$$

In our implementation we use a rich set of moments that are informative about the parameters of our model. Firstly, we construct moments that provide a description of the cross-sectional distribution of outcomes. Using SIPP data we construct moments that describe conditional outcomes including the distribution of wages, health status, employment, health insurance coverage, and health insurance take-up. Many of these moments relate to joint household outcomes. Using MEPS-HC data, we construct moments that describe the annual conditional distributions of medical expenditure by gender, health status, and insurance coverage.[36] Second, we construct moments that are related to the household dynamics. Using SIPP data we construct measures of annual health transitions, by health status and insurance coverage. We also construct annual employment transitions for workers (to non-employment, and to jobs with differing insurance coverage) and for non-workers (to employment with differing insurance coverage). Third, we construct moments that are related to the firm-side (firm size distribution, and the health insurance offering decision by firms) using KFF data. We discuss these moments further when we discuss model fit in Section 3.5. A complete list of moments is presented in Appendix F.

We construct the theoretical analogue to these empirical moments through a simulation procedure. Conditional on a candidate parameter vector $\boldsymbol{\theta}$ and a guess of the (endogenous) insurance premiums, this involves solving for the household value functions using value function iteration, and then constructing S datasets derived from a sequence of continuous time event histories. The simulated stationary distribution of outcomes is then used to provide an update for the insurance premiums, and we then repeat this procedure. In constructing our simulated moments $\overline{\mathbf{m}}_{\text{sim}}(\boldsymbol{\theta})$, we mimic any temporal aggregation to reflect the construction of the empirical moments.[37]

3.4 Identification

As part of our discussion of our multi-step estimation procedure in Section 3.3, we described how knowledge of the parameters that are relevant to the household decision problem, together with the structure of the model, allow us to identify the primitives of the firms' problem. Our discussion here focuses on the identification of the worker-side parameters. We ignore any temporal aggregation issues and also assume knowledge of the discount rate ρ and the open-

where $\boldsymbol{\Sigma}$ is the block-diagonal covariance matrix of the empirical moments, and $\mathbf{D_m} = \partial\overline{\mathbf{m}}_{\text{sim}}(\boldsymbol{\theta})/\partial\boldsymbol{\theta}|_{\boldsymbol{\theta}=\widehat{\boldsymbol{\theta}}}$ is the derivative matrix of the moment conditions with respect to the model parameters at $\boldsymbol{\theta} = \widehat{\boldsymbol{\theta}}$. Since we have discrete dependents, any attempt to approximate the derivative vector $\mathbf{D_m}$ by finite differences may be sensitive to the chosen step size. We therefore calculate the derivative by first approximating the function by a low-order polynomial function as we vary each parameter locally. See, e.g. Lise and Robin (2017), for a similar strategy. In our application we vary each parameter by $\pm 10\%$ on a uniformly spaced grid with 21 points, and fit a fourth order polynomial.

[36]The empirical distribution obtained from MEPS-HC are used to construct estimation moments, rather than to provide direct estimates of the medical expenditure distributions $M_j(\cdot|h_j, q_j, \mathbf{x})$. Obtaining a direct empirical analogue is not possible as we only have point-in-time measures of the conditioning variables. Our estimation will reflect how health status and insurance coverage changes over the course of a year.

[37]Estimation is performed using MIDACO, a distributed global optimization algorithm that is based on the Ant colony metaheuristic. It is well suited to applications that may involve non-smooth objective functions, as frequently occur in simulation based estimation. Moreover, the solver can easily be parallelized. See Schlueter et al. (2013).

enrollment rate η. Given these, note that the health transition rates $\nu_j(\cdot|h_j, q_j, \mathbf{x})$ are in principle directly observed, as are the job-destruction rates $\delta(\mathbf{x})$,[38] and the medical expenditure distributions $M_j(\cdot|h_j, q_j, \mathbf{x})$. Under the maintained assumption of steady state behavior, knowledge of the medical expenditure distribution, together with the joint distribution of labor market states and health insurance take-up, allows the insurance premiums $r(i; w, I)$ to be identified.

One of the main complications in establishing identification is the presence of *reservation wage heterogeneity*, which is due to differences in health status, spousal state, and the household unobserved values for leisure. Such heterogeneity implies that common identification arguments do not apply as the distribution of accepted wages out of non-employment will no longer coincide with the wage offer distribution. To understand identification here, consider for example, a couple in the *eu* state where the husband is employed at a low-wage in sector I, i.e. with $w \approx \underline{w}_I$. As the husband would be willing to accept essentially any wage from the same sector, the *within-sector* distribution of accepted wages by individuals currently employed at low wages will identify $F_I(w)$. By the same token, the rate at which a low-wage sector I worker will accept a job in the same sector identifies $\lambda_e^j(\mathbf{x}) \cdot \Delta_I$. Summing across all sectors identifies both $\lambda_e^j(\mathbf{x})$ and Δ_I.

Consider now individuals that are non-employed. Let $G_j^U(w; I, \mathbf{z})$ denote the cumulative distribution function of wages accepted out of non-employment into sector I given the current *observed* household state $\mathbf{z}$ (which includes, at the time of job acceptance, the joint health status, employment and wage of spouse, and household health insurance coverage). Given that the behavior of individuals can be characterized by a reservation wage property it follows that

$$G_j^U(w; I, \mathbf{z}) = \int_{-\infty}^{w} \Pr(W_I < w | W_I > w')\, \mathrm{d}R_j^U(w'; I, \mathbf{z}) = \int_{-\infty}^{w} \frac{F_I(w) - F_I(w')}{\overline{F}_I(w')}\, \mathrm{d}R_j^U(w'; I, \mathbf{z})$$

$$= R_j^U(w; I, \mathbf{z}) - \overline{F}_I(w) \int_{-\infty}^{w} \frac{\mathrm{d}R_j^U(w'; I, \mathbf{z})}{\overline{F}_I(w')}, \tag{23}$$

where $R_j^U(w; I, \mathbf{z})$ is the distribution of reservation wages among the non-employed. It follows from equation (23) that $R_j^U(w; I, \mathbf{z}) = G_j^U(w; I, \mathbf{z}) + \overline{F}_I(w) \cdot g_j^U(w; I, \mathbf{z}) / f_I(w)$ and hence, this distribution is identified on the support of wages given the identified wage offer distribution and the distribution of accepted wages. Given these, identification of $\lambda_u^j(\mathbf{x})$ then follows from the transition rate of the non-employed into employment.

Finally, we turn to identifying the coefficient of absolute risk aversion, $\psi(\mathbf{x})$. Given an initial job without health insurance, this is closely related to the lowest wage that the household would be willing to accept for a job with ESHI (holding all other household state variables fixed). Indeed, given such a wage differential, the risk aversion coefficient is the only unknown variable

[38] Since changes in the household state vector may induce an endogenous quit, this must be calculated conditional on the state remaining fixed over some time interval.

that enters the between the expected utility functions associated with these two jobs.[39]

3.5 Model fit and parameter estimates

We present parameter estimates, together with accompanying standard errors, in Appendix H. Here, we comment on some of the main features, together with the implications that they have for household outcomes and dynamics. Firstly, we note that our parameter estimates reveal much heterogeneity across demographic groups, and this is reflected in the model's ability to replicate the diverse patterns that we see in the data. In Figure 1 we consider the fit of the model to the cross-sectional distribution of wages, for different family types and by insurance coverage status. In general, we provide an excellent fit to these distributions, and are able to well capture both how wages differ by insurance coverage (wages are much lower and less dispersed for individuals without insurance coverage), and how they differ across these broad family types. Recall that the offer distribution of compensation packages $F(w, I)$, which we find is characterized by a greater concentration of low wages for jobs without health insurance, is common to workers of all types. As such, any differences across these groups, including the so-called marital wage premium and gender wage gap, must be explained by differences in objects such as job and health transition rates, and leisure values, as well as the behavioral mechanisms of the model. We now describe these differences.[40]

The job offer arrival rates for the non-employed are highest for married men and singles without children, where $\widehat{\lambda}_u^j(\mathbf{x}) \approx 1.5$ (recall that a unit-of-time is a year). The rate is lowest for single women with children with $\widehat{\lambda}_u^j(\mathbf{x}) = 0.73$. For all demographic groups, we obtain correspondingly lower estimates for the employed job offer arrival rate, with the relative arrival rate $(\widehat{\lambda}_u^j/\widehat{\lambda}_e^j) \circ (\mathbf{x})$ varying between around 2 and 7. That job offers accrue less frequently for employed workers is a common empirical finding (see, for example, van den Berg and Ridder, 1998). The estimated exogenous job destruction rates are lowest for married men, $\widehat{\delta}_j(\mathbf{x}) = 0.05$, and highest for married women with children, where $\widehat{\delta}_j(\mathbf{x}) = 0.15$. In Table 1 we show the ability of the model to fit annual transition rates from positions of employment and non-employment for married individuals. (The corresponding table for single individuals is presented in the Appendix.) In addition to the variation across groups that the model well reproduces, the estimates imply an important

[39] This is similar to the approach used by Dey and Flinn (2008) to identify the value of additive value of ESHI, which is a primitive in their model. In our context, this approach (here to identify the risk aversion coefficient) is not exact as the raw wage differential reflects both the insurance value of health insurance (entering expected utility functions as described above), and the effect that insurance has on the evolution of future health status within the household (and so also entering value functions). Similar arguments are also used in Aizawa and Fang (2018).

[40] While the empirical wage differentials between single and married men is well-documented (see, e.g., Korenman and Neumark, 1991), there is somewhat less agreement regarding the source of these differences. The potential role of household search and search differences in explaining the marital wage premium is analysed in Pilossoph and Wee (2019*b*) in a model with endogenous search intensity. Relatedly, Flabbi and Mabli (2018), estimate gender-specific wage offer distributions under alternative models that assume either individual or household search, and find that the estimated differences in the wage distributions across genders is much smaller under household search.

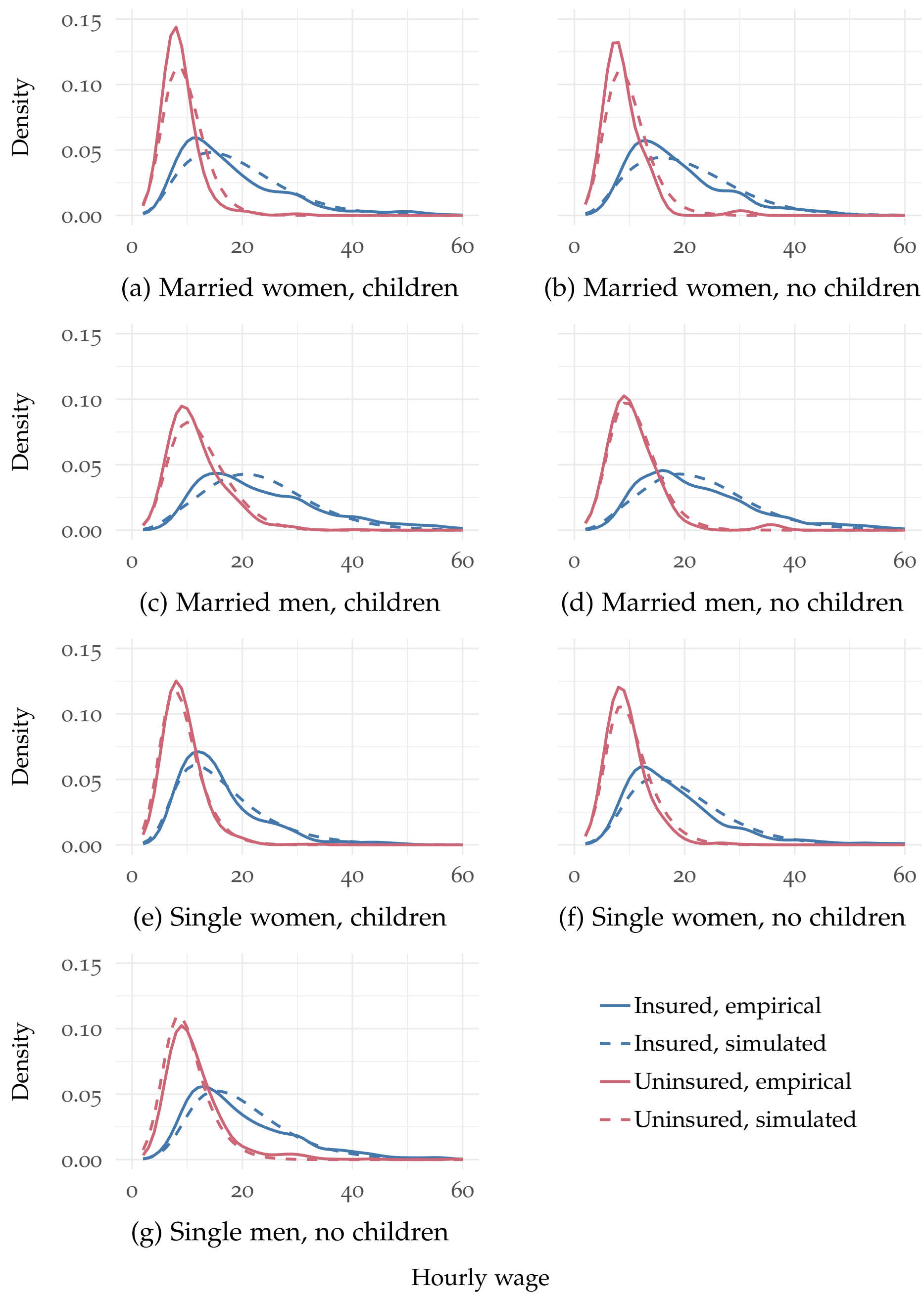


Figure 1: Simulated and empirical wage earnings by group. Horizontal axis refers to hourly wage rate in 2006 prices; Vertical axis refers to wage density. Simulated wages include wage measurement error. Empirical and simulated distributions are calculated using a Gaussian kernel with a bandwidth of 2. Empirical distributions are calculated using SIPP data.

