The Affordable Care Act After a Decade: Its Impact on the Labor Market and the Macro Economy*

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Abstract

The Affordable Care Act (ACA) is one of the most important reforms of the US health insurance system since the introduction of Medicare. Since employment is a main source of health insurance for the working age population in the United States, this sweeping health insurance reform also has important implications for the labor market and the macro economy. In this paper, we survey the prototype models that are used in the macro and labor literature, extended to integrate health and health insurance, to study the short- and long-run consequences of the ACA. We also suggest open areas for future research.

Keywords: Affordable Care Act, Health Insurance, Labor Market, Macro economy

JEL Classification Numbers: E62, H24, H51, I1, I13, I18

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1 Introduction

The Affordable Care Act (hereafter, ACA), signed into law by President Barack Obama in March 2010, represents the most significant reform to the U.S. health insurance and health care markets since the establishment of Medicare in 1965.[1] The health care reform in the U.S. was partly driven by the twin problems faced by the U.S. health care system: first, a large fraction of the U.S. population did not have health insurance (more than 15.2% for 2009), while all the other OECD countries have national health insurance; second, the U.S. spent a much larger share of national income on health care than the other OECD countries (health care accounts for about 18% the U.S. GDP in 2009).[2]

Even though the ACA adopted an incremental approach that maintained the existing combination of publicly provided health insurance through Medicare and Medicaid, private employer-sponsored (group) health insurance (ESHI), and private individual health insurance, it nonetheless is a sweeping reform of the US health insurance system. Among the many provisions, the most important components include the extension of the young adult coverage on the parents' employer sponsored insurance to age 26, the individual mandate, the employment mandate, the establishment of community-rated health insurance exchanges, the Medicaid expansion, and the federally funded premium subsidies for eligible individuals who purchase their health insurance from the exchange (see Section 2 for more details).

The ACA is mainly a reform of the health insurance system. However, it also has a large impact on the labor market, the macro economy and public health for several reasons. First, the health care sector accounts for about 18% of the U.S. GDP;[3] moreover, out-of-pocket health care cost shocks remain one of the most significant risks faced by American households (see Fang 2016), and cause about 26% of personal bankruptcies among low-income households (see Gross and Notowidigdo 2011). Thus, reforms to the health insurance system impact individual consumption, saving, and labor supply decisions, all of which are, once aggregated across all households, important for macroeconomic analysis. Second, as we detail in Section 4.1, there is a strong nexus between the health insurance and the labor market in the US. Figure 1 shows that in 2009, more than half of the US population had employment-based health insurance. In addition, as is well-documented in the empirical literature, firm size, wages, health insurance offerings and worker turnover are strongly correlated. For example, firms that do not offer health insurance are more likely to be small firms, to pay low wages, and to experience a higher rate of worker turnover. Moreover, workers in firms that offer health insurance are more likely to self report better health than those in firms that do not offer health insurance (see, e.g., Brown and Medoff 1989, Aizawa and Fang 2020). Third, public insurance programs such as Medicare and Medicaid are key government expenditure programs, providing insurance to 16.1% and 11.1% of the US population in 2009. Moreover, the tax exemption for the employer-sponsored health insurance is the largest tax expenditure program of the US tax code.[4]

[1] The Affordable Care Act includes both the Patient Protection and Affordable Care Act (PPACA) and the Amendment in the Health Care and Education Reconciliation Act of 2010.

[2] See OECD Health Data at `www.oecd.org/health/healthdata` for a comparison of the health care systems between the U.S. and the other OECD countries.

[3] See Centers for Medicare and Medicaid Services (CMS).

[4] The U.S. Treasury forecasts that in the decade from 2021-2030, tax expenditure on the exclusion of employer provided

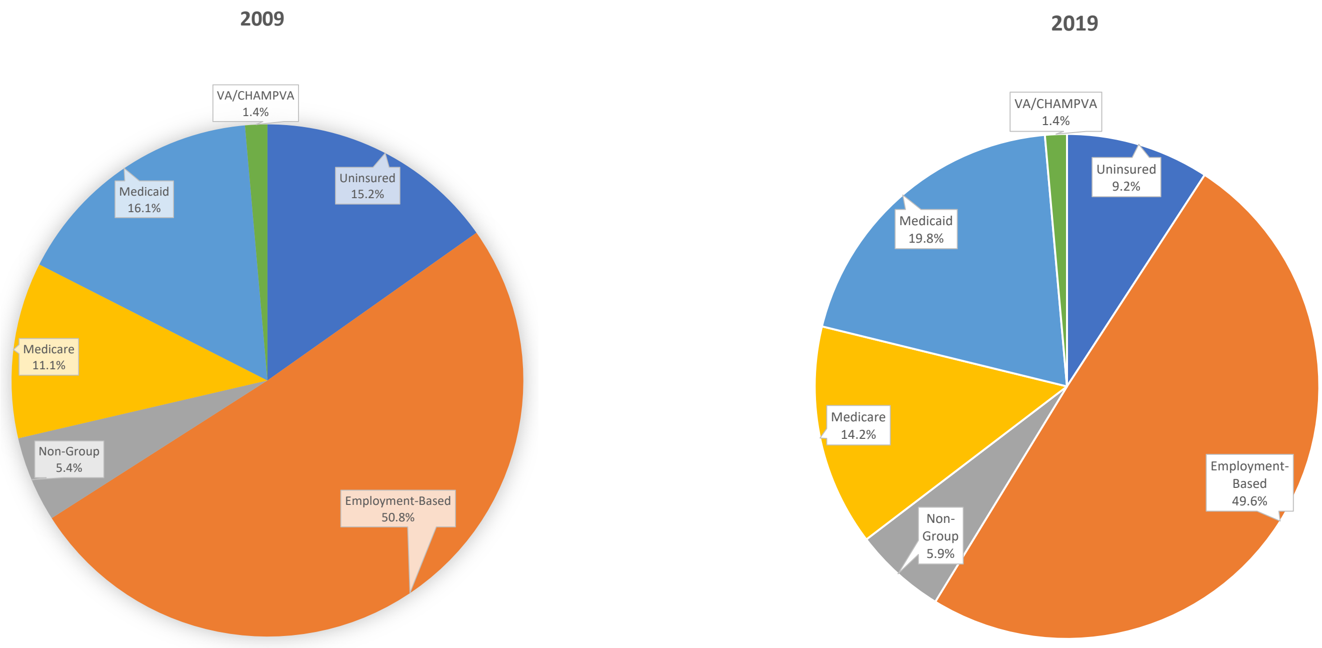

Figure 1: Health Insurance Status of the Population: 2009 vs. 2019
Source: Kaiser Family Foundation: https://www.kff.org/other/state-indicator/total-population/

The main goal of the Affordable Care Act is to address the first of the twin problems of the U.S. health care system by expanding the health insurance coverage rate. Figure 1 compares the population health insurance status in 2009 and in 2019. It shows that the rate of uninsured dropped from 15.2% to 9.2%, which means that about 20-24 million more Americans are covered by health insurance in 2019 than in 2009. The sources of insurance expansion stems from the increase in Medicaid (about 3.7 percentage points), and the increase in Medicare coverage (about 3.1 percentage points). The non-group (i.e. individual) private health insurance rate only increased by 0.5 percentage points, while the employment-based insurance rate decreased by 1.2 percentage points. While Figure 1 provides the overall distribution of health insurance status in the population, it does not reveal the possibly important changes in the enrollees in the non-group individual market, nor does it inform us about the potential changes in the population that are covered by the ESHI. Since the key components of the ACA involve income-contingent individual mandate penalties and premium subsidies, and a size-dependent employment mandate penalty, studying these distributional impacts of the ACA necessarily requires models that incorporate individual and firm heterogeneity, and allow for the potential substitution among different health insurance options.

There is a growing literature that analyzes the impact of the ACA on the labor market and the macro economy, consisting of both purely empirical studies and model-based quantitative evaluations. Our focus in this paper is on studies that use structural-quantitative models to perform (counter-)factual policy analysis. As we will see below, each paper in the literature often focuses on a subset of the ACA components and simplifies in other dimensions. To structure our discussion, we will first, in Section 3, discuss a canonical class of models employed in the quantitative macroeconomics literature that envisions a frictionless,

health insurance premium is over 2.8 trillion dollars.

competitive labor market in which workers are paid according to their marginal productivity. Individuals make labor supply decisions along the intensive and extensive margin, and make consumption/saving choices as well as health insurance and possibly health expenditure choices. A key simplification in this class of models is that the availability of employer sponsored health insurance option is exogenous. These models are not designed to study firm responses to the ACA because there is simply a representative firm operating an aggregate constant returns to scale production function and hiring perfectly substitutable workers supplying (potentially heterogeneous) labor efficiency units, rather than a well-defined notion of an individual firm with a certain number (or measure) of workers. The strength of this strand of the literature is that it can incorporate rich heterogeneity of households by income, wealth and health (and shocks to these variables) and permits a detailed analysis of dynamic consumption/savings choices, and possibly health care expenditure and health investment decisions.

The second strand, which we describe in Section 4, is based on an equilibrium frictional labor market model which extends the classical paper by Burdett and Mortensen (1998) by incorporating health and health insurance. In this class of models, workers with different health statuses search for jobs, including when they are on the job, and decide whether to accept the offers to leave unemployment or to switch to another job; firms with heterogeneous productivity endogenously decide on compensation package offerings, recognizing that the compensation packages they offer will affect their size in the steady state. Thus an attractive feature of the frictional labor market models is that there is a coherent notion of firm size, which is desirable to study size-dependent employer mandate; and it also has a notion of unemployment, which allows us to study the extensive margin impact of the ACA on the labor supply. Moreover, this class of models features the match between workers and firms, thus the ACA can potentially impact the overall productivity not only from the changes in population health, but also from changes in the sorting between workers and firms, and as such, they allow for a meaningful discussion of "job lock."