Table 1: Annual Employment Transitions

	Married Women						Married Men					
	Children			No Children			Children			No Children		
	Data	Model	S.E.	Data	Model	S.E.	Data	Model	S.E.	Data	Model	S.E.
Transitions from employment												
...to non-emp.	0.08	0.12	0.01	0.03	0.06	0.01	0.02	0.03	0.00	0.04	0.03	0.01
...to emp. (ins.)	0.08	0.17	0.01	0.11	0.13	0.02	0.07	0.06	0.01	0.09	0.07	0.02
...to emp. (unins.)	0.02	0.03	0.00	0.01	0.01	0.01	0.03	0.02	0.00	0.03	0.01	0.01
Transitions from non-employment												
...to emp. (ins.)	0.11	0.16	0.01	0.19	0.17	0.04	0.25	0.20	0.03	0.16	0.13	0.05
...to emp. (unins.)	0.06	0.06	0.01	0.04	0.04	0.02	0.17	0.13	0.03	0.04	0.05	0.03

Notes: Table shows annual transitions from employment and non-employment for married individuals to different labor market states. In parentheses, *ins.* (respectively *unins.*) refer to transitions to a job with (respectively without) health insurance. S.E. refers to the standard deviation of the empirical moment. Empirical moments are calculated using SIPP data.

role for health insurance. In particular, if employed individuals experience a job mobility event, they are much more likely to transition to a job with health insurance.[41]

Health and health insurance both play an important role in our analysis. Firstly, we estimate that unhealthy workers are less productive than healthy workers, with the relative productivity of an unhealthy worker estimated as $\widehat{a}(h_1) = 0.88$. Health insurance is valuable to households because it insures them from their medical expenditure risks, and reduces their probability of being unhealthy. In terms of the medical expenditure parameters, health insurance is estimated to have an important impact both on the probability of experiencing a positive medical expenditure shock, and on the conditional medical expenditure realization (both the probability and the conditional expected value increase with insurance coverage). In Figure 2 we show the fit of the model to the medical expenditure distribution (presented as cumulative distribution functions) over the duration of a year, conditional on having incurred positive medical expenditure in that year. The fit here is generally excellent. Our estimated model is able to capture the fact that healthy individuals have lower total expenditure than unhealthy ones, and that those with health insurance coverage have greater expenditure than those without insurance. Underlying this figure are the dynamics of both insurance coverage and health status. The parameters related to health transitions show that health insurance coverage simultaneously improves the chances of transitioning from unhealthy to healthy, and decreases the transition rate from healthy to unhealthy. For example, our estimated model implies an annual unhealthy-to-healthy transition

[41] It is also true that individuals with health insurance are less likely to change employer. In constructing Table 1 note that we are only comparing point-in-time employment states spaced one-year apart, and there may be additional transitions over this period. For example, an employed person whose job was destroyed and who then accepted a job from non-employment (in the space of a year) would be classified as an annual job-to-job transition.

Table 2: Annual Health Transitions

	Married Men						Married Women					
	Insured			Uninsured			Insured			Uninsured		
	Data	Model	S.E.	Data	Model	S.E.	Data	Model	S.E.	Data	Model	S.E.
Transitions from healthy												
...to healthy	0.98	0.97	0.00	0.92	0.88	0.01	0.97	0.98	0.00	0.92	0.87	0.01
...to unhealthy	0.02	0.03	0.00	0.08	0.12	0.01	0.03	0.02	0.00	0.08	0.13	0.01
Transitions from unhealthy												
...to healthy	0.65	0.60	0.04	0.41	0.32	0.05	0.56	0.65	0.04	0.45	0.33	0.06
...to unhealthy	0.35	0.40	0.04	0.59	0.68	0.05	0.44	0.35	0.04	0.55	0.67	0.06

Notes: Table shows annual health transitions for married individuals conditional on health and insurance coverage status at the start of the year. S.E. refers to the standard deviation of the empirical moment. Empirical moments calculated using SIPP data.

rate for married men without insurance equal to $\widehat{\nu}_1(h_2|h_1, q_1 = 0) = 0.41$, whilst with insurance coverage we have $\widehat{\nu}_1(h_2|h_1, q_1 = 0) = 0.65$. As we document in Table 2, which presents the fit to annual health transition rates for married individuals conditional on gender, health, and insurance coverage, these simulated rates closely match their empirical counterparts. (Again, the corresponding table for single individuals is presented in the Appendix.)

There are several features of our model that generate heterogeneity in job acceptance behavior, both within and across demographic groups, and which imply that not all job offers are acceptable to all workers. These sources of heterogeneity include differences in health status, labor market transition parameters, the value of leisure, and risk preferences. While risk preference estimates are somewhat context dependent, the estimated coefficients of absolute risk aversion that we obtain are in the range of values from the literature (accounting for the fact that here consumption is measured in tens of thousands of dollars). To provide a more interpretable metric and to facilitate comparison, we calculate the amount of income such that a household is just indifferent between the status quo and participating in a lottery in which they win $1000 or lose $X with equal probability. Depending on the household type, we obtain values of $X between $870 and $900. These are between the values implied by the median estimates reported in Cohen and Einav (2007) [$970] and Handel (2013) [$730].

Our estimates imply that the mean value of leisure is higher for single compared to married individuals, and is higher for women, particularly mothers. Moreover, as we described in Section 2, the reservation wage of a married individual depends upon the state of their spouse. To illustrate the importance of this, consider a married man with a working spouse. If his spouse is working at a job without employer sponsored health insurance, then our estimates imply the acceptance rate for the lowest paying job with (without) health insurance is 63% (49%). In contrast, if his spouse is working in a firm that provides health insurance, then he is more selective and

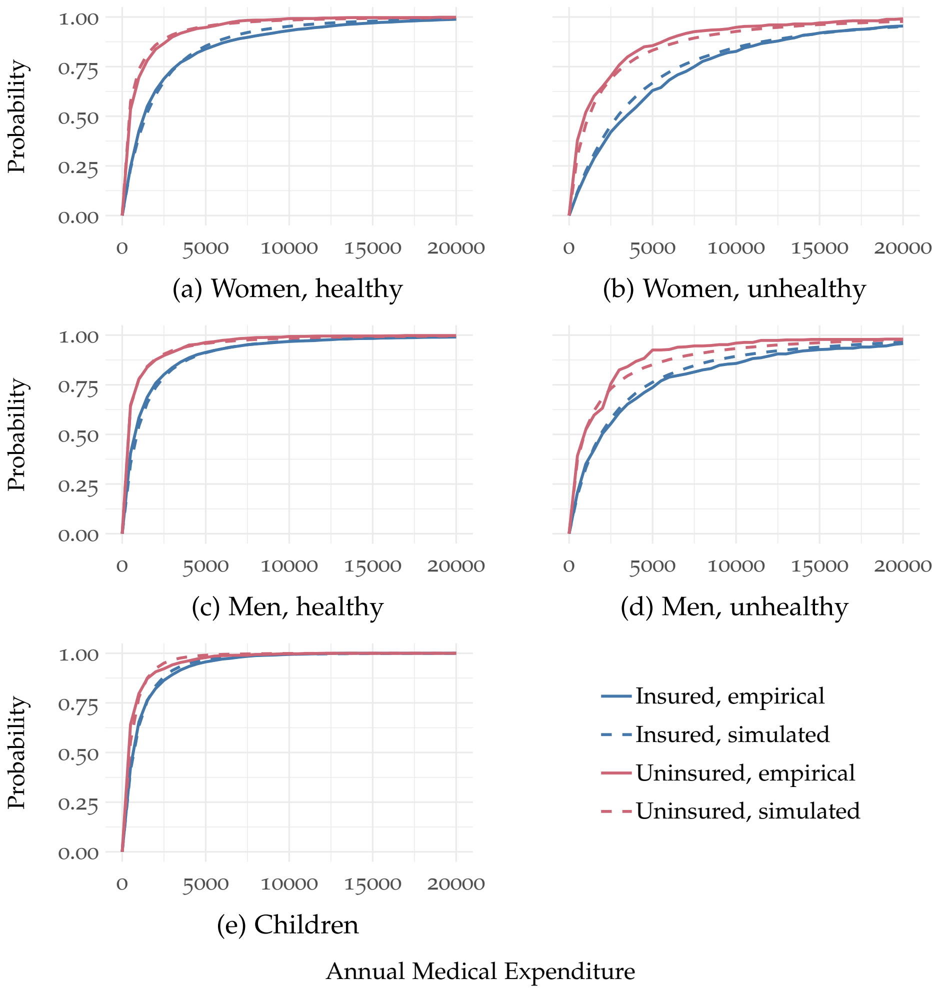


Figure 2: Simulated and empirical medical expenditure. The figure panels show the conditional cumulative distribution function of annual medical expenditure (in 2006 prices, and truncated at $20,000) for women, men, and children, respectively (by health and insurance coverage status). Health status and insurance status are measured at the start-of-year (point-in-time measures). The empirical distributions are calculated using MEPS-HC data. The simulated (empirical) zero-expenditure probabilities with insurance for groups (a)–(e) are 0.09, 0.01, 0.17, 0.03, and 0.09 (0.08, 0.06, 0.21, 0.13, and 0.07). With no insurance these are respectively 0.46, 0.17, 0.58, 0.25, and 0.09 (0.37, 0.22, 0.59, 0.37, and 0.15).

Table 3: Joint Employment Status and Insurance Coverage

		Female											
		$(e_2, q_2) = (1, 1)$			$(e_2, q_2) = (1, 0)$			$(e_2, q_2) = (0, 1)$			$(e_2, q_2) = (0, 0)$		
		Data	Model	S.E.	Data	Model	S.E.	Data	Model	S.E.	Data	Model	S.E.
Married with children													
Male	$(e_1, q_1) = (1, 1)$	0.50	0.51	0.01	0.01	0.01	0.00	0.24	0.25	0.01	0.02	0.01	0.00
Male	$(e_1, q_1) = (1, 0)$	0.01	0.03	0.00	0.06	0.05	0.00				0.09	0.06	0.01
Male	$(e_1, q_1) = (0, 1)$	0.03	0.04	0.00									
Male	$(e_1, q_1) = (0, 0)$	0.01	0.01	0.00	0.01	0.02	0.00				0.03	0.02	0.00
Married no children													
Male	$(e_1, q_1) = (1, 1)$	0.68	0.60	0.02	0.01	0.01	0.00	0.12	0.17	0.01	0.02	0.01	0.01
Male	$(e_1, q_1) = (1, 0)$	0.01	0.01	0.00	0.04	0.02	0.01				0.02	0.03	0.01
Male	$(e_1, q_1) = (0, 1)$	0.05	0.10	0.01									
Male	$(e_1, q_1) = (0, 0)$	0.01	0.01	0.00	0.02	0.02	0.00				0.03	0.02	0.01

Notes: Table shows the cross-sectional joint distribution of insurance coverage and employment status for married individuals. Employment is denoted e_j (1 is employed, 0 non-employed). Insurance coverage is denoted q_j (1 is insured, 0 uninsured). S.E. refers to the standard deviation of the empirical moment. Empirical moments are calculated using SIPP data.

these rates fall to 46% (29%). These behavioral channels have important implications for joint outcomes within the household. In Table 3 we show the fit of the model to the within-household distribution of employment and insurance coverage. The model is successful in replicating several prominent feature in the data, including that a large fraction (∼25%) of married women with children do not work, yet they are insured on the spousal insurance option from their husband's job. The fit of the model to a range of other joint outcomes is presented in the Appendix.

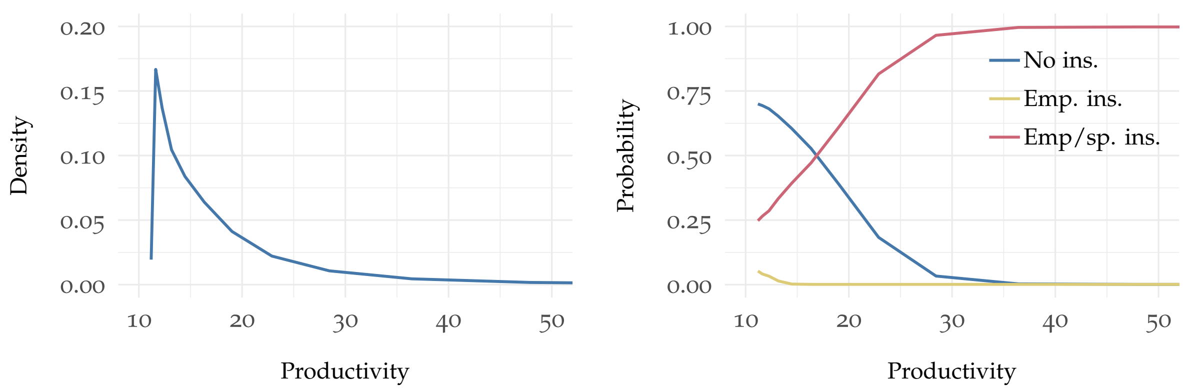
Finally, in Table 4 we present the fit of our model to the size distribution of firms (as measured by the number of workers), together with the relationship between firm size and the probability of health insurance offering. Our model estimates reproduce the salient empirical patterns that larger firms are more likely to offer health insurance, and that a large majority of firms (around 80%) have fewer than 25 workers. The underlying distributions of firm productivity that is recovered from our estimation is shown in Figure 3a, with the distribution seen to be heavily skewed to the right.[42] Figure 3b plots the associated insurance offering probability, $\Delta(I; p)$. As firm productivity increases, the fraction of firms offering employee and spousal coverage increases from around a third for the least productive firm to close to 100%. The incidence of employee-only insurance is our benchmark pre-ACA economy is negligible, with $\Delta_2 = 0.010$.

[42]In log-coordinates the relationship is approximately linear over much of the support, meaning that the distribution of firm productivity is approximately Pareto. These objects are calculated with $\sigma_{\epsilon_{12}} = 0.05$. The exact value of $\sigma_{\epsilon_{12}}$ is not very important in what follows, provided it is not too high.

Table 4: Firm Size and Health Insurance Offering Rate

	Firm Size			Offer ESHI		
	Data	Model	S.E.	Data	Model	S.E.
0–10	0.65	0.59	0.02	0.49	0.35	0.03
10–25	0.21	0.21	0.02	0.78	0.73	0.03
25–50	0.08	0.11	0.01	0.87	0.95	0.03
50–100	0.03	0.07	0.00	0.90	1.00	0.02
100+	0.04	0.02	0.00	0.98	1.00	0.01

Notes: Table shows the fraction of firms of different employee sizes, and the probability of offering ESHI conditional on firm size. S.E. refers to the standard deviation of the empirical moment. Empirical moments are calculated using KFF data.



(a) Productivity distribution

(b) Insurance offering probability

Figure 3: Productivity distribution and insurance offering probability. Panel a shows the exogenous productivity distribution $\gamma(p)$ that is calculated as part of our multi-step estimation procedure. Panel b presents the endogenous insurance offering probability $\Delta(I; p)$. See Section 3.3 for details regarding their calculation. Productivity corresponds to the hourly flow marginal product for a worker with maximal health status. Figures have been truncated at productivity levels exceeding \$50 in 2006 prices.