In both strands of the literature, the private health insurance market pre-ACA is allowed to be individual rated, but is required to be community rated post-ACA, with equilibrium premia determined by the break-even condition, i.e. the premium is equal to the expected health care costs of the enrollees, plus potentially a loading factor determined by the legally regulated medical loss ratio. While the macro and labor literature rightly abstract away from many aspect of the health insurance market, e.g., insurers' attempts for product differentiation and risk selection, and enrollees' behavioral biases, it emphasizes the "risk corridor" between the health insurance exchange and other insurance options. That is, such models recognize that the risk characteristics of those who enroll in the health insurance exchange is part of the equilibrium of the economy; namely, these are the individuals who either choose not to work, or are not offered ESHI options by their employers, but decide to purchase individual insurance from the exchange, possibly driven by both the "carrot" of the federal premium subsidy and the "stick" of individual mandate penalty. In contrast, the industrial organization (IO) literature tends to treat the risk pool of those in the health insurance exchange to be divorced from the labor market; and as a consequence, the IO literature tends to ignore the "jointness" of the optimal regulations for the labor market and for the health insurance market.[5]

[5]For a review of the IO literature on the health insurance exchange, see Handel and Kolstad (2022).

It has been a decade since the enactment of the ACA, and it survived numerous court challenges and several "repeal and replace" attempts. Absent a politically viable alternative, the ACA is likely here to stay for years to come. In Section 5, we provide a brief discussion about where we see as potential gaps in the literature on the more long-run and less direct impact of the ACA on issues in relationship to the labor markets, public finance and the macro economy.

In Section 2, we briefly summarize the key provisions of the ACA; in Section 3 we present a prototypical framework of frictionless labor market model that are used in the macroeconomics literature; in Section 4, we describe an equilibrium labor market with search frictions that allow us to study the long-run impact of the ACA and other alternative health reforms allowing for firm-side responses; and finally, in Section 5, we conclude and discuss the potential directions for future research.

2 The Key Provisions of the Affordable Care Act

There are many provisions in the ACA whose implementation was phased in over several years, with some of the most significant changes taking effect in 2014. The most important provisions of the ACA are:

Young Adult Dependent Coverage Extension. Prior to the ACA, ESHI benefits for dependents could be exempted from federal income taxes only if the dependent was under age 19, or under age 24 and a full-time student. The ACA requires plans and issuers that offer dependent child coverage to make the coverage available until the adult child reaches the age of 26. If a parent's plan covers children, the parent can add or keep his/her children on health insurance policy until they turn 26 years old, regardless of whether the child is married, living with the parent, attending school, or eligible to enroll in their own employer's plan.[6] This provision in the ACA went into effect on September 23, 2010.

Individual Mandate. The ACA requires that all individuals must have health insurance that meets the law's minimum standards or face a penalty when filing taxes for the year, which is 2.5 percent of income or $695, whichever is higher. These penalties were implemented fully from 2016 on. In 2014 the penalty was 1 percent of income or $95, and in 2015 it was 2 percent of income or $325, whichever is higher. Cost-of-living adjustments were made annually after 2016. If the least expensive policy available would cost more than 8 percent of one's monthly income, no penalties apply; hardship exemptions will be permitted for those who cannot afford the cost. The individual mandate was controversial and there were numerous lawsuits challenging its constitutionality. It was one of the core issues in the U.S. Supreme Course case 567 U.S. 2012 where twenty-six States, several individuals and the National Federation of Independent Business challenged the constitutionality of the individual mandate and the Medicaid expansion. The U.S. Supreme Court ruled on June 28, 2012 to uphold the constitutionality of the individual mandate on a 5-to-4 decision. The Tax Cut and Jobs Act of 2017 effectively repealed the individual mandate penalty for not having health insurance, starting in 2019, which is the current status quo.

[6] Moreover, when children lose coverage on their 26th birthday, they qualify for a special enrollment period.

Employer Mandate. Employers with 50 or more full-time employees will be required to provide health insurance or pay a fine of $2,000 per worker each year if they do not offer health insurance, where the fines would apply to the entire number of full-time equivalent employees minus an allowance of twenty.

The employer mandate in the ACA has been very contentious and its implementation was twice delayed. The first delay exempted all firms from the employer mandate penalty in 2014; the second delay exempts all employers with 50 to 99 workers from the employer mandate penalty in 2015.

Health Insurance Exchanges. State-based health insurance exchanges (or marketplaces) are established where the unemployed, the self-employed, and workers who are not covered by ESHI can purchase insurance. Importantly, the premiums for individuals who purchase their insurance from the insurance exchanges will be based on the average health expenditure of those in the exchange risk pool, i.e., *community rated*, and insurance companies can not deny or price health insurance based on the enrollees' pre-existing conditions. This is in stark contrast to the private individual health insurance market prior to the ACA where all health insurances were individually rated, and insurance companies could deny coverage based on pre-existing conditions. Thus, even though Figure 1 indicates that overall the fraction of the U.S. population with individual health insurance only increased by 0.5 percentage point from 1009 to 2019, it belies the drastic changes that occurred in the individual market after the ACA.

States that opt not to establish their own exchanges will be pooled in a federal health insurance exchange. Insurance companies that want to participate in an exchange need to meet a series of statutory requirements in order for their plans to be designated as "qualified health plans."

Medicaid Expansion. All adults in households with income under 138% of Federal poverty line (FPL) are eligible for receiving Medicaid coverage with no cost sharing. This represented a significant expansion of the pre-ACA Medicaid system because prior to ACA many States' Medicaid covered adults with children only if their income was considerably lower, and did not cover childless adults at all. However, the U.S. Supreme Court ruled on June 28, 2012 that the law's provision that, if a State does not comply with the ACA's new Medicaid expansion requirements, it may lose not only the federal funding for those requirements, but all of its federal Medicaid funds, is unconstitutional. This ruling allows states to opt out of ACA's Medicaid expansion, leaving each state's decision to participate in the hands of governors and state leaders. Most states, including all the Democratic leaning states (including the District of Columbia) and some Republican leaning ones, expanded their Medicaid coverage.[7]

Premium Subsidies in the Health Insurance Exchange. For individuals and families whose income is between the 138 percent and 400 percent of the FPL, subsidies are provided toward the purchase of health insurance from the exchanges, provided that they do not have access to employer-sponsored health insurance from their own or their spouses' employer.[8] Whether individuals in states that do not establish

[7] See `http://kff.org/health-reform` for an updated list of states that expanded the Medicaid coverage.

[8] In addition to the premium subsidies, households with income below 250% of the FPL also receive so-called cost-sharing reduction (CSR) subsidies if they enroll in a silver plan. The CSR subsidies allow the eligible households to have a lower copay, coinsurance, deductible, and out-of-pocket maximum. We abstract away from this part of the subsidy. The Trump

their own exchanges who purchase insurance from the federal health insurance exchange can receive the premium subsidies was challenged in the U.S. Supreme Court case *King v. Burwell*. The Supreme Court ruled to allow all subsidies, regardless of whether the insurance was purchased from the State or the Federal health insurance exchange, on June 25, 2015 on a 6-3 decision.

The ACA has faced significant political and legal challenges ever since its enactment. Some of the policy proposals have considered to repeal and replace the ACA, such as the American Health Care Act (2017), which passed in the House of Representatives but did not pass in the Senate by a single vote. There are also other smaller-scale policy changes, which modify a part of the ACA. An example is the eventually successful repeal of the individual mandate in the Tax Cuts and Jobs Act of 2017, which spurs active policy debates on its long-run consequence; another example is the attempt to reduce subsidies to health insurance premiums.

3 Macroeconomics: A Prototypical Stylized Framework

In this paper we focus on the literature that uses structural, micro-founded models to analyze the short-run, and predict the long-run impact of the ACA reforms.[9] For a massive reform such as the ACA, one would not expect the long-run effects of the policy reform to materialize empirically by the time of this writing, and structural modeling can provide a useful tool to make predictions about the long run. In addition, it can be used to evaluate policy alternatives that were not taken, and it allows to introduce the different components of the ACA into the model separately, in order to decompose the overall effect of the reform into its different provisions. This decomposition analysis would be very hard to do with purely empirical tools, since in the data the different aspects of the reform were announced, and to some degree, implemented at the same time. Finally, once one takes a stance on the objective function of households and policy makers, a normative model-based analysis of the ACA becomes feasible.

As discussed above, the main objective of the ACA was the reduction in the share of the population without health insurance. In the U.S. individuals obtain health insurance though their employer, through individual private insurance, and through tax-financed public insurance via Medicaid and Medicare. In addition, a significant share of the population does not have health insurance coverage. The key provisions of the ACA reformed the private health insurance markets and expanded access to publicly provided insurance, while keeping the employer-sponsored market largely unchanged.[10] Therefore a model that seeks to capture the economy-wide consequences of the ACA requires, in our view, the following elements. First, it allows health insurance choices, and permits all four options (individual-private, public, employer-based, remaining uninsured). Modelling health insurance includes spelling out the health risks individuals

Administration terminated the CSR payments to insurers in October 2017, however. See Zhang (2021) for a study on the market response to the termination of the CSR.

[9] See, e.g. Baicker and Sommers (2020) for a summary of the empirical literature investigating the short-run impact of the ACA on health insurance coverage, accessibility to health services and health outcomes.

[10] Orzag and Rekhi (2020) discuss why the ACA maintained the current mixed system of private (individual and group) and public (Medicare and Medicaid) insurance rather than move to a single payer system. Analyses of universal health care systems and their reform using quantitative life cycle models are performed, e.g., by Hsu and Lee (2013), Ozkan (2017) and Fehr and Feldman (2021).

face, and the impact that expenditures on health have on the evolution on health. Second, since the ACA expanded access to publicly financed insurance, a macroeconomic analysis needs to capture the impact on taxes induced by the reform, that is, it needs to include an (intertemporal) government budget constraint. Third, since the ACA reformed the private health insurance market, the environment needs to include at least a rudimentary model for the private supply of health insurance.

Finally, even though the ACA left employer-sponsored health insurance largely unchanged, a model of the entire economy also needs to capture, at least in reduced form, the fact that approximately half of the population in 2009 obtained insurance through their employer (or the employer of a family member), see Figure 1. In this section we treat employer health insurance as exogenous; we think of this as a plausible assumption at least for the short-run. In the medium run, the ACA is likely to have an impact on the ways employers compete for workers through benefit provision, and thus on the operation of the labor market, the focus of Section 4. Therefore, in this section we adopt a frictionless, competitive labor market where individual wages equal individual labor productivities, whereas the next section explicitly spells out model(s) with labor market frictions, and employer-employee interactions.

3.1 The Environment

We now spell out a prototypical macroeconomic model with a health sector in which heterogeneous individuals make health insurance choices, and in which a government supplies a public option to a subset of the population which it finances through taxes. To focus on the main qualitative mechanisms we first restrict attention to a two-period life cycle model, prior to reviewing quantitative results from the literature derived from multi-period extensions of this model.

Individuals are born as one of several types $s \in S$ with population distribution $\Psi(s)$, where types are distinguished by their earnings potential, their initial health and health risks, as well as their initial assets.[11] They live for two periods, and we denote by $y$oung individuals and by $o$lder individuals. Households face idiosyncratic income risk and health risk in the second working period of their life.[12] The income shock ε is distributed according to $G(\varepsilon; s)$ and the health shock η is distributed according to $H(\eta; s)$. Thus an individual's type s can influence the distribution of both idiosyncratic shocks.

Individuals have preferences over consumption c^y and labor supply l when young and consumption c^o and health h when old, given by

$$u(c^y, l) + \beta v(c^o, h) \tag{1}$$

The dependence of second period utility on health also captures, in a reduced form, the impact of health around retirement on remaining life expectancy and thus the value of life, as in Hall and Jones (2007). Individuals maximize expected lifetime utility (where expectations are taken with respect to the idiosyncratic income and health shocks). Note that the second period of life is not meant to capture retirement,

[11] Empirically, a type may be defined by educational attainment, initial health status and other characteristics relevant for the evolution and distribution of earnings and health over the reminder of the life cycle. We assume that s is observable.

[12] In this way we subsume all heterogeneity in young age in s, while retaining a precautionary savings motive for individuals. We do not explicitly model the retirement stage, but individuals will value good health in old(er) ages.

but rather working age in the prime earning years.[13]

In the first period of their lives individuals make a standard consumption-saving choice, a labor supply choice, and a health insurance choice. In the second period, conditional on the realization of the shocks and their health insurance status, they decide how much of their income to allocate to the purchases of health goods m, and how much to other consumption goods. Labor productivity when young is given by $z^y(s)$, and labor income when old $z^o(s, \varepsilon, h)$ is affected by the idiosyncratic income shock ε and health status h. Health in the second period is a function of the health shock η and depends on medical expenditures as well as household type, which captures aspects such as acquired or genetic differences in initial health:

$$h = f(s, m, \eta) \tag{2}$$

Individuals can choose between four options for health insurance, $i \in \{no, pr, gr, me\}$ where $i = no$ indicates that the individual remains uninsured, $i = pr$ represents private individual health insurance coverage, $i = gr$ stands for employer-sponsored group health insurance and $i = me$ indicates coverage through Medicaid. The health insurance premium for choice i is given by $\phi(s, i)$ (where $\phi(s, no) = \phi(s, me) = 0$), and the out-of-pocket expenditures associated with health expenditures m for an individual with health insurance choice i is determined by the function $\kappa(m, i; \eta, \varepsilon, p)$, where p is the price of health goods, relative to the consumption good. We will mostly use the form $\kappa(m, i; \eta, \varepsilon, p) = \gamma(i)pm$, in which case out-of pocket expenditures of an individual with health insurance i is a fraction $\gamma(i)$ of every dollar spent on health.

The health insurance choice is further constrained by the institutional features in the health insurance system. Whereas any individual can choose to remain uninsured or obtain private insurance (if she can afford the premium), Medicaid coverage is only available to individuals with income below a threshold $\bar{y}^{me}$. On the other hand, in order to qualify for employer-sponsored health insurance we assume that individuals have to work a minimal amount $\underline{l}$ of hours and have to work in sectors of the economy that offer health insurance benefits. In this section we approximate this feature by assuming that only types $s \in S^{gr} \subset S$ qualify for employer-sponsored health insurance; recall that type s, among other things, captures education and thus is related to the type of occupations and sectors an individual is qualified work in.

The government affects private choices by taxing labor income according to a differentiable function $T(.)$, by providing tax-financed public health insurance through Medicaid for eligible individuals, as well as by subsidizing and regulating the private and employer-sponsored health insurance market, as outlined below. We first describe the household decision problem prior to the ACA, and then discuss how the ACA impacts that decision problem and the associated aggregation across households. When discussing the normative properties of policy reforms, we will often assume that the government aggregates expected

[13] A large literature studies the importance of health expenditures, health status and health insurance reform in old age –and Medicare specifically– on private saving and retirement behavior as well as public finances. A subset of this literature is concerned with the impact of population aging on the need for health care reform. See French (2005), Attanasio and Violante (2010), De Nardi *et al.* (2010), French and Jones (2011), Galama *et al.* (2013), Hansen *et al.* (2014), Zhao (2014), Jones and Li (2018), Jung and Tran (2017), Braun and Koreshkova (2017) and Conesa *et al.* (2018). Here our focus is more narrowly on the ACA, which primarily reformed the health insurance market for individuals of working age.

lifetime utility $V(s)$ of the different types s according to a social welfare function of the form:

$$W = \int \Gamma(V(s))d\Psi(s) \tag{3}$$

where $\Gamma(.)$ is a concave function that captures the degree of inequality aversion in society. If Γ is linear, then the government has a Utilitarian social welfare function. If Γ only values the type with the lowest lifetime utility, then this corresponds to a Rawlsian social welfare criterion. Note that we can alternatively interpret (3) as ex ante expected utility of an individual, prior to her type s being realized. Finally, when quantifying the welfare impact of a policy reform such as the ACA for a specific type s we will often report consumption equivalent variation, the percentage increase in consumption in all periods of an individual's life in the no-reform scenario that makes this type indifferent to living under the reform scenario.

3.2 Household Maximization

We can now state the household maximization problem

$$\begin{aligned}
V(s) &= \max_{c^y,l,a',c^o,h,m\geq 0,i} u(c^y,l) + \beta E_{\varepsilon,\eta} v(c^o,h) \qquad s.t. && (4)\\
c^y + a' + \phi(s,i)i &\leq z^y(s)l + (1+r)a(s) - T(z^y(s)l - \phi(gr)\mathbf{1}_{i=gr}) && (5)\\
c^o + \kappa(m,i;\eta,\varepsilon,p) &= z^o(s,\varepsilon,h) + (1+r)a' && (6)\\
h &= f(s,m,\eta) && (7)\\
i &\in I(l,s)\\
m &\in M(\eta)
\end{aligned}$$

Here r is the risk-free interest rate. The set $I(l,s)$ captures the constraints imposed on health insurance choices: the type of an individual s and her labor supply l determine her income $y = z^y(s)l + r \times a(s)$ and thus her Medicaid eligibility as well as the availability of employer-sponsored health insurance. The last constraint restricts the choices for medical spending; depending on the model one might want to require that a life-threatening emergency must be treated. Alternatively, if for each η the set $M(\eta)$ is a singleton, then medical expenditures are stochastic but exogenous, and so is the stochastic evolution of health h.

For group health insurance through the employer, we note that the premium paid by the employee is tax-deductible, and that there is premium pooling, and thus $\phi(s,gr) = \phi(gr)$ for all types $s \in S^{gr}$. In practice, employers cover a fraction of the health insurance premium, but with perfect competition among firms they will have to lower wages correspondingly to break even; therefore we here assume that employees directly pay the entire premium rather than do so indirectly through lower wages.

Households pay taxes on labor income $z^y(s)l$ net of the premium for employer-sponsored health insurance; for ease of exposition we assume here that capital income is not taxed.[14]

[14]This assumption delivers sharper analytical results in Section 3.6.1 but is relaxed in the studies discussed in Section 3.7.