4 Implementing the ACA

We seek to examine the impact of the Affordable Care Act, its various components, and alternative policy designs. In implementing the ACA, we consider a stylized version which incorporates its main components as discussed in Section 1: first, all individuals are required to have health insurance or must pay a tax penalty; second, large employers are required to offer health insurance to *employees and dependents*, or have to pay a penalty; third, we introduce a health insurance exchange where individuals can purchase health insurance at a community rated premium; fourth, the participants in this health insurance exchange can obtain income-based subsidies, if they do not have access to employer-sponsored health insurance either from their own or their spouse's employers.

4.1 Health Insurance Exchange

The introduction of a health insurance exchange, which provides a pooling mechanism for insurance purchase outside of the workplace, represents a substantial departure from our benchmark model. As in the case of employer sponsored health insurance, health insurance from the exchange marketplace may be purchased either when there is an open-enrollment period, or when there is a qualifying event. We assume the same Poisson arrival rate $\eta > 0$ as in the benchmark economy, and that when faced with an open-enrollment event, households may optimize over any available employer provided options, together with marketplace health insurance. Importantly, these open-enrollment events now apply to both employed and non-employed households. Insurance purchased from the exchange is considered an imperfect substitute to those offered by employers. While we assume that it has the same impact on health (i.e., only insurance coverage status matter, not the source of insurance), it provides less than full insurance, insuring fraction v of medical expenditure.[43] This therefore affects the budget constraint and by consequence the associated risk adjustment factor R_j, whose definition is naturally extended.

For conciseness of notation, we introduce the availability of non-employer sponsored health insurance by extending the definition of the offering choice set: for any insurance menu $I \in \mathcal{I}$ households always have the option (at open-enrollment or following a qualifying event) to purchase insurance from the exchange at the pre-subsidy price r_{HIX}, and with this choice denoted $i = -1$ for the individual.[44] Using this notation, both the household value functions and steady

[43]In practice, there is significant variation in copays and coinsurance rates across the metal tiers (bronze, silver, gold, and platinum) of the exchange plans. Enrollment is largest in the bronze and silver exchange policies (lower monthly payments, but higher out-of-pocket costs), while the average employer-sponsored plan is closer to the gold and platinum exchange policies (Maher, 2017). Exchange plans also have more restrictive provider networks compared to most employer-sponsored plans. Based upon this, we set $v = 0.75$.

[44]The choice set for a non-employed individual is given by $I = 0$. Thus, when an individual is either non-employed or working for an employer that does not provide ESHI ($I = 0$) the options are to decline insurance ($i = 0$) or to purchase individual insurance from the insurance exchange market ($i = -1$). As in the case of the pre-ACA environment, individuals may still be insured when $i = 0$ if they are covered through the insurance policy of their

state flow equations take an almost identical form to those presented in Section 2 and so we do not present them here. The only differences are: i) there is now an open-enrollment event in the joint non-employed state; ii) in any joint state, any non-employed individual has the insurance set $I = 0$, which now allows the individual to choose $i = 0$ (decline insurance) or $i = -1$ (purchase insurance from the exchange); iii) household flow payoffs are modified to incorporate the financial incentives under the ACA and reflect marketplace premiums, premium tax credits, and tax penalties (see below).

The household decision of whether to purchase plans from the exchange will depend on the value of the endogenously determined exchange insurance premium r_{HIX}. This is determined by the expected medical expenditure of all individuals who choose to purchase insurance from the exchange in equilibrium, multiplied by $1 + \zeta$ where $\zeta > 0$ is the loading factor.[45] To derive this, first denote as $g^1_{HIX}(h_1; \boldsymbol{\alpha}, \mathbf{x})$ the total measure of men with health status h_1 who, conditional on persistent household type $(\boldsymbol{\alpha}, \mathbf{x})$, purchase marketplace insurance ($i_1 = -1$). This is given by,

$$g^1_{HIX}(h_1; \boldsymbol{\alpha}, \mathbf{x}) = \sum_{h_2} \sum_{i_2 \leq 0} g_{uu}([-1, i_2], \mathbf{0}, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) + \sum_{h_2} \sum_{I_1} \sum_{i_2 \leq 0} \int g_{eu}(w_1, [-1, i_2], [I_1, 0], \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \, \mathrm{d}w_1$$
$$+ \sum_{h_2} \sum_{I_2} \sum_{i_2 \in I_2} \int g_{ue}(w_2, [-1, i_2], [0, I_2], \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \, \mathrm{d}w_2 + \sum_{h_2} \sum_{\mathbf{I}} \sum_{i_2 \in I_2} \int g_{ee}(\mathbf{w}, [-1, i_2], \mathbf{I}, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \, \mathrm{d}\mathbf{w}, \quad (24)$$

and we analogously define $g^2_{HIX}(h_2; \boldsymbol{\alpha}, \mathbf{x})$ for women. Then, the equilibrium marketplace insurance premium r_{HIX} for an individual must satisfy[46]

$$r_{HIX} = v \times (1 + \zeta) \times \frac{\int \sum_j \sum_{h_j} g^j_{HIX}(h_j; \boldsymbol{\alpha}, \mathbf{x}) \cdot \mathbb{E}[m_j | h_j, 1, \mathbf{x}] \, \mathrm{d}B(\boldsymbol{\alpha}, \mathbf{x})}{\int \sum_j \sum_{h_j} g^j_{HIX}(h_j; \boldsymbol{\alpha}, \mathbf{x}) \, \mathrm{d}B(\boldsymbol{\alpha}, \mathbf{x})}. \quad (25)$$

spouse. Similarly, if employer-sponsored health insurance is available to the employee only, workers may decide not to purchase insurance from their employer or the marketplace ($i = 0$), purchase individual insurance from their employer ($i = 1$), or to purchase individual insurance from the insurance exchange ($i = -1$). Finally, if employer-sponsored health insurance is made available to both the employee and their spouse ($I = 2$), workers may either decline both insurance types ($i = 0$), purchase employee only insurance from their employer ($i = 1$), purchase employee and spouse insurance from their employer ($i = 2$), or purchase individual insurance from the exchange ($i = -1$).

[45] We calibrate ζ based on the requirement in the ACA that the medical loss ratio for all insurance sold in the exchange must be at least 80%. This implies that $\zeta \leq 0.25$.

[46] These are the marketplace insurance premiums for adults. The marketplace insurance premium for children is equal to the expected child medical expenditure, multiplied by $1 + \zeta$. Note that families with children always purchase dependent coverage if at least one adult is insured from any source, with insurance assumed to be purchased from the exchange when no adult is insured through an employer. To simplify the exposition, we do not include children when describing the premium subsidies and mandate penalties.

4.2 Household flow payoffs under the ACA

Household flow payoffs are affected by the ACA provisions regarding income-based premium subsidies and individual mandate tax penalties if uninsured. Both of these depend upon household income. First, we note that the household is only *categorically* eligible to receive a tax credit subsidy for adult j if they: i) purchase insurance from the exchange; and ii) do not have access to affordable employer-sponsored health insurance, either from their own or their spouse's employer, or another government program. Thus, the premium subsidy eligibility indicator for adult j is given by

$$\varrho_j(i_j, \mathbf{I}) = \begin{cases} 1 & \text{if } i_j = -1 \text{ and } I_j = 0, \text{ and } I_{3-j} \neq 2, \\ 0 & \text{otherwise,} \end{cases}$$

where $I_j = 0$ indicates that j's own employer does not offer ESHI, and $I_{3-j} \neq 2$ indicates that j's spouse is not offered ESHI with spousal insurance benefits. The amount of any marketplace subsidy received depends upon the equilibrium marketplace insurance premium r_{HIX}, the number of household members eligible for the subsidy, household modified adjusted gross income (MAGI), and household structure (through the demographic conditioning vector $\mathbf{x}$). Our definition of MAGI includes labor market earnings, less any employer-sponsored health insurance premiums, together with any unemployment compensation. We write this as

$$z(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{P}) \equiv P_1(w_1 - r_1(i_1; w_1, I_1)) + P_2(w_2 - r_2(i_2; w_2, I_2)) + (2 - P_1 - P_2)b_{UI}. \tag{26}$$

The details of how we parameterize the ACA rules regarding the income-based premium subsidy eligibility are described in Appendix G. These rules map into the function $S(z, r_{HIX} \times \sum_j \varrho_j(i_j, \mathbf{I}); \mathbf{x})$, which describes the amount of subsidy that the household receives when purchasing from the marketplace exchange, given modified adjusted gross income z, and the total household marketplace premium for eligible adults. Thus, we may write the household after-subsidy price for marketplace insurance as

$$\widehat{r_{HIX}}(z, \mathbf{i}, \mathbf{I}; \mathbf{x}) = r_{HIX} \times \sum_j \mathbb{1}[i_j = -1] - S(z, r_{HIX} \times \sum_j \varrho_j(i_j, \mathbf{I}); \mathbf{x}), \tag{27}$$

and where we note that by construction $\widehat{r_{HIX}}(\cdot) = 0$ whenever $\sum_j \mathbb{1}[i_j = -1] = 0$.

Household members who are not insured from any source face a tax penalty that is the maximum of a per-person penalty, and an income-based penalty that depends upon household modified adjusted gross income (less the applicable household tax filing threshold). Again, see Appendix G for details. We denote this tax penalty function as $\varkappa(z, \mathbf{i}; \mathbf{x})$, which we note is zero whenever all household members are insured, i.e. when $\min\{q_1(\mathbf{i}), q_2(\mathbf{i})\} = 1$. It follows that the modified household budget constraint under our extended model is given by

$$c^{ACA} = y[z(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{P})] - \widehat{r_{HIX}}(z(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{P}), \mathbf{i}, \mathbf{I}; \mathbf{x}) - \varkappa(z(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{P}), \mathbf{i}; \mathbf{x}) - \sum_j o(m_j | q_j(\mathbf{i})), \qquad (28)$$

and where modified adjusted gross income $z(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{P})$ is defined in equation (26).

4.3 Firms' flow profits under the ACA

Under the ACA, large firms now face a penalty if they do not offer health insurance to their employees (and their dependents). Employers do not face a penalty under the ACA if they do not offer coverage to the spouse of an employee. In the context of the model presented here, this means that a penalty will only potentially apply if the firm chooses $I = 0$. More generally, given a firm size ℓ, a firm with insurance offering I is subject to a penalty amount given by the function $\mho(\ell, I)$, whose calculation is described in Appendix G.[47] Profit flows under the ACA are therefore written as

$$\pi^{ACA}(w, I; p) = [A(w, I; p) - w] \times \ell(w, I) - \mho(\ell(w, I), I). \qquad (29)$$

Subject to this modified profit definition, the insurance offering decision and wage offer are as described in our benchmark pre-ACA economy.

5 The labor market impact of the ACA

We now present simulation results that pertain to the long-run impact of the ACA. There are several stages to our analysis here. First, we describe how firms' insurance offering decisions, and households' insurance take-up decisions, together with other outcomes, are affected by the ACA. Second, we compare some of these long-run predictions to early survey evidence, and to the short-run impacts observed in the data. Third, we use our model to calculate households' valuation of spousal health insurance and show this changes under the ACA. Fourth, we examine how the ACA affects job mobility.

[47]Note that the employer penalty taxes are non-deductible for the purposes of calculating businesses' income tax liability. Accordingly, we scale the dollar employer responsibility penalties by $[(1-\tau_b)(1+\tau_s)]^{-1}$, where τ_b reflects combined federal and state business income tax, and τ_s is the employer payroll tax rate. Given the existence of various tax breaks we do not use the statutory corporate tax rate (35% in the period of investigation), but rather use the estimate reported in PricewaterhouseCoopers (2011) and set $\tau_b = 27.7\%$. Following Mulligan (2015*b*) we set $\tau_s = 7.65\%$. These adjustments are reflected in our definition of $\mho$. Again, see Appendix G for details.

5.1 Firm and household behavior under the ACA

We proceed to calculate the new equilibrium of our model with the major provisions of the ACA implemented as described in Section 4 above. Of particular interest is the impact that the ACA has upon firms' insurance offering probabilities, which we illustrate in Figure 4. We note the following features. First, recall that in the pre-ACA equilibrium (see Figure 4a, which reproduces Figure 3b from earlier), that the health insurance offering probability among the least productive firms is around one third, with the probability of employee and spouse insurance ($I = 2$) approaching one as firms' productivity increases, and with the incidence of employee-only insurance ($I = 1$) essentially negligible. In the post-ACA equilibrium there are important changes in these offering probabilities (see Figure 4b). In particular, given the availability of community-rated health insurance from the exchange, the overall employer-sponsored health insurance probability declines over much of the productivity distribution: the fraction of firms that offer health benefits declines by 15%. Moreover, the employee-only insurance option emerges as a non-negligible alternative for less productive firms. Indeed, the offering rate is approximately 20% for the least productive firms, while across the distribution of firms the overall rate of employee-only insurance increases from $\Delta_1 = 0.010$ to $\Delta_1 = 0.061$. This corresponds to 15% of firms that are offering health benefits in the new equilibrium.

Before describing the broader impact of the ACA, we again emphasize that the incentives for the provision of employee-only insurance are directly related both to the availability of health insurance through the marketplace exchange, and the categorical eligibility structure for the associated premium subsidies. Specifically, and as we discussed in Section 1, individuals are ineligible to receive the tax credit subsidy if they have access to employer-sponsored health insurance either through their own employer or their spouse's employer. To understand the quantitative importance of these rules, we also consider an equilibrium (referred to as "ACA-SP") where categorical eligibility is only restricted by access to health insurance through workers' own employer. The results of this exercise are presented in Figure 4c. The figure shows that relative to the ACA equilibrium, there is a clear shift away from employee-only insurance towards employee and spouse insurance, with the overall health insurance offering rate across firms ($\Delta_1 + \Delta_2$) broadly unchanged. In contrast, if we consider an equilibrium where the premium subsidy is completely removed (not illustrated), then we obtain schedules that are essentially between the pre-ACA equilibrium and ACA-SP, with the overall fraction of firms offering health benefits declining by 7% relative to the pre-reform equilibrium (compared to a 15% decline under the full ACA with premium subsidies).