3.3 Health Insurance Companies

Insurance companies observe the type s of an individual and, prior to the implementation of the ACA, can charge type-specific insurance premia $\phi(s;pr)$. Perfect competition implies that insurance companies make zero expected profits from the insurance contract offered to a given type s, which implies the following relationship between the health insurance premium, the optimally chosen health expenditure policy function of the household $m(.)$ and the out-of-pocket expenditure function stipulated by the contract, $\kappa(.)$:

$$\phi(s;pr) = (1+r)^{-1} \int_{\varepsilon}\int_{\eta} [pm(s,\varepsilon,\eta) - \kappa(m,i;\eta,\varepsilon,p)]\, dG(\varepsilon;s)dH(\eta;s) \tag{8}$$

In group health insurance markets, government regulation requires that neither the premium nor the out-of-pocket expenditure requirements can depend on household type. Furthermore, no type can be denied coverage. Individuals of course have the choice not to take up the offered group health insurance. The competitively provided group health insurance contract then has to break even in expectation over household types that are being offered and decide to accept group health insurance. The zero profit condition then becomes

$$\phi(gr) = \frac{\int_{s\in S^{gr}}\int_{\varepsilon}\int_{\eta} [pm(s,\varepsilon,\eta) - \kappa(m,i;\eta,\varepsilon,p)]\, \mathbf{1}_{i=gr}(s) dG(\varepsilon;s)dH(\eta;s)d\Psi(s)}{(1+r)\int_{s\in S^{gr}} \mathbf{1}_{i=gr}(s)d\Psi(s)} \tag{9}$$

The set S^{gr} captures the fact that only a certain share of the population is offered employer-sponsored health insurance. The indicator function $\mathbf{1}_{i=gr}(s)$ enters this zero profit condition because only a subset of the population that is offered this insurance takes it, despite its associated tax subsidy. This is especially true for healthy types (those with a favorable health shock distribution) who subsidize less healthy types.[15]

3.4 The Government Budget Constraint

The government collects income taxes from households and uses them to pay for exogenous government spending as well as health care expenses net of possible co-pays for those covered by Medicaid. Thus the government budget constraint reads as

$$\begin{aligned} G &+ (1+r)^{-1}\int_s\int_{\varepsilon}\int_{\eta} [pm(s,\varepsilon,\eta) - \kappa(m,i(me);\eta,\varepsilon,p)]\, \mathbf{1}_{i=me}(s)dG(\varepsilon;s)dH(\eta;s)d\Psi(s) \\ &= \int_s T(z^y(s)l(s) - \phi(s,gr)\mathbf{1}_{i=gr}(s))d\Psi(s) \end{aligned} \tag{10}$$

where G is the present discounted value of government spending. Note that the co-pay function κ can differ between private, group and public insurance (since it is indexed by i).

[15] Since there is no within-type heterogeneity in the first period of life, either all members or none of a given type obtain group health insurance. In order to avoid this arguably extreme outcome much of the literature has modeled stochastic access to group-health insurance and/or preference shocks over health, health expenditures or insurance directly to generate heterogeneity of take-up within household types.

3.5 Aggregation and Equilibrium

Households take prices as given when solving their maximization problem. In this paper we will treat the interest rate r and wages, as well as the relative price p of health goods as exogenous parameters. The typical approach to endogenizing aggregate wages and interest rates in a stationary general equilibrium is to posit an aggregate constant returns to scale production function

$$Y = AF(K, L), \tag{11}$$

operated a representative firm, as in Aiyagari (1994) and many other quantitative macro papers with household heterogeneity. With competitive labor and asset markets the equilibrium interest rate r and wage rate w per labor efficiency units are given by the standard first order conditions

$$w = AF_L(K, L) \tag{12}$$

$$r = AF_K(K, L) - \delta \tag{13}$$

where δ is the capital depreciation rate. The labor market clearing conditions would then equate aggregate labor demand L to the integral over idiosyncratic labor productivity times labor supply of the young, $z^y(s)l(s)$, plus inelastic labor supply of the old, $z^{o,\varepsilon,h}(s)$, integrated over types s and shocks. The capital market clearing condition would equate the capital demand K to aggregated asset holdings across all households. Note that one can always choose the productivity parameter A such that wages in a stationary equilibrium equal to 1, as the household problem above already assumed.

To endogenize the relative price of health goods requires to specify a production function for health goods. The most straightforward approach is to assume a linear (in labor) production technology with productivity parameter A_h, in which case the equilibrium price for health goods is then given by $p = \frac{1}{A_h}$.

3.6 Optimal Choices and Mechanisms

In order to characterize the main impacts of health insurance reform on household behavior we now characterize optimal individual choices. The optimal choice variables in the first period are functions of s and thus $c^y(s), l(s), a'(s), i(s)$. The second period choices also depend on the realization of both the income and the health shocks, i.e. $c^o(s, \varepsilon, \eta), h(s, \varepsilon, \eta), m(s, \varepsilon, \eta)$. We assume that suitable Inada conditions are in place such that the optimal consumption choices are always interior. On the other hand, we permit the nonnegativity constraints on assets a', hours l and medical spending m to potentially be binding.

We will first describe the optimal consumption, labor and health allocation choices conditional on a given health insurance choice and then discuss the optimal health insurance choice and how it interacts with the other household choices. Note that if the choice set for health insurance $I(l, s)$ is independent of labor supply, then the household decision problem can indeed be solved in two stages, where in a first stage optimal allocations of labor, assets, consumption and health spending are determined as a function of health insurance choice i, and in a second step the optimal health insurance choice is chosen among one of the four alternatives. If the set $I(l, s)$ depends on labor supply (because the availability of employer-sponsored health insurance or the eligibility for Medicaid does), then it should be kept in mind that the fully optimal household choices have to be determined jointly.

Combining the first order conditions gives rise to three key optimality conditions. The standard intratemporal optimality condition reads as

$$-\frac{u_l(c^y(s),l(s))}{u_c(c^y(s),l(s))} \geq z^y(s)\left[1 - T'(z^y(s)l - \phi(gr)\mathbf{1}_{i=gr}(s))\right] \tag{14}$$

with equality if $l(s) > 0$. The intertemporal Euler condition is also standard and takes the form

$$u_c(c^y(s),l(s)) \geq (1+r)\beta \int\int v_c(c^o(s,\varepsilon,\eta),h(s,\varepsilon,\eta))dG(\varepsilon;s)dH(\eta;s) \tag{15}$$

with equality if $a'(s) > 0$. Finally, the optimality condition governing medical expenditures reads as

$$\kappa_m(m(s,\varepsilon,\eta),i;\eta,\varepsilon,p) \geq f_m(s,m,\eta)\left[z_h^o(s,\varepsilon,h) + \frac{v_h(c^o(s,\varepsilon,\eta),h(s,\varepsilon,\eta))}{v_c(c^o(s,\varepsilon,\eta),h(s,\varepsilon,\eta))}\right] \tag{16}$$

with equality if $m > 0$. This last equation equates the out-of-pocket cost of a marginal dollar spent on health goods κ_m to the marginal benefit. The marginal benefit is the marginal impact $f_m(s,m,\eta)$ of spending m on health h, times the impact of better health on earnings $z_h^o(s,\varepsilon,h)$ plus the impact of better health on utility $v_h(c^o,h)$, translated from utils to resource units by the marginal utility of wealth $v_c(c^o,h)$. The marginal utility of health in this simple model approximates both the direct impact of health on well-being as well as a potentially longer lifetime due to better health. If the marginal cost at zero spending exceeds the marginal benefits in state (ε,η) of the world, optimal health spending is zero in that state.

In general the optimal choices are jointly characterized by these three optimality conditions and the three constraints (budget constraints (5) and (6) and the health equation (7)), and are jointly determined with the optimal health insurance choice. This typically requires numerical solutions, especially in multi-period extensions of these types of models. We now briefly discuss some analytical insights and then turn to results from the quantitative literature on ACA reform.

3.6.1 Optimal Labor Supply

For the purpose of this subsection, assume that the first-period utility function is of the Greenwood *et al.* (1988) variety which assumes away income effects on labor supply, and also assume that the tax function obeys the functional form proposed by Benabou (2002) and Heathcote *et al.* (2014).

Assumption 1 *Assume that the first period utility function is given by*

$$u(c^y,l) = \log\left(c - \varphi\frac{l^{1+\frac{1}{\chi}}}{1+\frac{1}{\chi}}\right) \tag{17}$$

where the preference parameter $\chi \geq 0$ measures the Frisch labor supply elasticity. Assume that the disutility *parameter satisfies* $\varphi = 1$ *and that the tax schedule is given by*

$$T(y) = y - \theta_0 y^{1-\theta_1} \tag{18}$$

The tax policy parameters (θ_0, θ_1) capture, respectively, the level and the progressivity of the income tax system. With this tax system after tax income is a strictly concave function $\theta_0 y^{1-\theta_1}$ of taxable income y, under the restriction that $\theta_1 \in (0, 1)$. The larger is θ_0, the larger is the share of pre-tax income an individual gets to keep; we can interpret $1 - \theta_0$ as a measure of the level of tax rates. The larger is θ_1 the more progressive is the tax function; $\theta_1 = 0$ represents a proportional tax system.

With these assumptions the optimality condition becomes

$$l^{\frac{1}{\chi}} = z^y(s)(1 - \theta_1)\theta_0 \left[(z^y(s)l - \phi(gr)\mathbf{1}_{i=gr}(s))\right]^{-\theta_1}. \tag{19}$$

Suppose first that the individual does not have access to employer-sponsored health insurance (or does not find it optimal to enroll in it if offered). Then optimal labor supply is given by

$$l(s) = \left[(1 - \theta_1)\theta_0\right]^{\frac{1}{\frac{1}{\chi}+\theta_1}} \left[z^y(s)\right]^{\frac{1-\theta_1}{\frac{1}{\chi}+\theta_1}}. \tag{20}$$

We observe that hours are strictly increasing in labor productivity $z^y(s)$ and thus individual wages, as well as strictly decreasing in the level of taxes $1 - \theta_0$, the more so the more elastic is labor supply (i.e. the larger is χ). A more progressive tax system (a larger θ_1) reduces the hours dispersion across productivity types.

Turning to the impact of health insurance and its reform through the ACA, one readily sees from equation (20) that if an expansion of tax-financed Medicaid leads to higher average tax rate (a reduction in θ_0) to balance the government intertemporal budget, then this leads to a decline in labor supply, an effect that again is the stronger the larger is χ. Of course, if preferences exhibit income effects on labor supply, this effect is correspondingly weaker (and might be overturned if these income effects are sufficiently strong). For those that have access to and choose to take up employer-provided health insurance labor ($\mathbf{1}_{i=gr}(s) = 1$), although labor supply cannot be solved in closed form, the impact of a reduction in θ_0 on labor supply is qualitatively similar to the case without. In addition, as equation (19) shows, the tax deductibility of the premium reduces the marginal tax rate on labor income with a progressive tax system ($\theta_1 > 0$) and thus increases labor supply.

Thus far we have ignored the impact the labor supply choice might have on the set $I(s, l)$ of feasible health insurance choices, and we have ignored the possibility of an operative extensive margin. As long as the marginal disutility of labor at zero hours is zero (as it is with preferences given in Assumption 1) and marginal tax rates are less than one (as in the tax function from Assumption 1), households optimally choose to work positive hours. However, if the income tax function were to include means-tested income transfers, or if the utility function incorporates income effects on labor supply, this need not be guaranteed.

More relevantly for the purpose of this paper, since individuals are only eligible for Medicaid if $z^y(s)l + ra(s) \leq \bar{y}^{me}$, household types with productivity $z^y(s)$ and assets $a(s)$ that absent the Medicaid means-test would choose optimal labor supply (characterized by the optimality condition above) such that income exceeds $\bar{y}^{me}$ might find it optimal to lower hours to reduce income below the threshold. Depending on the level of assets $a(s)$ this might entail not participating at all. Furthermore, an expansion of Medicaid eligibility by increasing the income threshold $\bar{y}^{me}$ will potentially lead to a reduction of hours of those with incomes originally close to, but above the new threshold, but also a potential increase in labor supply of those with optimally chosen incomes just below the old Medicaid threshold.

Finally, types that work in occupations offering employer-sponsored health insurance ($s \in S^{gr}$) might find it optimal to supply $l(s) = \underline{l}$ hours to gain access to a job with tax-favored and health risk-pooled (across s types) group health insurance when in the absence of such insurance opportunities (or for types $s \notin S^{gr}$) optimal labor supply given by equation (20) satisfies $l(s) < \underline{l}$. See e.g. Chivers *et al.* (2017) and Feng and Zhao (2018) for the impact of employment-based health insurance on macroeconomic outcomes.

3.6.2 Optimal Intertemporal Consumption and Saving

The intertemporal optimality condition (15) governing consumption-saving choices is standard in models with idiosyncratic income- and thus consumption risk, and gives rise to a precautionary saving motive as long as the utility function exhibits prudence (has a positive third derivative).[16] However, as the right hand side of equation (15) clarifies, the extent of precautionary saving will be affected by the extra source of risk, health risk η in addition to income risk ε. To make this most transparent, let us make the following

Assumption 2 *Assume that the first period utility function is given by*

$$u(c^y, l) = \log(c^y) \tag{21}$$

(i.e. $\varphi = 0$ in Assumption 1) and assume that the time endowment constrains labor supply to $l \leq 1$. Furthermore assume that

$$v(c^o, h) = \log(c^o) + \nu(h) \tag{22}$$

where $\nu(.)$ is an increasing function of health. Finally, assume that $M(\eta) = \{\eta\}$, that is, an individual receiving a health shock η must spend $m = \eta$ on health goods, and that

$$\kappa(m, i(me); \eta, \varepsilon, p) = \gamma(i)pm. \tag{23}$$

Effectively, these assumptions make health shocks into exogenous health expenditure shocks, a share $1 - \gamma^i$ of which is covered by health insurance of type i. This assumption is made, in some variants, in a large literature that integrates health spending risk into quantitative life cycle and macro models with idiosyncratic risk. Using the budget constraints (and plugging in the health equation) yields the optimality

[16] In multi-period extensions of the model potentially binding future borrowing constraints might also induce precautionary saving behavior, even when the utility function is quadratic and thus has zero third derivative, see Deaton (1992).

condition (for now ignoring the non-negativity constraint):

$$1 = (1+r)\beta \int\int \frac{z^y(s)l + (1+r)a(s) - T(z^y(s)l - \phi(gr)\mathbf{1}_{i=gr}) - \phi(s,i)i - a'}{z^o(s,\varepsilon,f(s,\eta,\eta)) - \gamma^i p\eta + (1+r)a'} dG(\varepsilon;s)dH(\eta;s) \tag{24}$$

The optimal savings choice is the solution $a' = a'(s)$ to this nonlinear equation. Idiosyncratic consumption risk emanates from the risk in income net of health expenditures, $yn(\varepsilon,\eta) = z^o(s,\varepsilon,f(s,\eta,\eta)) - \gamma(i)p\eta$, and the extent of precautionary saving is determined by total income risk, which in turn stems from both labor income risk and health expenditure risk.[17] Thus, under these assumptions the standard theory of idiosyncratic income risk goes through completely unchanged, with health expenditure risk simply being an additional source of net income risk, whose magnitude is partially controlled by health insurance contracts and choices (summarized by $(\phi(s,i),\gamma(i))$).

A reduction of the number of uninsured through the reforms of the ACA, either though the expansion of Medicaid eligibility or incentivizing the purchase of private health insurance, ceteris paribus, reduces net income risk for a subset of the population, therefore lowering aggregate precautionary saving. If private asset accumulation is tied to the rate of return r in general equilibrium as spelled out in section 3.5, then, other things equal, the reduction in precautionary savings leads to a lower long-run capital stock and aggregate wages as well as a higher interest rate.

3.6.3 Optimal Medical Spending and Health

When health expenditures are endogenous, the distribution of net income risk is endogenous as well and potentially interacts with the cross-sectional distribution of health (if its evolution is endogenous) and thus earnings, and therefore the impact of health insurance (reform) on private saving, capital accumulation and factor prices is more complex. We now study the optimal allocation of health expenditures in our stylized model.

Assumption 3 *Assume that the out-of pocket expenditure requirement is the same as in Assumption 2, i.e. $\kappa(m,i(me);\eta,\varepsilon,p) = \gamma(i)pm$, and that the health production function is given by*

$$h = f(s,m,\eta) = \bar{h}(s) + m - \eta \tag{25}$$

and that labor productivity (income) in the second period is determined as

$$z^o(s,\varepsilon,h) = \gamma^o(s)h^\alpha + \varepsilon \tag{26}$$

Finally, assume that $v(c^o,h) = \log(c^o)$, that is, health does not directly affect utility/longevity, and impacts labor productivity/income in the second period in a concave fashion, with $\alpha \in [0,1]$, and with type-specific productivity factor $\gamma^o(s)$.

[17] This discussion abstracts from health shocks of a size that do not permit positive consumption, and thus require the household to default on health expenditure bills. The household finance literature studying personal bankruptcy decisions has pointed to medical bills as a major driver of household personal bankruptcy decisions, see e.g. Chatterjee *et al.* (2007).

Under this assumption the health expenditure optimality condition reads as

$$\gamma(i)p \geq \alpha\gamma^{o}(s)[\bar{h}(s) + m - \eta]^{\alpha-1} \tag{27}$$

with equality if $m > 0$. A social planner that can freely reallocate consumption across individuals equates the cost of spending one unit of resources on health, p, to the marginal societal benefit in the form of more production, $\alpha\gamma^{o}(s)[\bar{h}(s) + m - \eta]^{\alpha-1}$. Thus the socially efficient level of health expenditures is given by

$$m^{SP}(s,\eta) = \max\left\{0, \eta - \bar{h}(s) + \left(\frac{\alpha\gamma^{o}(s)}{p}\right)^{\frac{1}{1-\alpha}}\right\} \tag{28}$$

Health spending is increasing in the health shock η and in the health impact on labor productivity $\gamma^{o}(s)$, and decreasing in the initial health condition and the relative price of health goods p. If the former is low or the latter high, it is inefficient to spend anything on health care in the current period, and $m^{SP}(s,\eta) = 0$. In contrast, for an individual with health insurance i and thus co-pay requirement $\gamma(i)$ it is optimal to spend

$$m(s,\eta) = \max\left\{0, \eta - \bar{h}(s) + \left(\frac{\alpha\gamma^{o}(s)}{\gamma(i)p}\right)^{\frac{1}{1-\alpha}}\right\} \tag{29}$$

Comparing the optimal household choice with the socially efficient health expenditure allocation, as long as the individual has health insurance with less than a 100% co-pay ($\gamma(i) < 1$), she will overspend on health: $m(s,\eta) \geq m^{SP}(s,\eta)$, with strict inequality if $m^{SP}(s,\eta) > 0$.[18] This result is the well-known moral hazard problem in health spending in the presence of health insurance: since the individual only internalizes the part $\gamma(i)$ of the social resource cost of her health spending, the consumption of health goods is suboptimally high in the competitive equilibrium, relative to the fully efficient level. To the extent that the ACA expands health insurance coverage to previously uninsured individuals, or leads to more generous coverage ($\gamma(me)$ or $\gamma(pr)$ fall), this moral hazard problem might be exacerbated in the aggregate, leading to larger (and potentially suboptimally large) medical spending.