In Table 5 we document how individuals' health insurance coverage changes in the long-run ACA equilibrium. Here we classify individuals according to whether they are covered by their own employer's health insurance (own ESHI), their spouse's health insurance (spouse ESHI), insurance purchased from the marketplace health insurance exchange (HIX), or whether they

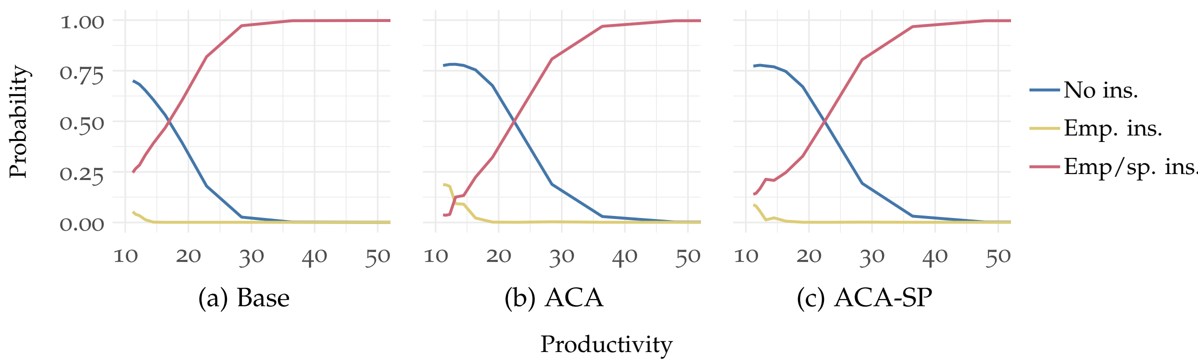


Figure 4: Endogenous insurance offering probability $\Delta(I; p)$ under the baseline, the ACA, and a modified version of the ACA. See Section 3.3 for details regarding their calculation. *Base* (panel a) refers to the pre-ACA benchmark economy from our estimation, *ACA* (panel b) refers to the post-ACA equilibrium, *ACA-SP* (panel c) refers to the equilibrium of a modified ACA system, where access to spousal employer-sponsored health insurance does not restrict eligibility for marketplace subsidies. Productivity corresponds to the hourly flow marginal product for a worker with maximal health status. Figures have been truncated at productivity levels exceeding $50 in average 2006 prices.

are uninsured (uncovered). As we are also interested in how these vary by labor market state, we present these conditional on i) both the husband and wife being employed (panel a), and ii) when the husband is employed and the wife non-employed (panel b). The table shows that there are important shifts in the sources of insurance coverage in the new equilibrium. For example, in the joint-employment state, the fraction of married couples where both individuals are insured through their own employer declines from 17% to 10%, while the total fraction of households that are covered by spousal insurance declines from 63% to 51%. Meanwhile, insurance through the marketplace exchange becomes important: 22% of households receive coverage for at least one adult through this channel.

Returning to the long-run labor market impact of the ACA, we present the impact on select outcomes in Table 6. For single households, there is a 5 percentage point decline in the employment rate, while both the insurance coverage rate and the fraction of individuals in good health improve substantially. Similarly, for married households, we find somewhat small adjustments in the steady state joint employment shares (a slight shift towards male single earner households). Reflecting what we saw in Table 5 above, while the overall insurance rate increases, the fraction who are insured through their spouse declines. There are also small improvements in the health status of married men and women.

5.2 Post-reform empirical comparison

We view the model as being informative about firm and household behavior in the long-run equilibrium under the ACA. With some of the most significant provisions (including the mar-

Table 5: The impact of the ACA on household health insurance coverage

(a) Husband and wife both employed

		Female			
		Own ESHI	Spousal ESHI	HIX	Uncovered
Male	Own ESHI	0.17 / 0.10	0.39 / 0.34	0.00 / 0.08	0.07 / 0.06
	Spousal ESHI	0.23 / 0.17	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00
	HIX	0.00 / 0.05	0.00 / 0.00	0.00 / 0.07	0.00 / 0.02
	Uncovered	0.05 / 0.03	0.00 / 0.00	0.00 / 0.02	0.09 / 0.05

(b) Husband employed and wife non-employed

		Female			
		Own ESHI	Spousal ESHI	HIX	Uncovered
Male	Own ESHI	0.00 / 0.00	0.72 / 0.69	0.00 / 0.06	0.06 / 0.04
	Spousal ESHI	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00
	HIX	0.00 / 0.00	0.00 / 0.00	0.00 / 0.19	0.00 / 0.00
	Uncovered	0.00 / 0.00	0.00 / 0.00	0.00 / 0.01	0.21 / 0.01

Notes: Table shows household insurance coverage conditional on joint labor market state. Coverage status is presented as X.XX / Y.YY where X.XX (respectively Y.YY) corresponds to coverage under the pre-ACA (respectively post-ACA) equilibrium. Numbers may not sum to one due to rounding.

Table 6: The impact of the ACA on household outcomes

	Base	ACA
Married Couples		
Male employed, female employed	0.75	0.73
Male employed, female non-employed	0.16	0.18
Male non-employed, female employed	0.08	0.08
Insurance rate	0.82	0.90
Spousal insurance rate	0.64	0.54
Male good health	0.93	0.95
Female good health	0.93	0.95
Single Individuals		
Employed	0.70	0.65
Insurance rate	0.55	0.95
Good health	0.88	0.98

Notes: Table shows select household outcomes for married and single households under the base and reform (ACA) systems.

ketplace health exchanges) taking effect from 2014, we now have several years of post-reform data. That said, comparing model outcomes to data is complicated by the fact that the transition to the new steady state equilibrium may take some time, with this problem compounded by the well-documented policy uncertainty regarding the ACA under both the Obama and the Trump administration. In Appendix H we show, using data from the Kaiser Family Foundation Employer Health Benefit Annual Survey, how the fraction of firms that offer any form of health insurance benefits has changed over time. While the interpretation of some changes is complicated by pre-reform trends in the data, we do see notable reductions in the fraction of firms that are offering health insurance (a 5 percentage point decline since 2013), with this reduction largest for small firms, while the offering decision among large firms is relatively unaffected. Using the same data source, we similarly document how the fraction of firms not extending health insurance to the spouses of their employees has changed beginning in 2014. While early survey evidence (see Section 1) suggested important changes in spousal insurance benefits, given sample size limitations the data series unfortunately exhibits considerable noise and it is difficult to discern clear trends.[48]

5.3 The value of spousal insurance

Here we seek to quantify how much households' value the availability of employer-sponsored spousal health insurance, and how these valuations change in the long-run post-ACA equilibrium.[49] As our model is stationary we proceed to define the welfare $\mathcal{W}(\boldsymbol{\alpha}, \mathbf{x})$ of a type-$(\boldsymbol{\alpha}, \mathbf{x})$ household to be the associated value functions weighted by the respective steady-state measures. That is

$$\begin{aligned}
\mathcal{W}(\boldsymbol{\alpha}, \mathbf{x}) = & \sum_{\mathbf{h}} g_{uu}(\mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \cdot \mathcal{V}(\mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \\
& + \sum_{\mathbf{h}} \sum_{I_1} \sum_{i_1 \in I_1} \int g_{eu}(w_1, i_1, I_1, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \cdot \mathcal{V}_{eu}(w_1, i_1, I_1, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \, \mathrm{d}w_1 \\
& + \sum_{\mathbf{h}} \sum_{I_2} \sum_{i_2 \in I_2} \int g_{ue}(w_2, i_2, I_2, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \cdot \mathcal{V}_{ue}(w_2, i_2, I_2, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \, \mathrm{d}w_2 \\
& + \sum_{\mathbf{h}} \sum_{\mathbf{I}} \sum_{\mathbf{i} \in \mathbf{I}} \int g_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \cdot \mathcal{V}_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}; \boldsymbol{\alpha}, \mathbf{x}) \, \mathrm{d}\mathbf{w}. \qquad (30)
\end{aligned}$$

[48]The Kaiser Family Foundation Employer Health Benefit Annual Survey only explicitly asks about whether health insurance coverage is offered to the spouses of employees beginning in 2014. Prior to this, firms were only asked whether they provide "family coverage". In a given year, the number of (unweighted) survey observations that report not offering spousal insurance varies ranges from 13 to 27.

[49]While other papers have attempted to quantify the value of health insurance, to the best of our knowledge none of these quantify the value of *spousal* health insurance. See Dey and Flinn (2008), Finkelstein, Hendren and Luttmer (2018), Conti, Ginja and Narita (2018), and Finkelstein, Hendren and Shepard (2019).

We first calculate these welfare metrics under the pre-ACA benchmark equilibrium. Next, we remove the availability of spousal health insurance by exogenously making the purchase of employee and spouse insurance prohibitively expensive, i.e. letting $r(2; w, 2) \to +\infty$, but otherwise leave the structure of compensation packages unchanged. We then proceed to calculate the increase in consumption in every labor market position such that the welfare measures in the new steady state is equal to $\mathcal{W}(\boldsymbol{\alpha}, \mathbf{x})$ from our initial benchmark equilibrium. We refer to this consumption change as the *direct valuation* of spousal health insurance, and in our pre-ACA equilibrium we obtain a mean average valuation of $1160 (standard deviation $400) for couple households. The valuation of spousal insurance is directly related to spousal employment prospects. If we condition upon type-$(\boldsymbol{\alpha}, \mathbf{x})$ households where there is a low incidence of joint employment (defined as no greater than 20% probability of joint-employment in the steady state of the pre-ACA benchmark economy), then as both spouses are much less likely to have access to health insurance through their own employer, these direct valuations are correspondingly higher, with a mean valuation of $2290 (standard deviation $470).

Of course, if spousal health insurance were not available then firms would likely respond by changing the compensation packages that they offer to their workers. To quantify this, we calculate a new equilibrium where the insurance contract space is restricted to $I = 0$ (no insurance) and $I = 1$ (employee only insurance). In this new equilibrium, we find that the overall offering rate of employer-sponsored health insurance $(\Delta_1 + \Delta_2)$ increases by 4.6 percentage points, with this counterfactual highlighting a quantitatively important externality that is associated with the provision of spousal health insurance. We then proceed to calculate the *equilibrium valuation* of spousal insurance in the same way: starting from this new equilibrium we calculate the necessary increase in consumption such that we obtain the welfare measure from our benchmark economy. On average, we obtain an equilibrium valuation of $900 for couple households, while among those households with a low incidence of joint employment (again defined with respect to the equilibrium of our benchmark economy) we calculate $1900.[50]

Next, we quantify how these valuations change post-ACA. Our calculations proceed as before. First, we calculate the household welfare measure (equation 30) under the ACA equilibrium. We then calculate the change in consumption that is needed to attain the same welfare should the purchase of spousal health insurance become prohibitive, but the structure of compensation packages otherwise remain unchanged. This is the post-ACA *direct valuation* of spousal health insurance. Given the (subsidized) availability of non-employer provided insurance through the health insurance exchange, the mean average valuation for couple households falls considerably to $280 (compared to $1160 in the pre-ACA equilibrium economy). Given the health insurance exchange acts to decouple health insurance from employment, these value reductions are

[50]For single households, the direct valuation is zero by construction. The equilibrium valuation is -$70. As this is negative, single households prefer the equilibrium in an environment that prohibits employers from offering spousal health insurance.

even larger for households with a low incidence of joint-employment,[51] with the mean valuation for this group now quantitatively very similar to that for the aggregate population. As in the pre-reform economy, the *equilibrium valuation* are lower than the direct valuations, although the quantitative differences compared to the direct valuation are not large (for example, the mean equilibrium valuation for married couples in $240).

Finally, to better understand how the incentive structure under the ACA affects these valuations we compute a new equilibrium where the income-based subsidy for purchasing from the health insurance exchange is completely removed. In this equilibrium we obtain a direct valuation of employer-provided spousal health insurance equal to $410, while the equilibrium valuation is equal to $300.

5.4 Spousal insurance and job mobility

There is now considerable evidence that employer-provided health insurance may have important implications for the labor market mobility of individuals.[52] Our focus here is on the extent to which spousal health insurance affects job mobility rates, and how this is affected by the ACA. As a simple way of illustrating this, we first calculate the continuous time exit rate to another job as a function of both the current wage and whether their *spouse* is employed in a job that offers spousal health insurance or not. This is illustrated in Figure 5 for married women, where we also condition upon the type of insurance offered of the wife's employer.

In Figure 5a we present this exit rate in the pre-ACA benchmark economy when the wife does *not* have access to employee and spouse health insurance through her own employer ($I_2 < 2$), while Figure 5b provides the corresponding figure when she does ($I_2 = 2$). As job offers accrue at the same rate regardless of the wage or the insurance coverage status, any differences must reflect differential job acceptance behavior. We note the following features. First, the conditional exit rates are declining in the wage. Second, exit rates are typically higher when the wife does not have access to health insurance through her own employer. Third, there is an important interdependency between exit rates and the insurance coverage options available to both spouses. To understand this last point consider first a woman who has insurance through her own employer. If her husband also has health insurance through his employer ($I_1 = I_2 = 2$) then the household can be less selective in the jobs that the wife will accept, while if her husband does not have his own coverage ($I_1 < 2, I_2 = 2$), there will be increased selectivity as some job offers will result in the household losing insurance coverage. This behavior generates the patterns that we see in Figure 5b. For example, at low wages, the female exit rate is 10% higher when her husband has access to spousal insurance coverage. Conversely, if neither spouse has access to employer provided health insurance ($I_1, I_2 < 2$), then the wife would be more willing to accept lower

[51] Note that we define the set of such type-$(\boldsymbol{\alpha}, \mathbf{x})$ households in the pre-ACA equilibrium.

[52] This phenomenon is often referred to as "job-lock". See Gruber and Madrian (2004) for a recent survey of the empirical literature.

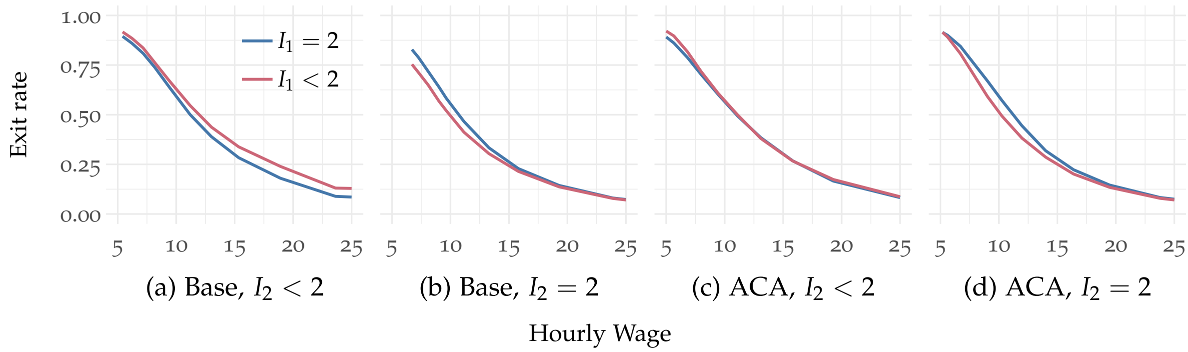


Figure 5: Figure shows continuous time exit rate to another job for married women conditional on their wage and whether the woman and her husband is employed in a job that provides spousal health insurance ($I_j = 2$) or not ($I_j < 2$). The unit-of-time is a year. *Base* (panels a and b) refers to the pre-ACA benchmark economy from our estimation, *ACA* (panels c and d) refers to the post-ACA equilibrium. Figures have been truncated at wages exceeding $25 in average 2006 prices.

paying jobs to secure health insurance compared to when her husband has insurance coverage ($I_1 = 2, I_2 < 2$), which produces the patterns seen in Figure 5a.[53]

Consider now the impact that the ACA has upon these transition rates. Given that the health insurance exchange increases access to health insurance, one may expect that the difference between exit rates (by access to employer-sponsored health insurance) may decrease. This pattern is clearly seen in Figure 5c. Interestingly, the gap is not reduced as significantly when they both have access to employer-sponsored health insurance through their respective employers, except at low wages (Figure 5d).