Note, however, that this argument relies on the comparison of the equilibrium allocation with an unconstrained planner that can costlessly transfer resources across households and thus insure household consumption against the η shocks. In the absence of such direct consumption insurance medical spending offsets part of the idiosyncratic health and thus consumption risk, especially if binding borrowing constraints prevent the adjustment of privately financed health expenditures. These insurance benefits are strengthened by direct utility benefits from better health, i.e. when $v_h(c^{o}, h) > 0$.

Furthermore, since individual health and thus the future population health distribution is endogenous in this class of models, individual health spending might positively affect the aggregate labor income tax base and reduces public spending on health, a fiscal externality individuals do not take into account. By the same argument, if wages and interest rates are endogenously determined in general equilibrium, endogenous health expenditures, by changing future aggregate labor supply, carries a pecuniary externality

[18] Both spending levels might be zero, or the individual might find it optimal to have positive health care expenditures when the socially optimal level is zero.

and thus medical spending might be inefficiently high or low in competitive equilibrium.[19] Positive health externalities in aggregate production (as in Lucas (1988) for general human capital) of course further strengthen the normative argument for an expansion of health expenditures encouraged by wider insurance coverage in the population.

3.6.4 Optimal Health Insurance Choice

Finally, households choose between the four health insurance options, $i \in \{no, pr, gr, me\}$. The principal objective of the ACA was to increase health insurance coverage within the population, that is, move individuals from $i = no$ to $i \in \{pr, gr, me\}$. From the perspective of the model outlined thus far reducing the number of uninsured is of course not the ultimate goal per se; rather, the government seeks to maximize the social welfare function (3) when choosing how to reform health care.

The focus of the current model is on the choices $i \in \{pr, me\}$ versus $i = no$. An individual eligible for Medicaid will never find it optimal to remain uninsured (but might find it optimal to choose private insurance if the latter provides more generous coverage). One main question then is how the change in the regulation of the private health insurance market (enforcing premium pooling $\phi(s; pr) = \phi(pr)$ to provide social insurance against being born a bad (health) type s and encouraging participation through subsidies and penalties) impacts private insurance choice. Since good health types will potentially face higher premia $\phi^{ACA}(pr) > \phi(s; pr)$, even accounting for subsidies and penalties, they might opt to remain uninsured (or adjust labor supply to become eligible for Medicaid), worsening the private insurance pool and increasing $\phi^{ACA}(pr)$. This in turn might induce further types to leave the private insurance market. Quantifying the magnitude and welfare impact of this potential adverse selection spiral is an important component of the quantitative literature evaluating the ACA discussed below.

3.7 Modeling the ACA Reform(s)

The key provisions of the ACA were discussed in Section 2. The model in this section is not suitable for analyzing the employer mandate since it has no meaningful model of firms. We pick up this issue in Section 4. Furthermore, an analysis of the expansion of dependent coverage requires a model with different generations of the same family interacting, and is therefore beyond the scope of this section as well.

Of the remaining provisions, these can broadly be divided into items that enhance redistribution towards lower income individuals and families, and provisions that regulate the individual health insurance market. Within the context of the model, these provisions can be introduced as follows:[20]

1. New regulation of the individual health insurance market

   (a) Community rating: The private health insurance premium is now pooled across all household types choosing to sign up for private insurance. That is, $\phi(s, pr) = \phi(pr)$. In equilibrium, this

[19] See Davila *et al.* (2012) or Krueger *et al.* (2021) for an analysis of optimal tax policy in the presence of such fiscal and pecuniary externalities.

[20] We fully acknowledge that the institutional details of the implementation of the ACA are more complex than represented in this necessarily stylized model.

premium is determined by an equation similar to (9), where the integration is over all household types choosing private (as opposed to group-) health insurance.[21]

(b) Individual mandate and penalties: Individuals that choose $i = no$ and remain uninsured now pay a premium $\phi(y(s), no) > 0$ (since the penalty depends on income $y(s) = z^y(s)l(s) + ra(s)$, something the individual takes into account when making labor supply decisions), instead of facing no cost of remaining uninsured, $\phi(s, no) = 0$. Revenues from penalties paid in equilibrium enter the government budget constraint (10).

2. Increased redistribution towards lower income individuals

   (a) Medicaid Expansion: The threshold $\bar{y}^{me}$ for income $y(s) = z^y(s)l(s) + ra(s)$ below which individuals are eligible for Medicaid increases to $\bar{y}^{me\prime}$.

   (b) Premium Subsides for Private Health Insurance: In the same way as with penalties from the individual mandate, premium subsidies are introduced by making the premium for private insurance income dependent, $\phi(y(s), pr) \leq \phi(s, pr)$, where $\phi(s, pr)$ is given by equation (8).

3.7.1 The ACA in a Model with Exogenous Health Expenditures

The first generation of heterogeneous agent macro models used to predict and quantitatively evaluate the positive and normative consequences of the main provisions of the ACA model health expenditures as exogenous idiosyncratic shocks, very much in the same way a large literature in macroeconomics and life cycle consumption studies following Bewley (1986), Imrohoruglu (1989), Huggett (1993) and Aiyagari (1994) had previously modeled idiosyncratic labor income shocks or labor productivity shocks. Whereas the literature incorporating exogenous health shocks into quantitative macro models is by now quite sizeable, the set of papers that use this class of models to actually evaluate (parts of) the ACA is more limited.[22]

An important early contribution is Pashchenko and Porapakkarm (2013) who evaluate the impact of the key provisions of the ACA on the number of uninsured and on societal welfare. Their specific focus is on the question whether the increase in redistribution (through the Medicaid expansion and the subsidization of private health insurance premia) or the regulatory changes in the private health insurance market (the penalties associated with the individual mandate and the enforced community rating) is more important for these outcomes. They employ a model that is a multi-period extension of the one outlined thus far, and with a richer description of the public tax-transfer system. The key model input, the stochastic health expenditure process, is calibrated using data from the Medical Expenditure Panel Survey (MEPS), and then the model is subjected to the ACA reform, with the introduction of subsidies and penalties, the mandatory pooling of health insurance premia in the individual health insurance market as well as an increase of the Medicaid income eligibility threshold to 138% of the federal poverty level. As is common in the macroeconomic literature, the reform is assumed to be completely unexpected by the private sector

[21] In full life cycle models the private premium is also allowed to depend on age.

[22] Important papers in this genre that do not focus on health insurance reform include Palumbo (1999) and Capatina (2015), and contributions that study health insurance and its reform but do not focus on the ACA specifically include Jeske and Kitao (2009), Zhao (2017) and De Nardi *et al.* (2020).

(i.e. it is a so-called MIT shock), but expected to be permanent once implemented. Since private wealth (and private health as well as the aggregate capital stock, if these are endogenous) adjusts slowly over time in response to the reform, the economy undergoes a transition path from its pre-reform steady state to a final, post reform steady state. The positive consequences of the reform change over time, and for its normative implications the explicit consideration of the transitional welfare effects are important.

Table 1 displays the key long-run consequences of the reform, comparing the old (pre-ACA) and the new long-run post-ACA steady state. The first line shows that the aggregate share of the population that is working does not change much. This observation, however, masks very substantial heterogeneity in the labor supply response in the population: those types with relatively low earnings potential and vulnerable to bad health shocks (and thus valuing health insurance strongly) previously could only work little or not at all to qualify for Medicaid. The Medicaid expansion allows them to work without losing their eligibility. In contrast those types with higher earnings potential (in the paper proxied by college education) and strongly valuing health insurance (because their current health status captured by s signals large future health expenditures) previously had to work at least $\underline{l}$ to qualify for employer-sponsored health insurance. The expanded availability of Medicaid (or premium subsidies for private health insurance for lower income levels) induces these groups of households to work less, or not work at all. In fact, despite the fact that the ACA does not directly change the employer-sponsored health insurance market (besides introducing the employer mandate discussed in greater detail in Section 4), the changes in Medicaid and premium subsidies induces previously ESHI-insured individuals to select out of this market, primarily by changing their labor supply, as already discussed in Section 3.6.1. See the third row of Table 1.[23]

The table also shows the reduction in private asset accumulation (and thus the aggregate capital stock if the model is cast in general equilibrium) induced by the reduction in health expenditure risk associated with a reduction of the population that is uninsured, as we discussed analytically in Section 3.6.2.

Table 1: Comparing Pre- and Post-ACA Steady States

Variable	Pre-ACA	Post-ACA
Employment	89.7	89.1
Capital (Assets)/Output	3.00	2.92
Insured by ESHI (in %)	64.4	62.5
Individually Insured (in %)	7.3	18.5
Publicly Insured (in %)	8.6	10.1
Uninsured (in %)	19.7	8.9

Notes: The table shows selected steady state statistics. It is based on Table 4 in Pashchenko and Porapakkarm (2013). The paper focuses on household heads in working age, and shows that the initial model steady state accords well with health insurance rates in the MEPS data prior to the adoption of the ACA.

Turning to the predictions of the model with respect to health insurance coverage, we see that in the long run the ACA reform is successful in cutting the share of the uninsured population roughly in half (see the last row in Table 1). The table also shows that a significant share of the population remains uninsured.

[23] This partial crowding-out of private insurance by the expansion of Medicaid has been documented empirically for earlier Medicaid expansions by Cutler and Gruber (1996).