6 Conclusion

We have studied an important, yet under explored aspect of the employer-sponsored health insurance system in the United States, namely, that employers typically offer insurance not only to their own employees, but also to the spouses of their employees. We show that the wide-ranging set of provisions in the Affordable Care Act (ACA) significantly alter the firms' incentives to offer health insurance to the spouses of their employees. More generally, the ACA may be expected to have important equilibrium effects on the labor market (Aizawa and Fang, 2018). To explore the role of spousal health insurance, and how it is affected by the ACA, we present an equilibrium labor market search model that extends the Burdett and Mortensen (1998) framework to an environment where multiple household members are searching for jobs. The distribution of job offers is endogenously determined, with compensation packages consisting of a wage and

[53]The same patterns in exit rates exist for married men, but the difference in these by spousal health insurance status is smaller.

menu of insurance offerings (including whether coverage is extended to the spouses of workers' and the associated premiums) that risk averse agents/households select from. In this framework we incorporate important institutional features, including the qualifying event restrictions on households' choice of health insurance.

A multi-step estimation procedure is proposed, and we empirically implement our model using the Survey of Income and Program Participation as our primary data source. Our estimated model is able to replicate important joint household outcomes from the data, including that a large fraction of both working and non-working individuals are insured through their spouses' employers. Further, we are able to reproduce salient patterns concerning labor market and health dynamics, wages, medical expenditure, and the insurance distributions of employer sizes. We use our estimated model to evaluate the long-run equilibrium labor market responses to the Affordable Care Act. Consistent with early survey evidence, our model simulations imply that while the provisions in the ACA are successful in reducing the uninsurance rate and improving health outcomes, there are significant changes in firms' insurance offering decisions. First, the overall health insurance offering rate of firms declines. Second, an "employee-only" health insurance contract, which is largely impertinent in the pre-ACA equilibrium, emerges among low productivity firms. These equilibrium responses are shown to be closely related to the availability of non-employer sponsored insurance from the marketplace exchange, and the specific eligibility rules of the associated premium subsidies. Indeed, if individuals' access to health insurance through their spouses' employers did not render households categorically ineligible for the premium subsidies, then the incidence of employee-only insurance is considerably muted. We further use our model to assess how households' valuation of spousal health insurance is changed under the ACA, and show that these valuations decline significantly.

The framework we have developed has been used to examine the role of the household, both in terms of their behavior in the labor market, and the consequences that this has for the optimal strategies of firms. An important feature of our framework is that we have considered a unitary model, where the household unit is fixed. Many of the components of the ACA are based on household income which therefore acts to introduce an implicit marriage penalty. Moreover, the availability of non-employer sponsored health insurance imply that an individual who is not covered by his/her own employer does not require a married partner to obtain coverage. As such, the ACA may have implications for the incentives to enter marriages. Finally, we note that our empirical framework can also be used to assess other policies where the role of the household is important, such as tax and transfer policy, which in many countries depend upon family income. These are interesting areas to apply our framework in future research.

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Online Appendices

A Worker value functions

In Section 2.4, we presented the value functions for couple households in the male single earner (*eu*) state from the baseline (pre-ACA) economy. (Value functions in the female single earner state are obtained symmetrically.) For completeness, we now present the value functions for both the joint employment (*ee*) state, and joint non-employment (uu) state. For notational conciseness we continue to suppress the explicit conditioning of both the value functions and worker parameters on leisure values and the vector of demographic characteristics ($\boldsymbol{\alpha}$ and $\mathbf{x}$).

A.1 Joint employment state

The expected flow utility when both adults are employed is given by $\overline{u}_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h})$, which is obtained by integrating the flow utility function (equation (1)) over the distribution of medical expenditure shocks for all household members. In describing the value function in this state, we note that the following events may happen. First, either adult may experience a health transition, which occurs at rate $\overline{\nu}_j(h_j, q_j)$ for spouse j. In this event, both may continue being employed at $(\mathbf{w}, \mathbf{i}, \mathbf{I})$, or individuals may exit to non-employment. Note that health transitions themselves do not allow individuals to re-optimize over the set of insurance offerings by their employers. Second, either adult may receive a job offer. If the offer is accepted, the couple decides whether the other adult will remain employed or exit to non-employment. In both cases, optimization over the set of insurance options is permitted. Third, at rate δ_j spouse j experiences an exogenous job destruction. At this level of generality, we allow the other spouse to also quit to non-employment. If one individual remains employed, then again, re-optimization over insurance options is allowed. Fourth, at rate η there is an open enrollment event which allows re-optimization over the set of insurance options, absent a job change, with value $\overline{\mathcal{V}}_{ee}(\mathbf{w}, \mathbf{I}, \mathbf{h})$ then attained. It follows that

$$
\begin{aligned}
&\mathcal{D}_{ee}(\mathbf{i}, \mathbf{h}) V_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}) = \overline{u}_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}) \\
&+ \textstyle\sum_{h_1'} \nu_1(h_1'|h_1, q_1(\mathbf{i})) \max\{\mathcal{V}_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, h_1', h_2), \overline{\mathcal{V}}_{eu}(w_1, I_1, h_1', h_2), \overline{\mathcal{V}}_{ue}(w_2, I_2, h_1', h_2), \mathcal{V}_{uu}(h_1', h_2)\} \\
&+ \textstyle\sum_{h_2'} \nu_2(h_2'|h_2, q_2(\mathbf{i})) \max\{\mathcal{V}_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, h_1, h_2'), \overline{\mathcal{V}}_{eu}(w_1, I_1, h_1, h_2'), \overline{\mathcal{V}}_{ue}(w_2, I_2, h_1, h_2'), \mathcal{V}_{uu}(h_1, h_2')\} \\
&+ \lambda_e^1 \int \max\{\overline{\mathcal{V}}_{ee}(w_1', w_2, I_1', I_2, \mathbf{h}), \overline{\mathcal{V}}_{eu}(w_1', I_1', \mathbf{h}), \mathcal{V}_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h})\} \, \mathrm{d}F(w_1', I_1') \\
&+ \lambda_e^2 \int \max\{\overline{\mathcal{V}}_{ee}(w_1, w_2', I_1, I_2', \mathbf{h}), \overline{\mathcal{V}}_{ue}(w_2', I_2', \mathbf{h}), \mathcal{V}_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h})\} \, \mathrm{d}F(w_2', I_2') \\
&+ \delta_1 \max\{\overline{\mathcal{V}}_{ue}(w_2, I_2, \mathbf{h}), \mathcal{V}_{uu}(\mathbf{h})\} + \delta_2 \max\{\overline{\mathcal{V}}_{eu}(w_1, I_1, \mathbf{h}), \mathcal{V}_{uu}(\mathbf{h})\} + \eta \overline{\mathcal{V}}_{ee}(\mathbf{w}, \mathbf{I}, \mathbf{h}),
\end{aligned}
$$

where $\mathcal{D}_{ee}(\mathbf{i}, \mathbf{h}) \equiv \rho + \overline{\nu}_1(h_1, q_1(\mathbf{i})) + \overline{\nu}_2(h_2, q_2(\mathbf{i})) + \lambda_e^1 + \lambda_e^2 + \delta_1 + \delta_2 + \eta$.

A.2 Joint non-employment state

In our baseline (pre-ACA) economy, there is no availability of non-employer sponsored health insurance. Thus, both adults are necessarily uninsured whenever the couple is in the joint non-employment state, so that $q_1(\mathbf{0}) = q_2(\mathbf{0}) = 0$. The current state may be exited if either adult experiences a health transition, or if either adult optimally exits to employment. Therefore

$$\begin{aligned}\mathcal{D}_{uu}(\mathbf{h})\mathcal{V}_{uu}(\mathbf{h}) = \overline{u}_{uu}(\mathbf{h}) + \textstyle\sum_{h_1'} \nu_1(h_1'|h_1, q_1(\mathbf{0}))\mathcal{V}_{uu}(h_1', h_2) + \textstyle\sum_{h_2'} \nu_2(h_2'|h_2, q_2(\mathbf{0}))\mathcal{V}_{uu}(h_1, h_2')\\ + \lambda_u^1 \int \max\{\overline{\mathcal{V}}_{eu}(w_1', I_1', \mathbf{h}), \mathcal{V}_{uu}(\mathbf{h})\} \, \mathrm{d}F(w_1', I_1')\\ + \lambda_u^2 \int \max\{\overline{\mathcal{V}}_{ue}(w_2', I_2', \mathbf{h}), \mathcal{V}_{uu}(\mathbf{h})\} \, \mathrm{d}F(w_2', I_2'),\end{aligned}$$

where $\overline{u}_{uu}(\mathbf{h})$ is expected flow utility in the joint non-employment state given $\mathbf{h}$, and with $\mathcal{D}_{uu}(\mathbf{h}) \equiv \rho + \overline{\nu}_1(h_1, q_1(\mathbf{0})) + \overline{\nu}_2(h_2, q_2(\mathbf{0})) + \lambda_u^1 + \lambda_u^2$.

B Flow equation derivations

In this Appendix we present the flow equations for couple households, corresponding to the measures in both the joint employment and joint non-employment states. See Section 2.5 for the flow equations that define the measure of single earner couple households. As in the preceding Appendix, we suppress the conditioning on the persistent household characteristics, $(\boldsymbol{\alpha}, \mathbf{x})$.

B.1 Joint employment state

Consider $g_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h})$, the measure of workers in the joint employment state. Exits from this joint state occur following: i) either spouse experiencing an exogenous job destruction; ii) either spouse experiencing a change in their health status; iii) either spouse accepting a new job; iv) an open enrollment event that facilitates re-optimisation over the set of insurance options. Total outflows are therefore

$$g_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}) \cdot \left[\delta_1 + \delta_2 + \overline{\nu}_1(h_1, q_1(\mathbf{i})) + \overline{\nu}_2(h_2, q_2(\mathbf{i})) + \lambda_e^1 \int_{\boldsymbol{\Omega}_{ee}^{1-}(\mathbf{w},\mathbf{i},\mathbf{I},\mathbf{h})} \mathrm{d}F(w_1', I_1') + \lambda_e^2 \int_{\boldsymbol{\Omega}_{ee}^{2-}(\mathbf{w},\mathbf{i},\mathbf{I},\mathbf{h})} \mathrm{d}F(w_2', I_2') + \eta\right], \tag{B.1}$$

where $\boldsymbol{\Omega}_{ee}^{1-}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}) = \{w_1', I_1' : \max\{\overline{\mathcal{V}}_{ee}(w_1', w_2, I_1', I_2, \mathbf{h}), \overline{\mathcal{V}}_{eu}(w_1', I_1', \mathbf{h})\} > \mathcal{V}_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h})\}$ is the set of acceptable spouse 1 job offers given $(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h})$. Similarly, the set of acceptable spouse 2 job offers is $\boldsymbol{\Omega}_{ee}^{2-}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}) = \{w_2', I_2' : \max\{\overline{\mathcal{V}}_{ee}(w_1, w_2', I_1, I_2', \mathbf{h}), \overline{\mathcal{V}}_{ue}(w_2', I_2', \mathbf{h})\} > \mathcal{V}_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h})\}$.

Now consider all inflows into this joint employment state, conditional on the inequality $\mathcal{V}_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}) > \max\{\overline{\mathcal{V}}_{eu}(w_1, I_1, \mathbf{h}), \overline{\mathcal{V}}_{ue}(w_2, I_2, \mathbf{h}), \mathcal{V}_{uu}(\mathbf{h})\}$ being satisfied.[54] Firstly, inflows may

[54] If this does not hold then we necessarily have $g_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}) = 0$ since quits are always permitted.

occur following changes in health from an existing $(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}')$ state. The contribution of health changes to total inflows is obtained by summing over all possible health transitions. That is

$$\sum_{h_1'} \nu_1(h_1|h_1', q_1(\mathbf{i})) \cdot g_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, h_1', h_2) + \sum_{h_2'} \nu_1(h_2|h_2', q_2(\mathbf{i})) \cdot g_{ee}(\mathbf{w}, \mathbf{i}, \mathbf{I}, h_1, h_2'). \tag{B.2}$$

Inflows also result following a job acceptance. These may be from an initial single earner state, or from a lower value joint-employment state. In both cases, we require that the joint insurance choices are optimal given $(\mathbf{w}, \mathbf{I}, \mathbf{h})$, since job changes are qualifying events. The male (adult 1) inflows into this state are given by

$$v_{ee}^*(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}) \cdot f(w_1, I_1) \times \Bigg[\underbrace{\lambda_u^1 \sum_{i_2' \in I_2 \wedge \mathbf{\Omega}_{ee}^{1+}(\mathbf{w},\mathbf{I},\mathbf{h})} g_{ue}(w_2, i_2', I_2, \mathbf{h})}_{\text{adult 1 inflows from } ue} + \underbrace{\lambda_e^1 \sum_{I_1'} \sum_{i_1' \in I_1'} \sum_{i_2' \in I_2} \int_{\mathbf{\Omega}_{ee}^{2+}(\mathbf{w},\mathbf{i}',\mathbf{I},I_1',\mathbf{h})} g_{ee}(w_1', w_2, \mathbf{i}', I_1', I_2, \mathbf{h}) \, dw_1'}_{\text{adult 1 inflow from lower value } ee \text{ state}} \Bigg], \tag{B.3}$$

and where the inflow set $\mathbf{\Omega}_{ee}^{1+}(\mathbf{w}, \mathbf{I}, \mathbf{h}) = \{i_2' : \overline{\mathcal{V}}_{ee}(\mathbf{w}, \mathbf{I}, \mathbf{h}) > \max\{\mathcal{V}_{ue}(w_2, i_2', I_2, \mathbf{h}), \overline{\mathcal{V}}_{eu}(w_1, I_1, \mathbf{h})\}\}$ defines the conditional set of choices in the female single earner state, from which the joint state $(\mathbf{w}, \mathbf{I}, \mathbf{h})$ may arise. Similarly, the inflows from the lower value joint-employment states is given by the set $\mathbf{\Omega}_{ee}^{2+}(\mathbf{w}, \mathbf{i}', \mathbf{I}, I_1', \mathbf{h}) = \{w_1' : \overline{\mathcal{V}}_{ee}(\mathbf{w}, \mathbf{I}, \mathbf{h}) > \max\{\mathcal{V}_{ee}(w_1', w_2, \mathbf{i}', I_1', I_2, \mathbf{h}), \overline{\mathcal{V}}_{eu}(w_1, I_1, \mathbf{h})\}\}$.

The female (adult 2) job mobility transitions into the joint state $(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h})$ are symmetrically defined by

$$v_{ee}^*(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}) \cdot f(w_2, I_2) \times \Bigg[\underbrace{\lambda_u^2 \sum_{i_1' \in I_1 \wedge \mathbf{\Omega}_{ee}^{3+}(\mathbf{w},\mathbf{I},\mathbf{h})} g_{eu}(w_1, i_1', I_1, \mathbf{h})}_{\text{adult 2 inflows from } eu} + \underbrace{\lambda_e^2 \sum_{I_2'} \sum_{i_2' \in I_2'} \sum_{i_1' \in I_1} \int_{\mathbf{\Omega}_{ee}^{4+}(\mathbf{w},\mathbf{i}',\mathbf{I},I_2',\mathbf{h})} g_{ee}(w_1, w_2', \mathbf{i}', I_1, I_2', \mathbf{h}) \, dw_2'}_{\text{adult 2 inflow from lower value } ee \text{ state}} \Bigg], \tag{B.4}$$

with the acceptance sets $\mathbf{\Omega}_{ee}^{3+}(\mathbf{w}, \mathbf{I}, \mathbf{h}) = \{i_1' : \overline{\mathcal{V}}_{ee}(\mathbf{w}, \mathbf{I}, \mathbf{h}) > \max\{\mathcal{V}_{eu}(w_1, i_1', I_1, \mathbf{h}), \overline{\mathcal{V}}_{ue}(w_2, I_2, \mathbf{h})\}\}$ and $\mathbf{\Omega}_{ee}^{4+}(\mathbf{w}, \mathbf{i}', \mathbf{I}, I_2', \mathbf{h}) = \{w_2' : \overline{\mathcal{V}}_{ee}(\mathbf{w}, \mathbf{I}, \mathbf{h}) > \max\{\mathcal{V}_{ee}(w_1, w_2', \mathbf{i}', I_1, I_2', \mathbf{h}), \overline{\mathcal{V}}_{ue}(w_2, I_2, \mathbf{h})\}\}$.

Third, inflows may occur as a result of an open enrollment event whenever the insurance choice $\mathbf{i} \in \mathbf{I}$ is optimal given $(\mathbf{w}, \mathbf{I}, \mathbf{h})$

$$v_{ee}^*(\mathbf{w}, \mathbf{i}, \mathbf{I}, \mathbf{h}) \times \eta \times \sum_{\mathbf{i}' \in \mathbf{I}} g_{ee}(\mathbf{w}, \mathbf{i}', \mathbf{I}, \mathbf{h}). \tag{B.5}$$

In steady state, the sum of these inflow terms must exactly balance the outflows. That is, (B.1) = (B.2) + (B.3) + (B.4) + (B.5).

B.2 Joint non-employment state

Consider the measure of jointly non-employed workers with the joint health status $\mathbf{h}$. The couple will exit this state if either spouse experiences a health transition, or if either spouse receives a job offer that is acceptable. Thus, total outflows are given by

$$g_{uu}(\mathbf{h}) \cdot \left[\overline{\nu}_1(h_1, q_1(\mathbf{0})) + \overline{\nu}_2(h_2, q_2(\mathbf{0})) + \lambda_u^1 \int_{\mathbf{\Omega}_{uu}^{1-}(\mathbf{h})} \mathrm{d}F(w_1', I_1') + \lambda_u^2 \int_{\mathbf{\Omega}_{uu}^{2-}(\mathbf{h})} \mathrm{d}F(w_2', I_2') \right], \tag{B.6}$$

where the set $\mathbf{\Omega}_{uu}^{1-}(\mathbf{h}) = \{w_1', I_1' : \mathcal{V}_{eu}(w_1', I_1', \mathbf{h}) > \mathcal{V}_{uu}(\mathbf{h})\}$ describes the set of jobs that adult 1 would accept given current state $\mathbf{h}$. The set $\mathbf{\Omega}_{uu}^{2-}(\mathbf{h}) = \{w_2', I_2' : \mathcal{V}_{ue}(w_2', I_2', \mathbf{h}) > \mathcal{V}_{uu}(\mathbf{h})\}$ is similarly defined as the conditional set of job offers that would be accepted by adult 2.

Now consider inflows into the joint non-employment state with health status $\mathbf{h}$. These can occur for both endogenous and exogenous reasons. Firstly, there may be exogenous health transition flows within the joint non-employment state from some health vector $\mathbf{h}'$ to $\mathbf{h}$. That is

$$\sum_{h_1'} \nu_1(h_1 | h_1', q_1(\mathbf{0})) \cdot g_{uu}(h_1', h_2) + \sum_{h_2'} \nu_2(h_2 | h_2', q_2(\mathbf{0})) \cdot g_{uu}(h_1, h_2'). \tag{B.7}$$

Secondly, there will be inflows from the employed states following a health transition if such a transition results in endogenous quits. These inflows are given by

$$\begin{aligned}
&\underbrace{\sum_{h_1'} \sum_{I_1'} \sum_{i_1' \in I_1'} \int_{\mathbf{\Omega}_{uu}^{1+}(i_1', I_1', \mathbf{h})} \nu_1(h_1 | h_1', q_1(i_1')) g_{eu}(w_1', i_1', I_1', h_1', h_2) \, \mathrm{d}w_1'}_{\text{adult 1 health transition from } eu \text{, adult 1 quits}} \\
&+ \underbrace{\sum_{h_2'} \sum_{I_2'} \sum_{i_2' \in I_2'} \int_{\mathbf{\Omega}_{uu}^{2+}(i_2', I_2', \mathbf{h})} \nu_2(h_2 | h_2', q_2(i_2')) g_{ue}(w_2', i_2', I_2', h_1, h_2') \, \mathrm{d}w_2'}_{\text{adult 2 health transition from } ue \text{, adult 2 quits}} \\
&+ \underbrace{\sum_{h_1'} \sum_{\mathbf{I}'} \sum_{\mathbf{i}' \in \mathbf{I}'} \int_{\mathbf{\Omega}_{uu}^{3+}(\mathbf{i}', \mathbf{I}', \mathbf{h})} \nu_1(h_1 | h_1', q_1(\mathbf{i}')) g_{ee}(\mathbf{w}', \mathbf{i}', \mathbf{I}', h_1', h_2) \, \mathrm{d}\mathbf{w}'}_{\text{adult 1 health transition from } ee \text{, both adults quits}} \\
&+ \underbrace{\sum_{h_2'} \sum_{\mathbf{I}'} \sum_{\mathbf{i}' \in \mathbf{I}'} \int_{\mathbf{\Omega}_{uu}^{3+}(\mathbf{i}', \mathbf{I}', \mathbf{h})} \nu_2(h_2 | h_2', q_2(\mathbf{i}')) g_{ee}(\mathbf{w}', \mathbf{i}', \mathbf{I}', h_1, h_2') \, \mathrm{d}\mathbf{w}'}_{\text{adult 2 health transition from } ee \text{, both adults quits}},
\end{aligned} \tag{B.8}$$

where the inflow sets above are defined by $\mathbf{\Omega}_{uu}^{1+}(i_1', I_1', \mathbf{h}) = \{w_1' : \mathcal{V}_{uu}(\mathbf{h}) > V_{eu}(w_1', i_1', I_1', \mathbf{h})\}$, $\mathbf{\Omega}_{uu}^{2+}(i_2', I_2', \mathbf{h}) = \{w_2' : \mathcal{V}_{uu}(\mathbf{h}) > \mathcal{V}_{ue}(w_2', i_2', I_2', \mathbf{h})\}$, and finally $\mathbf{\Omega}_{uu}^{3+}(\mathbf{i}', \mathbf{I}', \mathbf{h}) = \{\mathbf{w}' : \mathcal{V}_{uu}(\mathbf{h}) >$

$\max\{\mathcal{V}_{ee}(\mathbf{w}', \mathbf{i}', \mathbf{I}', \mathbf{h}), \mathcal{V}_{eu}(w_1', I_1', \mathbf{h}), \mathcal{V}_{ue}(w_2', I_2', \mathbf{h})\}\}$.

Thirdly, inflows arise as a result of job destruction events. We have inflows from both single earner states, together with possible inflows from the joint employment state should one spouse's exogenous job destruction event induce their spouse to endogenously quit. The job destruction induced inflows are

$$\underbrace{\delta_1 \sum_{I_1'} \sum_{i_1' \in I_1'} \int g_{eu}(w_1', i_1', I_1', \mathbf{h})\, \mathrm{d}w_1' + \delta_2 \sum_{I_2'} \sum_{i_2' \in I_2'} \int g_{ue}(w_2', i_2', I_2', \mathbf{h})\, \mathrm{d}w_2'}_{\text{adult 1 job destroyed from } eu/\text{adult 2 job destroyed from } ue}$$
$$+ \underbrace{\delta_1 \sum_{\mathbf{I}'} \sum_{\mathbf{i}' \in \mathbf{I}'} \int_{\boldsymbol{\Omega}_{uu}^{4+}(I_2, \mathbf{h})} g_{ee}(\mathbf{w}', \mathbf{i}', \mathbf{I}', \mathbf{h})\, \mathrm{d}\mathbf{w}' + \delta_2 \sum_{\mathbf{I}'} \sum_{\mathbf{i}' \in \mathbf{I}'} \int_{\boldsymbol{\Omega}_{uu}^{5+}(I_1', \mathbf{h})} g_{ee}(\mathbf{w}', \mathbf{i}', \mathbf{I}', \mathbf{h})\, \mathrm{d}\mathbf{w}'}_{\text{adult 1 job destroyed from } ee/\text{adult 2 job destroyed from } ee\text{, spouse quits}}, \quad \text{(B.9)}$$

with the conditional inflow sets defined $\boldsymbol{\Omega}_{uu}^{4+}(I_2', \mathbf{h}) = \{w_2' : \mathcal{V}_{uu}(\mathbf{h}) > \mathcal{V}_{ue}(w_2', I_2', \mathbf{h})\}$, and $\boldsymbol{\Omega}_{uu}^{5+}(I_1', \mathbf{h}) = \{w_1' : \mathcal{V}_{uu}(\mathbf{h}) > \mathcal{V}_{eu}(w_1', I_1', \mathbf{h})\}$.

The steady state condition for the joint non-employment state is therefore given by (B.6) = (B.7) + (B.8) + (B.9).

C Tax schedule implementation

In our model tax schedules (as a function of family earnings and demographic characteristics $\mathbf{x}$) are calculated using the NBER TAXSIM program (Feenberg and Coutts, 1993), using the 2006 tax code. For non-employed workers, we impute a value of unemployment insurance (UI) that is equal to the equivalent of $98 per-week (the average UI payment multiplied by the recipiency rate). For married couples we assume joint filing status, and for singles with children we assume head-of-household filing status. Note that while UI is taxed, it is taxed differently from earned labor earnings, and we account for this tax treatment.

We smooth the underlying tax schedules using the method proposed by MaCurdy, Green and Paarsch (1990). With $K > 1$ tax brackets, the marginal tax rate approximation for a family with observable characteristics $\mathbf{x}$ at *household* earnings z, and total UI receipt b is given by

$$\widehat{MTR}(z; b, \mathbf{x}) = \sum_{k=1}^{K} \left[\Phi_{\mathbf{x},b}^{k}(z) - \Phi_{\mathbf{x},b}^{k+1}(z) \right] \tau_{\mathbf{x},b}^{k},$$

where $\tau_{\mathbf{x},b}^{k}$ is the marginal tax rate at the k^{th} bracket given $\mathbf{x}$ and $\Phi_{\mathbf{x},k}$ is the normal cumulative distribution function with a mean equal to the value of the k^{th} tax bracket given $\mathbf{x}$ and with standard deviation $\sigma_{\mathbf{x},k}$. The value of $\sigma_{\mathbf{x},k}$ determines how quickly the smoothed marginal tax rates $\widehat{MTR}(z; \mathbf{x})$ change in the neighborhood of the break points, with a small value fitting the underlying step function more closely. We set $\sigma_{\mathrm{x},k} = 400$ (measured in annual dollars in average 2006 prices), although our results are not sensitive to this particular choice. The same smoothing procedure is applied in our implementation of individual tax penalties and premium subsidies.

D Medical expenditure distribution

In Section 3.2 we described our parametrization of the medical expenditure distribution. We assume a mixture distribution, with the distribution of medical expenditure conditional on a positive realization specified as a (truncated) Gamma-Gompertz distribution. In this appendix we present expressions for the expected medical expenditure and the expected utility risk adjustment factor under these assumptions.

In what follows we suppress the dependence of medical expenditure distributions on demographics, gender, health status, and insurance coverage. In the case of the *untruncated* conditional medical expenditure distribution, the mean unconditional expenditure can be derived by simply using the expression for the expectation of the Gamma-Gompertz distribution (see Bemmaor and Glady, 2012). That is

$$\mathbb{E}[m] = \frac{1-M^0}{bs}\, {}_2F_1\left(s,1;s+1;1-1/\beta\right), \tag{D.1}$$

where ${}_2F_1$ is the Gaussian hypergeometric function (see Abramowitz and Stegun, 1964), and with a slight change of our earlier notation, we let b, s, and β, denote the parameters of the Gamma-Gompertz distribution. In the case where medical expenditures are drawn from a truncated distribution with support $[0,x]$, the expected value is given by

$$\begin{aligned}
\mathbb{E}[m|m\in[0,x]] &= \frac{1}{M^+(x)}\int_0^x \frac{mbse^{bm}\beta^s}{(\beta-1+e^{bm})^{s+1}}\,\mathrm{d}m \\
&= \frac{\beta^s}{M^+(x)}\left[\frac{{}_2F_1(s,s;s_1,1-\beta)}{bs} - \frac{{}_2F_1(s,s;s+1,(1-\beta)e^{-bx})}{bse^{bsx}} - \frac{x}{(\beta-1+e^{bx})^s}\right] \\
&= \frac{1}{M^+(x)}\left[\mathbb{E}[m] - \frac{\beta^s}{bs(\beta-1+e^{bx})^s}\,{}_2F_1\left(s,1;s+1,\frac{\beta-1}{\beta-1+e^{bx}}\right) - \frac{\beta^s x}{(\beta-1+e^{bx})^s}\right],
\end{aligned}$$

where the third equality follows from the identity ${}_2F_1(a,b;c,z) = (1-z)^{-a}{}_2F_1(a,c-b;c,z/(z-1))$ and the definition of the untruncated mean.