These are individuals with incomes that make them ineligible for Medicaid and premium subsidies, and their good health type (low expected future health expenditures) makes signing up for individual or group health insurance suboptimal at the pooled health insurance premium, despite the penalty they face for not adhering to the individual mandate. This share would of course rise in the model if the individual mandate and the penalties associated with them are removed. Finally, the table demonstrates that the model predicts that in the long run most of the reduction in the uninsured stems from the increased uptake of private insurance. Premium subsidies and the greater generosity of coverage makes especially older individuals prefer to sign up for private insurance rather than rely on Medicaid, even if they are eligible for the latter.[24]

One of the advantages of a structural, model-based approach is that it permits an explicit evaluation of the welfare consequences of the ACA reform, and of alternative policy reforms. Furthermore, it permits a decomposition of the welfare consequences into the separate provisions of the ACA, in order to determine which parts of the reform had the most beneficial impact. Table 2 shows, separately by individuals with low education (high-school drop-outs) and high education, the welfare gains from the ACA reform and its components, measured in terms of consumption equivalent variation. The key insights from the table are: (a) the overall welfare impact of the ACA reform is significantly positive at ca. 2/3 of one percent of permanent consumption; (b) increased redistribution, and the introduction of private insurance premium subsidies specifically, are primarily responsible for these gains, and they accrue primarily to household types with lower incomes and/or higher health risks (low education in the case of the paper); and (c) premium pooling and penalties for non-participation *alone* are, if anything, welfare reducing. This last finding stems from the fact that, at least in the context of the model, the penalties are not large enough to avoid a complete unraveling of the private health insurance market due to an adverse selection spiral.[25]

Table 2: Welfare Consequences of Different Versions of ACA Reforms [CEV in %]

Type of Reform	All	Low s	High s
Only Community Rating, Penalties	-0.11	-0.07	-0.12
Only Redistribution	0.50	1.36	0.35
Only Medicaid Expansion	-0.02	0.32	-0.08
Only Subsidies	0.43	1.19	0.29
Full Reform	0.64	1.43	0.51

Notes: Based on Table 7 in Pashchenko and Porapakkarm (2013) and shows average welfare gains of type s, and averages within types are taken over all individuals alive at the time of the reform. It therefore includes the impact of the transition.

Especially noteworthy of the results is the key role of the expansion of subsidies for the reduction of the share of uninsured and the welfare gain from the reform. Even after the Medicaid expansion many low-to-medium income individuals do not qualify for it, and if not offered ESHI the health insurance premium in the private market is too high for them to purchase insurance. In the model subsidies solve this affordability

[24]See Figure 6 of the paper. The magnitude of this finding is likely sensitive to the precise calibration of the relative generosity $\gamma(me)$ of Medicaid v/s private insurance ($\gamma(pr)$).

[25]Three times larger penalties are sufficient to stop the spiral, and make the reform roughly welfare-neutral.

problem[26] for many households, and since these subsidies are financed by higher progressive taxes, this part of the ACA reform provides welcome social insurance. Note that even high types might benefit from this part of the policy reform since the loss from redistribution away from their type is more than offset by the better insurance against within type idiosyncratic income and health risk, and the fact that ESHI premia fall for this group due to an improved health composition of the pool. As Table 2 shows, even though the welfare gains the redistributive components of the ACA are concentrated among the low type, even high type individuals on average benefits from the enhanced social insurance provided by the subsidization of private insurance for those just too income rich to fall under the Medicaid threshold.

3.7.2 The ACA in a Model with Endogenous Evolution of the Health Distribution

The previous section discussed simulations of the ACA in a model with health expenditure risk in which medical spending and the evolution of health was exogenous. A recent literature at the intersection of quantitative macroeconomics, empirical microeconomics and health economics has sought to integrate models of endogenous health spending and dynamic health accumulation in the spirit of Grossman (1972) into the class of life cycle models with idiosyncratic income risk discussed in the previous section. Papers that model health expenditures and/or the evolution of health over the life cycle endogenously include Halliday *et al.* (2019), Fonseca *et al.* (2021) and Khwaja and White (2021). The papers by Hugonnier *et al.* (2013) and Yogo (2016) focus on asset pricing in such models.

Within this literature, a few recent papers have used this model structure to simulate the consequences of stylized versions of the ACA. The papers by Jung and Tran (2016) and Khwaja and White (2021) model precisely the same components of the ACA reform as Pashchenko and Porapakkarm (2013), but do so in a model with endogenous health spending. As we saw in Section 3.6.3, these model elements introduce a moral hazard problem that might be exacerbated by the expansion of health insurance. The analysis by Jung and Tran (2016), whose main results are summarized in Table 3, focuses exactly on this question.

Table 3: Pre- and Post-ACA Steady States: Model with Endogenous Medical Spending & Health

Variable	Pre-ACA	Post-ACA
GDP (% Change)	NA	-1.23
Hours worked (% Change)	NA	-2.46
Med. Goods m (% Change)	NA	1.87
Insured by ESHI (in %)	61.0	62.9
Individually Insured (in %)	6.4	22.3
Publicly Insured (in %)	9.8	14.4
Uninsured (in %)	22.8	0.4
Welfare (CEV in %)	NA	-1.7

Notes: The table is based on Table 4 in Jung and Tran (2016).

[26] Ferreira and Gomes (2017) asks by how much the price of health goods (p in this model) has to fall to achieve the same welfare gains as the ACA reform, in a model and for an ACA reform similar to the one discussed thus far, and find a large number of about 5.21%. They conclude that empirically plausible cost-cutting measures alone provide no good alternative to the ACA. Colla and Skinner (2020) review the empirical literature on the actual cost savings induced by the ACA.

The first part of the table shows the long-run steady state allocational consequences of the reform. In order to finance the ACA, and specifically the Medicaid expansion as well as the premium subsidies, income taxes have to rise; the paper shows that a labor income tax increase of 1.2% on earners above $\$200,000$ is sufficient. That, plus the disincentive effect from the Medicaid expansion lowers labor supply in the long run; the decline in uninsured health risk reduces the need for precautionary saving and thus the capital stock in the long run. Therefore output falls. At the same time, the economy as a whole consumes more medical goods, a manifestation of the moral hazard problem exacerbated by more individuals being covered by health insurance (and thus paying less than 100% of the cost of their medical care). This last effect is by construction absent in models with exogenous health expenditures.

The second part of the table indicates that the ACA reform is successful in expanding health care coverage, in that in the long run essentially everybody is insured. As in the previous section, both the Medicaid expansion as well as the increased share of individuals purchasing individual health insurance are responsible, with the latter being more dominant.[27]

The last row of Table 3 displays perhaps the biggest difference between the evaluation of the ACA in the previous and in this section. Now the welfare consequences of the entire reform (community rating, penalties, subsidies and Medicaid expansion) are substantially negative rather than positive, as in Table 2. The reasons for this difference are two-fold, and serve to make general points that extend beyond the comparison of the two specific papers. First, when medical expenditures are endogenously chosen by individuals the potential ex post moral hazard problem leading to higher health expenditures and higher taxes to finance the Medicaid expansion and private premium subsidies can lead to adverse welfare consequences of the ACA reform, as emphasized by Jung and Tran (2016). Second, whereas their paper focuses on steady state welfare, Pashchenko and Porapakkarm (2013) consider the welfare consequences of individuals living through the transition towards the new steady state. For a reform that leads to a reduction of capital and output along the transition (as does the ACA in both papers) the long-run welfare consequences tend to be more adverse than those in the short run. Thus, accounting for transitional dynamics and distinguishing between the short- and long run consequences of the ACA reform is important, as is the choice of the weights on current versus future generations in the social welfare function.

3.7.3 Interaction of the ACA and Labor Income Insurance Policies

Thus far we have treated the initial type distribution $\Psi(s)$ in young age as exogenously given; recall that s in part captures the initial health constitution of an individual that also determines the distribution of health shocks in the second period. Both labor productivity when young $z^y(s)$ as well as the health insurance premium on private health insurance markets $\phi(s;pr)$ depends on this health state s, and the ACA enforced community rating, mandating $\phi(s;pr) = \phi(pr)$ which rules out the dependence of health insurance premia on pre-existing health conditions as captured by s. For any social welfare function, like the one outlined in (3), that values social insurance against being born as an unfavorable type, such community rating provides exactly this social insurance. By the same token, health-related policies in the

[27] The main disagreement between the two papers is whether it is the penalties or the subsidies mostly responsible for it, and how large effective penalties have to be, see also Khwaja and White (2021).

labor market[28] that enforce the compression of wages $z^y(s)$ and earnings across health types compress the distribution of lifetime utilities $V(s)$. If labor supply in the first period is exogenous (i.e. under Assumption 2, which we maintain for the sake of exposition), it would in fact be optimal to socially insure income fully.[29]

However, now assume that initial (health) type s is partially endogenous. Suppose that individuals can exert health effort e (exercising, adhering to a healthy diet, refraining from smoking or drinking) at a utility cost $\nu(e)$, that impact their (and thus the population's) distribution over health status $\Psi(s;e)$. In addition to the community rating mandate of the ACA, the government contemplates social insurance in the labor market by providing wage insurance indexed by a parameter τ such that wages (and thus labor earnings) are given by a weighted average of individual and average productivity $\bar{z}^y$:

$$z^y(s;\tau) = (1-\tau)z^y(s) + \tau\bar{z}^y \tag{30}$$

Absent effort choice, that is, for a constant health type distribution $\Psi(s)$ it is optimal to provide full social insurance, both in the labor market and in the health insurance market. If health effort is endogenous, though, such full insurance insulates individuals from all economic consequences (through lower wages and/or higher health insurance premia) of unhealthy behavior, leading to a worse population health distribution, potentially lower output and higher health insurance costs. Furthermore, if future health depends on current health status, as in (7), then perhaps most of the costs of the introduction of increased social insurance through the ACA (or other policies) materializes only far into the future. Finally, as Cole *et al.* (2019) argue, now health care reform and labor market policies interact, and need to be studied jointly.[30] In the context of this simple model (which Cole *et al.* (2019) expand to a quantitative life cycle model estimated on income and health data from the PSID and MEPS), the policy design problem amounts to choosing whether to implement the community legislation (community rating) of the ACA[31] and the optimal extent of wage compression.