The main complication in deriving the expected utility risk adjustment factor (see equation (3)) is the evaluation of the expectation

$$\mathbb{E}[\exp(\psi m)|m\in[0,x]] = \frac{1}{M^+(x)}\int_0^x \exp(\psi m)\,\mathrm{d}M^+(m) = \frac{1}{M^+(x)}\int_0^x \frac{e^{\psi m}bse^{bm}\beta^s}{\left(\beta-1+e^{bm}\right)^{s+1}}\,\mathrm{d}m, \tag{D.2}$$

which we note is just the moment generating function for the random variable m. Evaluating the indefinite integral and using straightforward, but tedious calculations, we obtain

$$\begin{aligned} &\mathbb{E}[\exp(\psi m)|m \in [0,x]] \\ &= \frac{1}{M^{+}(x)}\left[{}_2F_1(1,-\psi/b,1-s,\beta) - (1-M^{+}(x))e^{\psi x}\, {}_2F_1\left(1,-\psi/b,1-s,\frac{e^{bx}-1+\beta}{e^{bx}}\right)\right]. \end{aligned} \tag{D.3}$$

This expectation always exists for finite x. In the unbounded case, $x \to \infty$, this will only converge when $\psi < bs$. In these cases, multiplying equation (D.3) by $1 - M^0$ (positive expenditure probability) and adding M^0 (zero expenditure probability) then gives us the required risk adjustment factor when a single household member is uninsured. Given the assumed independence of the medical expenditure shocks within the household, it is straightforward to extend the definition of the risk adjustment factor when multiple household members are uninsured.

E Numerical implementation

Here we provide a brief sketch of the numerical implementation of our model. The algorithm that we develop begins by discretizing the underlying firm productivity distribution, together with the leisure flow distribution for all demographic groups. For all values of p on our grid, we provide an initial guess of the wage policy functions, $w_I(p)$, and sector choice probabilities $\Delta(I;p)$ for all I. This allows us to obtain the joint cumulative distribution function $F(w,I)$. The associated wage offer density functions are obtained through numerical differentiation. We also provide an initial guess of the insurance premiums $r(i,w;I)$.

For each type-$(\boldsymbol{\alpha},\mathbf{x})$ household we solve the household decision problem by iterating on the value functions as presented in Section 2.4 and Appendix A. Given these value functions, we then solve for the system of flow equations (Section 2.5 and Appendix B) by iterating. From these flow equations, we calculate conditional firm sizes (equation (10)) and then numerically integrate to obtain the aggregate firm size $\ell(w,I)$ (equation (12)). Note that while theoretically allowing for a continuous distribution of leisure flows will smooth the labor supply function at the aggregate, in our implementation we necessarily have a finite number of leisure values on our integration grid. Our approach to this problem is to replace the indicator functions $\mathbb{1}(\cdot)$ that appear in our flow equations with a Logistic smoothing kernel $\mathbb{K}(\cdot)$.[55] This function depends upon the difference in values between states, together with a smoothing parameter that the researcher may control. Given these (smoothed) flow equations we calculate firm size and the implied average worker productivity $A(w,I;p)$ using equation (13). We also obtain updated insurance premiums $r(i,w;I)$ by using equation (14), to be applied in the next iteration step.

[55] This is similar to the approach taken in Arcidiacono et al. (2019), where the logistic errors are given a behavioral interpretation.

In order to update the wage policy function, it is necessary to solve the problem of the least productive firm, $\underline{p}$. This is achieved by constructing a wage *subgrid* for each sector I that contains wages both above and below (and including) the candidate $w_I(\underline{p})$. For each wage on this subgrid, we perform value function iteration and solve flow equations to determine firm size and worker productivity as before. (For conciseness, these flow equations are not presented here, but take a similar form to those derived on the support of wages.) An update of the wage for the least productive firm is obtained by considering which wage *on this subgrid* maximizes flow profits (equation (15)). This provides an update to the profits of the least productive firm in all sectors I, denoted $\pi_I(\underline{p})$. We are then able to update the wage function everywhere using

$$w_I^+(p) = A(w_I(p), I; p) - \left[\pi_I(\underline{p}) + \int_{\underline{p}}^{p} \ell(w_I(x), I)\,\mathrm{d}x\right] \frac{1}{\ell(w_I(p), I)},$$

which is derived by first noting that $\pi_I'(p) = \ell(w_I(x), I)$ by application of the Envelope Theorem and then relating maximized profits flows (equation (16)) to the definite integral of maximized profits from $\underline{p}$ to p. That is, $\pi_I(p) = \pi_I(\underline{p}) + \int_{\underline{p}}^{p} \pi_I'(x)\,\mathrm{d}x$. The sector choice probabilities $\Delta(I; p)$ are then updated using equation (18).

The algorithm then proceeds by iterating on these equilibrium objects until we obtain a fixed point. While we have no proof in the general case of either existence or uniqueness of equilibrium, in practice we are always able to calculate an equilibrium and obtain this from a wide variety of initial guesses.

F Estimation moments

In this appendix we describe the full set of targeted estimation moments. Recall that we have $H = 2$ health categories and $\dim(\mathbf{x}) = 5$ demographic household types. The first set of moments that we construct relate to health and insurance coverage outcomes. Using SIPP we calculate the fraction of individuals of each demographic type with a given health and insurance coverage status. For couples, we also calculate the fraction in each joint health state. Additionally, we describe annual health transitions conditional on gender, marital status, and both initial health status and insurance coverage. There are a total of 68 moments in this set.

The second set of moments, also calculated using SIPP, summarize employment and insurance outcomes. We calculate the fraction of individuals of each demographic type observed in each possible joint employment and insurance coverage state.[56] For individuals of each demographic type, we describe the annual transition rate from unemployment to employment (by insurance coverage), the annual transition rate from employment to non-employment, and the

[56] Recall that all single non-employed individuals are treated as being uninsured, and all individuals in couples are treated as uninsured in the joint non-employment state.

annual transition rate from employment to another job (broken down by insurance coverage). We also calculate insurance take-up rates using data from the SIPP employer health-benefits topical module (from wave 5). For each demographic type we calculate the joint insurance coverage state, conditional on ESHI being available. There are a total of 93 moments in this set.

The third set of moments relate to wages. Using SIPP, the cross-sectional distribution of wages is summarized by the mean, standard deviation, and the 1st, 5th, 10th, 25th, 50th, 75th, 90th, 95th, and 99th percentiles of the distribution. These are calculated conditional on individual type and insurance coverage. For individuals in two-earner couples (separately with and without children), we also calculate the mean and standard deviation of the product of male and female wages. The distribution of wages for individuals observed as non-employed in the initial cross section ("accepted wages") are summarized by their mean, median, and standard deviation. There are a total of 183 wage moments.

The fourth set of moments relate to medical expenditure and are calculated using MEPS-HC. We calculate the zero medical expenditure mass, the 5th, 10th, 25th, 50th, 75th, 90th, 95th percentiles of the conditional medical expenditure distribution, together with the mean, standard deviation, and skewness coefficient[57] of this distribution. For adults these moments are constructed conditional on gender, health status, and insurance coverage status. For children, they condition on insurance coverage status. A total of 110 moments are in this set.

The fifth and final set of moments, derived from KFF, are related to the firm. We describe average firm size, the fraction of firms in five binned size categories (defined as less than 10 employees, 10–25 employees, 25–50 employees, 50–100 employees, 100+ employees), and the fraction of firms within these size categories that offer employer sponsored insurance. There are a total of 11 firm-side moments in this set.

G ACA parameters

G.1 Tax credits

Under the ACA, households are eligible to receive premium subsidies if households have a Modified Adjusted Gross Income (MAGI) that is between 100% and 400% of the federal poverty line (FPL).[58] The "premium cap" defines the maximum percentage of income for the 2nd lowest cost silver plan, with the cap rate dependent upon household income. The actual rates and poverty levels from the 2016 benefit year are presented in Table G.1.

The subsidy amount is the difference between the cost of the plan, and income times the premium cap. In our implementation we apply a few modifications to the schedule to ensure

[57] Defined as Bowley's (1920) robust skewness measure.

[58] The definition of MAGI includes income sources such as wages and salary income, taxable interest, Social Security, and unemployment insurance. Note that tax credits for a given year are calculated using the previous years federal poverty guideline.

Table G.1: Premium cap, by household income

Income	Income range		Premium cap
(% of FPL)	Single Individual	Family of Four	(% of MAGI)
100%–133%	$11,770–$15,654	$24,250–$32,253	2.03%
133%–150%	$15,654–$17,655	$32,253–$36,375	3.05%–4.07%
150%–200%	$17,655–$23,540	$36,375–$48,500	4.07%–6.41%
200%–250%	$23,540–$29,425	$48,500–$60,625	6.41%–8.18%
250%–300%	$29,425–$35,310	$60,625–$72,750	8.18%–9.66%
300%–400%	$35,310–$47,080	$72,750–$97,000	9.66%

Table shows applicable premium cap according to the MAGI of the taxpayer, spouse, and dependents and measured as a percentage of the FPL. Tax credits for 2016 are calculated using 2015 federal poverty guidelines.

that there are no discontinuities and that marginal effective tax rates are always less than 100%. Firstly, in the 100%–133% income range, we let the premium cap vary from 0% to 3.05%. This prevents a discontinuous change in the premium at 100% of the FPL (below which households are covered by Medicaid) and 133% (where the premium cap rate changes discontinuously). Second, we remove the upper income threshold to prevent the discontinuous change when household incomes exceed 400% of the FPL (the so-called "subsidy cliff"), with the implicit premium subsidy now declining smoothly to zero. Third, we replace the original schedule by a piecewise linear schedule that is formed by linearly interpolating the original function at the income levels associated with the different cap rates. Fourth, we smooth the subsidy in the neighborhood of any marginal rate changes using the same method as we apply to the income tax schedule, and described in Appendix C. Note that the first two changes act to slightly increase subsidies (decrease post-subsidy price) at incomes around 100% and above 400% of the federal poverty line. In Figure G.1a we illustrate how these modifications change the subsidy schedule.

G.2 Individual mandate

The individual mandate requires that individuals are covered by a health insurance policy or face a tax penalty.[59] The amount of the tax penalty is either a flat rate amount for each uninsured individual ($695 per adult and $347.50 per child under 18),[60] or 2.5% of gross income (defined as household modified adjusted gross income less the applicable tax filing threshold), whichever is higher. In the case of the income based penalty, the penalty is capped at the national average cost for a bronze plan for each uninsured individual. Using the notation introduced in Section 2

[59] In practice there are coverage exemptions. These apply if the gross income of the household is below the tax filing threshold (in which case it is not necessary to file a federal income tax return). Coverage exemptions are also granted for certain hardship situations, to members of certain religious sects, and select other reasons.

[60] These flat rates amounts are for the year 2016.

it follows that the tax penalty $Q(z, \mathbf{i}; \mathbf{x})$ for a household without dependent children is given by

$$Q(z, \mathbf{i}; \mathbf{x}) = \max\{\$695 \times \sum_j [q_j(\mathbf{i}) = 0], \min\{0.025 \times (z - \underline{z}_\tau(\mathbf{x})), r_{HIX} \times \sum_j \mathbb{1}[q_j(\mathbf{i}) = 0]\}\},$$

where z is the modified adjust gross income (as defined in equation (26)), and $\underline{z}_\tau(\mathbf{x})$ is the tax filing threshold for a household with characteristics $\mathbf{x}$.[61] The definition of the tax penalty function extends naturally for households with dependent children. As before, we smooth this tax penalty function in the neighborhood of any marginal rate changes. Again, see Appendix C for details.

G.3 Firm penalties

The ACA requires that firms with 50 or more full-time employees provide health insurance to workers and their dependents or pay a fine. The definition of dependents under the ACA includes children up to age 26 but does not include an employee's spouse. The penalty for a non-complying firm is equal to \$2904 (2016) per employee (minus the first 30).[62] Small firms (less than 50 employees) are not subject to a penalty.[63] Thus, the penalty is given by

$$\$2904 \times \mathbb{1}[I = 0 \wedge \ell(w, I) \geq 50] \times [\ell(w, I) - 30].$$

The form of this unmodified penalty function introduces technical complications as firms' profits fall discontinuously at the wage $w_\ell = \ell^{-1}(50, 0)$ that is associated with the threshold firm size. In our application we instead implement the following form for the firm penalty function

$$\mho_E(\ell, 0) = \begin{cases} \$0 & \text{if } \ell \leq 30 \\ \$2904 \times \mathbb{B}[(\ell - 30)/40; p_a, p_b] \times (\ell - 30) & \text{if } 30 < \ell < 70 \\ \$2904 \times (\ell - 30) & \text{if } \ell \geq 70, \end{cases} \quad \text{(G.1)}$$

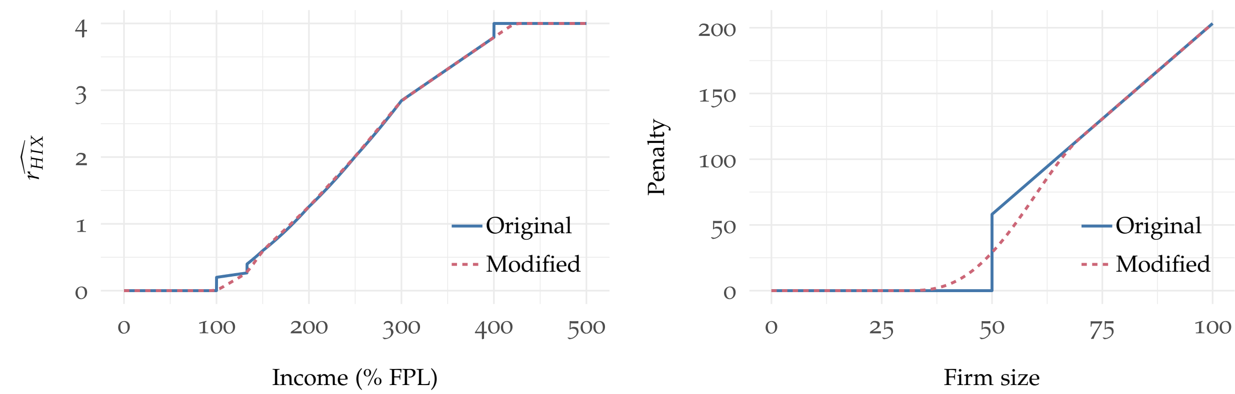
where $\mathbb{B}(\cdot; p_a, p_b)$ is the incomplete beta function with parameters $p_a > 1$ and $p_b > 1$.[64] It has the following properties. Firstly, the penalty function coincides with the unmodified schedule for $\ell \leq 30$ and $\ell \geq 70$. Second, for $30 < \ell < 70$ the penalty is now replaced by an increasing smooth function, with the unmodified schedule obtained in the limiting case when $p_a, p_b \to \infty$. The choice of parameters p_a, p_b is important as differentiability of the schedule alone is not sufficient

[61] In 2016 this is \$10,350 for a single filing status, \$13,350 for head-of-household filing status (applicable for single individuals without children), and \$20,700 for a married couple filing jointly.

[62] This dollar amounts reflects that employer penalty taxes are non-deductible for the purposes of calculating a business' income tax liability. It is calculated as $\$2904 = \$2290 \times [(1 - \tau_b)(1 + \tau_s)]^{-1}$, with $\tau_b = 0.277$ reflecting business taxes and $\tau_s = 0.0765$ reflecting payroll taxes. See Footnote 47 from the main text for more discussion.

[63] Size dependent policies exist in other countries and in other contexts. See, for example, Guner, Ventura and Xu (2008), Gourio and Roys (2014), and Garicano, Lelarge and Van Reenen (2016).

[64] The requirement that these parameters (p_a and p_b) exceed 1 ensures the function is continuously differentiable.



(a) Post-subsidy marketplace premium

(b) Firm penalty

Figure G.1: Original and modified policy functions the under 2016 rules. Panel a shows the original and modified post-subsidy marketplace premium $\widehat{r_{HIX}}$ (in thousands of dollars per year) as a function of household income. Here we assume a single tax payer with no dependents and an annual pre-subsidy market place premium $r_{HIX} = \$4,000$. Horizontal axis measures household MAGI relative to the FPL. Panel b shows the original and modified firm penalty schedule if it does not offer health insurance ($I = 0$), when the dollar fine is $2,904 and with the modified schedule calculated with $p_a = p_b = 2$. Penalty is expressed in thousands of dollars per year.

to rule out mass points in the wage distribution. Rather, we require that the penalty function can never increase more quickly than firm profits (exclusive of the penalty). We set these to $p_a = p_b = 2$.[65] Figure G.1b illustrates how these modifications impact the penalty function.

H Additional tables

In this Appendix we present further results tables. In Table H.1 we present our model parameter estimates and the accompanying standard errors. In Tables H.2 and H.3 we respectively present the fit to the annual employment and health status transition rates for single individuals. (The analogous tables for married individuals are presented in Tables 1 and 2 from the main text.) Additional model fit tables are presented in Table H.4 (the bivariate distributions of insurance coverage and health status), Table H.5 (the bivariate distributions of insurance coverage and employment), Table H.6 (the health insurance take-up decision conditional on availability), and Table H.7 (the joint distribution of health status within the household). Finally, in Table H.8 and Table H.9 we document how both the percentage of firms offering health insurance benefits, and the fraction of firms that do not offer spousal health insurance, has changed over time.

[65] In the context of a homogeneous worker and firm model with a diminishing marginal value labor product, Mortensen and Vishwanath (1993) demonstrate that the equilibrium wage distribution is characterized by a mass point at the upper support of the distribution, where the wage is equal to the marginal product of labor. Our setting differs as we have heterogeneous productivity and the penalty-implied diminishing marginal returns are only local.

Table H.1: Parameter Estimates

	Estimate	Standard Error
Job offer arrival rates (non-employed)		
Married men	1.450	0.065
Married women, children	1.119	0.046
Married women, no children	1.234	0.064
Single, no children	1.567	0.065
Single women, children	0.733	0.034
Job offer arrival rates (employed)		
Married men	0.606	0.019
Married women, children	0.955	0.035
Married women, no children	0.809	0.034
Single, no children	0.282	0.012
Single women, children	0.100	0.004
Job destruction rates		
Married men	0.049	0.002
Married women, children	0.200	0.007
Married women, no children	0.107	0.004
Single, no children	0.079	0.003
Single women, children	0.088	0.004
Wage offer distributions		
No health insurance, lowest wage	6.000	0.168
No health insurance, highest wage	32.454	0.980
No health insurance, Beta_α	1.010	0.039
No health insurance, Beta_β	9.591	0.420
Health insurance, lowest wage	5.372	0.139
Health insurance, highest wage	58.022	1.322
Health insurance, Beta_α	1.010	0.034
Health insurance, Beta_β	6.065	0.195
Wage measurement error, s.d.	0.198	0.009
Fraction no health insurance	0.441	0.012
Relative measure of workers	18.000	0.810
Leisure distribution (mean)†		
Constant	−0.419	0.017
Couple	−1.101	0.041
Female	0.302	0.013
Children	−0.784	0.027
Female × Children	1.031	0.036
Leisure distribution (s.d.)†	0.277	0.014
Risk aversion‡		
Couples, children	1.131	0.015
Couples, no children	1.217	0.023
Single men, no children	1.217	0.021
Single women, no children	1.286	0.039
Single women, children	1.433	0.033
Relative productivity (unhealthy)	0.886	0.002

† Log-linear index function of the parameters.
‡ Consumption is measured in tens of thousands of dollars in flow utility.

Table H.1: (continued)

	Estimate	Standard Error
Health transition (unhealthy to healthy)†		
Constant	−1.735	0.058
Couple	−0.373	0.017
Female	0.127	0.006
Insured	2.106	0.066
Health transition (healthy to unhealthy)†		
Constant	−1.909	0.037
Couple	0.221	0.011
Female	0.057	0.003
Insured	−1.775	0.066
Adult zero medical expenditure probability§		
Healthy	1.051	0.040
Unhealthy	−0.326	0.015
Female	−0.661	0.032
Insured	−2.580	0.048
Adult conditional medical expenditure, Gamma-Gompertz†		
b: Healthy	−12.552	0.199
b: Unhealthy	−18.174	0.202
b: Female	0.431	0.019
b: Insured	−8.450	0.144
s: Healthy	0.114	0.005
s: Unhealthy	−0.267	0.008
s: Female	0.342	0.011
s: Insured	0.559	0.018
β: Healthy	−7.344	0.178
β: Unhealthy	−12.122	0.209
β: Female	1.313	0.029
β: Insured	−6.005	0.158
Child zero medical expenditure probability§		
Constant	−1.882	0.053
Insured	−0.317	0.012
Child conditional medical expenditure, Gamma-Gompertz†		
b: Constant	−8.959	0.092
b: Insured	−1.630	0.051
s: Constant	0.846	0.039
s: Insured	0.283	0.013
β: Constant	−1.942	0.079
β: Insured	−0.744	0.032

Notes: All parameters estimated using procedure as detailed in Section 3.3 from the main text. See Footnote 35 for a description of the method used to calculate standard errors.

† Log-linear index function of the parameters.
§ Logistic index function of the parameters.

Table H.2: Annual Employment Transitions, Singles

	Single Men			Single Women					
	No Children			Children			No Children		
	Data	Model	S.E.	Data	Model	S.E.	Data	Model	S.E.
Transitions from employment									
... to non-emp.	0.05	0.06	0.01	0.10	0.08	0.01	0.04	0.07	0.01
... to emp. (ins.)	0.08	0.05	0.01	0.07	0.03	0.01	0.07	0.06	0.01
... to emp. (unins.)	0.06	0.03	0.01	0.07	0.02	0.01	0.05	0.02	0.01
Transitions from non-employment									
... to emp. (ins.)	0.12	0.11	0.02	0.05	0.09	0.01	0.07	0.11	0.01
... to emp. (unins.)	0.15	0.05	0.02	0.19	0.06	0.02	0.09	0.04	0.02

Notes: Table shows annual transitions from employment and non-employment for single individuals to different labor market states. In parentheses *ins.* (respectively *unins.*) refer to transitions to a job with (without) health insurance. S.E. refers to the standard deviation of the empirical moment. Empirical moments are calculated using SIPP data.

Table H.3: Annual Health Transitions, Singles

	Single Men						Single Women					
	Insured			Uninsured			Insured			Uninsured		
	Data	Model	S.E.	Data	Model	S.E.	Data	Model	S.E.	Data	Model	S.E.
Transitions from healthy												
... to healthy	0.96	0.98	0.01	0.89	0.89	0.01	0.96	0.98	0.01	0.84	0.88	0.01
... to unhealthy	0.04	0.02	0.01	0.11	0.11	0.01	0.04	0.02	0.01	0.16	0.12	0.01
Transitions from unhealthy												
... to healthy	0.72	0.72	0.07	0.38	0.28	0.04	0.58	0.75	0.06	0.31	0.27	0.03
... to unhealthy	0.28	0.28	0.07	0.62	0.72	0.04	0.42	0.25	0.06	0.69	0.73	0.03

Notes: Table shows annual health transitions for single individuals conditional on health and insurance coverage status at the start of the year. S.E. refers to the standard deviation of the empirical moment. Empirical moments are calculated using SIPP data.

Table H.4: Insurance and Health Status

	Insured						Uninsured					
	Healthy			Unhealthy			Healthy			Unhealthy		
	Data	Model	S.E.	Data	Model	S.E.	Data	Model	S.E.	Data	Model	S.E.
Married couples												
Men, children	0.76	0.77	0.01	0.03	0.05	0.00	0.17	0.15	0.01	0.03	0.02	0.00
Men, no children	0.82	0.85	0.02	0.06	0.04	0.01	0.09	0.10	0.01	0.04	0.02	0.01
Women, children	0.74	0.78	0.01	0.04	0.05	0.00	0.19	0.15	0.01	0.03	0.02	0.00
Women, no children	0.82	0.85	0.01	0.05	0.04	0.01	0.11	0.09	0.01	0.02	0.02	0.01
Single individuals												
Men, no children	0.53	0.53	0.01	0.02	0.04	0.00	0.34	0.35	0.01	0.11	0.08	0.01
Women, children	0.41	0.42	0.01	0.04	0.03	0.00	0.43	0.41	0.01	0.13	0.15	0.01
Women, no children	0.59	0.52	0.01	0.03	0.03	0.01	0.26	0.36	0.01	0.12	0.08	0.01

Notes: Table shows the cross-sectional joint distribution of insurance coverage and health status for women and men of different demographic types. S.E. refers to the standard deviation of the empirical moment. Empirical moments are calculated using SIPP data.

Table H.5: Insurance and Employment Status

	Insured						Uninsured					
	Employed			Non-employed			Employed			Non-employed		
	Data	Model	S.E.	Data	Model	S.E.	Data	Model	S.E.	Data	Model	S.E.
Married couples												
Men, children	0.77	0.78	0.01	0.03	0.04	0.00	0.16	0.14	0.01	0.05	0.04	0.00
Men, no children	0.82	0.78	0.02	0.05	0.10	0.01	0.08	0.07	0.01	0.05	0.05	0.01
Women, children	0.54	0.58	0.01	0.24	0.25	0.01	0.08	0.08	0.01	0.13	0.09	0.01
Women, no children	0.75	0.72	0.02	0.12	0.17	0.01	0.06	0.05	0.01	0.06	0.06	0.01
Single individuals												
Men, no children	0.55	0.57	0.01				0.25	0.18	0.01	0.20	0.26	0.01
Women, children	0.45	0.45	0.01				0.26	0.21	0.01	0.29	0.35	0.01
Women, no children	0.62	0.55	0.01				0.14	0.13	0.01	0.24	0.32	0.01

Notes: Table shows the cross-sectional distribution of insurance coverage and employment status for women and men of different demographic types. S.E. refers to the standard deviation of the empirical moment. Empirical moments are calculated using SIPP data.

Table H.6: Health Insurance Take-Up Decisions

	Children			No Children		
	Data	Model	S.E.	Data	Model	S.E.
Married couples						
Male insured, female insured	0.89	0.86	0.01	0.93	0.92	0.01
Male insured, female, uninsured	0.04	0.03	0.00	0.03	0.02	0.01
Male uninsured, female insured	0.02	0.03	0.00	0.03	0.02	0.01
Male uninsured, female uninsured	0.05	0.08	0.00	0.02	0.04	0.01
Single individuals						
Male insured				0.89	0.92	0.01
Female insured	0.80	0.93	0.01	0.93	0.96	0.01

Notes: Table shows the cross-sectional insurance take-up rate for women and men of different demographic types. S.E. refers to the standard deviation of the empirical moment. Empirical moments are calculated using SIPP data.

Table H.7: Married Couples Joint Health Status

	Children			No Children		
	Data	Model	S.E.	Data	Model	S.E.
Married couples						
Male healthy, female healthy	0.88	0.87	0.01	0.87	0.89	0.01
Male healthy, female, unhealthy	0.05	0.06	0.00	0.04	0.05	0.01
Male unhealthy, female healthy	0.05	0.06	0.00	0.06	0.05	0.01
Male unhealthy, female unhealthy	0.02	0.01	0.00	0.03	0.01	0.01

Notes: Table shows the cross-sectional joint distribution of health status for married individuals. S.E. refers to the standard deviation of the empirical moment. Empirical moments are calculated using SIPP data.

Table H.8: Percentage of Firms Offering Health Benefits, by Firm Size

	1999	2001	2003	2005	2007	2009	2011	2013	2015	2017
Firm size										
3–9 Workers	55	58	55	47	45	47	48	45	47	40
10–199 Workers	81	83	81	79	80	79	77	75	72	73
200 or More Workers	99	99	97	97	99	98	99	99	98	99
All firms	66	68	66	60	59	59	60	57	57	53

Source: Kaiser/HRET Survey of Employer-Sponsored Health Benefits, various years.
Notes: Table shows fraction of firms that offer ESHI conditional on firm size (as measured by the number of workers). Estimates are based on the sample of both firms that completed the entire survey and those that answered just one question about whether they offer health benefits

Table H.9: Percentage of Firms Not Offering Spousal Health Benefits, by Firm Size

	2014	2015	2016	2017	2018
Firm size					
3–199 Workers	4	2	11	6	3
200 or More Workers	1	0	1	0	1

Source: Kaiser/HRET Survey of Employer-Sponsored Health Benefits, various years.
Notes: Table shows fraction of firms that do not extend health insurance to the spouses of workers, conditional on offering benefits. The survey question regarding spousal benefits was not asked prior to 2014.