Figure 2 depicts the welfare results. The x-axis measures the degree of policy-induced wage insurance (as measured by τ), and the y-axis shows the welfare consequences of a specific policy reform, measured as consumption equivalent variation, relative to the unregulated equilibrium in which both health insurance premia and wages are competitively determined and fully depend on the health-relevant state s. Initially, increasing wage insurance τ is beneficial. However, beyond a certain point ($\tau > 70-80\%$, depending on the presence of community rating –named *No Prior Conditions* in Cole *et al.* (2019)) further wage compression is detrimental, precisely because the reduction in incentives to lead a healthier life and associated negative dynamic effects on the population health distribution outweigh the short-run insurance effects. It also shows the policy interaction: optimal labor income insurance is smaller when health insurance premium

[28]Examples include the 1990 American with Disabilities Act (ADA) and its 2008 amendment act, the ADAAA. Li (2015) also studies the ACA and disability insurance jointly.

[29]A recent literature studies the interaction between health, health insurance and income inequality, as well as the desirability of progressive taxation in this context, see e.g. Tsujiyama (2013), Prados (2018), Chen *et al.* (2020) and Jung and Tran (2020).

[30]Nakajima and Tuzeman (2017) also analyze the interaction between the ACA policy reform in the health insurance markets and labor market reforms, but model both worker and firm heterogeneity explicitly.

[31]Cole *et al.* (2019) assume mandatory participation or subsidies/penalties such that everyone participates.

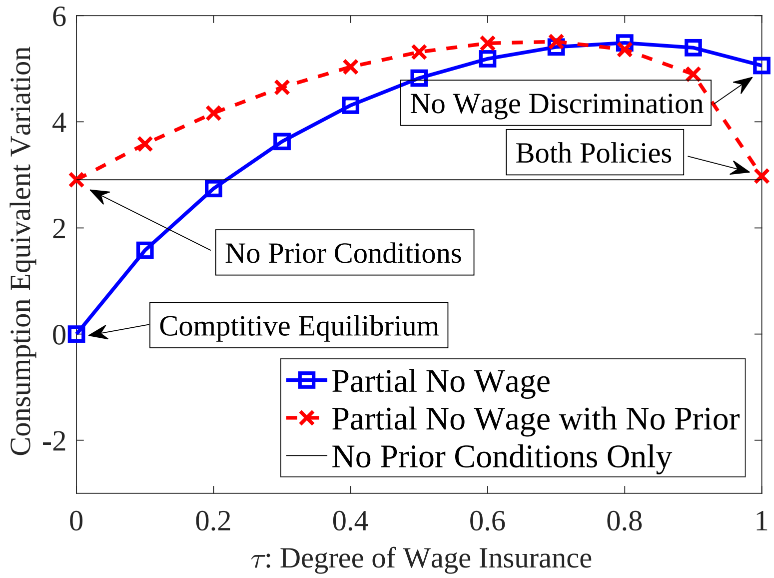

Figure 2: Welfare Effects of Varying Wage Insurance (Figure 14 of Cole *et al.* (2019))

risk is insured through the ACA.

The analysis in Figure 2 reinforces two points we have made repeatedly in this section: a) the short-run effects of a policy reform, holding the distribution in individual health and economic characteristics constant, can differ vastly from its long-run consequences b) providing additional social insurance can be less favorable in models where health expenditures, health efforts and thus the population health distribution is endogenous. Finally, it suggests that health insurance market reforms such as the ACA interact strongly with labor market policies. To make this last point more fully, an explicit model of the labor market with endogenously determined employer health insurance is needed. This class of models, to which we now turn, also allows us to study an aspect of the ACA hitherto ignored, the employer mandate.

4 Frictional Labor Market Models

The ACA is mainly a reform on the US health insurance system. However, as we argued in the introduction, given the fact that most of the working age Americans receive heath insurance coverage from their employers, the ACA can also be construed as a large-scale labor market reform. In this section, we first provide a quick summary about the nexus of the labor market and insurance market in the United States, and then describe the frameworks that have been proposed to study, both empirically and theoretically, the equilibrium effects of the ACA on the labor market.

4.1 Nexus between Labor and Health Insurance Markets

First, the United States is unique among industrialized nations in that it lacks a national health insurance system and most of the working-age population obtain health insurance coverage through ESHI. According to Kaiser Family Foundation and Health Research and Educational Trust (2009), more than 60 percent of the non-elderly population received their health insurance sponsored by their employers, and about 10 percent of workers' total compensation was in the form of ESHI premiums.[32] Second, there have been many well-documented connections between firm sizes, wages, health insurance offerings, and worker turnovers. For example, it is well known that firms that do not offer health insurance are more likely to be small firms, to offer low wages, and to experience higher rate of worker turnover. In the 1997 Robert Wood Johnson Foundation Employer Health Insurance Survey, Aizawa and Fang (2020) finds that the average size was about 8.8 for employers that did not offer health insurance, in contrast to an average size of 33.9 for employers that offered health insurance; the average annual wage was $20,560 (1996 constant US dollar) for workers at firms that did not offer health insurance, in contrast to an average wage of $29,077 at firms that did; also, annual separation rate of workers at firms that did not offer health insurance was 17.3%, while it was 15.8% at firms that did; moreover, workers in firms that offer health insurance are more likely to *self report* better health than those in firms that do not offer health insurance.

The U.S. insurance system that ties health insurance to employment may lead to inefficiency in multiple dimensions. First, it may lead to workers making socially inefficient mobility decisions, which are often referred to as " job lock" or "job push" effects. Madrian (1994) and Gruber and Madrian (1994) provide reduced-form evidence for job locks induced by the ESHI, and Dey and Flinn (2005) quantify job locks and job pushes through the lens of an estimated equilibrium model of the labor market in which firms and workers bargain over both wages and health insurance offerings.[33] It can also result in dynamic inefficiency in terms of health investment over one's life cycle. Fang and Gavazza (2011) argue that health is a form of general human capital, and provide evidence that labor turnover and labor-market frictions prevent an employer-employee pair from capturing the full surplus from investment in an employee's health, generating under-investment in health during working years and increasing medical expenditures during retirement.

4.2 Labor Market Models with Health and Health Insurance

Here we sketch the ingredients of equilibrium labor market models that have been proposed in the literature (see Aizawa 2019, Aizawa and Fang 2020 and Fang and Shephard 2019, among others). The model features individuals (or households) and firms, where individuals (or households) experience health shocks, value health, and have risk averse preferences (thus value health insurance), and supply labor; and the firms decide wage and health insurance offerings to compete for workers. The workers and firms interact through a frictional labor market. Risk neutral employers recognize that risk averse workers value health insurance, and also that health insurance may improve workers' health which in turn makes workers more productive. For both of these reasons, employers may choose to offer health insurance as an instrument to attract new workers and/or to retain existing workers from being poached. Firms that offer health insurance may be self insured; or they can join a risk pool (e.g., small group insurance market).

Individuals or Households. To integrate health insurance into an equilibrium model, individuals must value health insurance. The literature has adopted two main approaches to introduce health insurance in

[32] Among those with private coverage, about 95% obtained employment-related health insurance, see Selden and Gray (2006).

[33] See Currie and Madrian (1999) for a survey of the large reduced form literature on the interactions between health, health insurance and labor market.

labor market models.

The first and more reduced-form approach is to think of health insurance as a form of *amenity* valued by workers. This is an approach taken by Hwang *et al.* (1998) and Dey and Flinn (2005, 2008). For example, Dey and Flinn (2005) assumes that workers' instantaneous (indirect) utility function is given by:

$$u_\xi(w,d) = w + \xi d \tag{31}$$

where ξ is the worker's exogenous value of having health insurance, and $d \in \{0,1\}$ is an indicator for whether the worker has health insurance. In the population, the amenity value ξ can be heterogeneous and drawn from some distribution, say $H(\cdot)$ with non-negative support. Notice that this formulation maintains individuals' risk neutrality. This approach is simple, but has several limitations. First, it does not link the value of the health insurance to health expenditure;[34] second, it does not allow health insurance to affect the evolution of health, though Dey and Flinn (2005) does allow health insurance to be a productive factor in the sense that it reduces the rate of separations into unemployment.

A second approach, taken in Aizawa and Fang (2020), Aizawa (2019) and Fang and Shephard (2019), derives workers' valuation for health insurance by explicitly assuming risk averse utility functions and modeling the health expenditure risks. Specifically, individuals are assumed to have a utility function $u_\chi(c)$ where χ denotes individual's observable characteristics, and the function $u_\chi(\cdot)$ is often assumed to be of constant absolute risk aversion (CARA):

$$u_\chi(c) = -\frac{\exp\left(-\gamma_\chi c\right)}{\gamma_\chi}, \tag{32}$$

where $\gamma_\chi > 0$ is the absolute risk aversion parameter for demographic type χ; or it may take a constant relative risk aversion (CRRA) form:

$$u_\chi(c) = \frac{c^{1-\gamma_\chi} - 1}{1-\gamma_\chi}, \tag{33}$$

where $\gamma_\chi > 0$ is the relative risk aversion parameter for demographic type χ.

It is useful to describe the trade-offs in the choice of CARA or CRRA utility function. Since CRRA utility function does not allow for negative consumption, if the researcher were to adopt a CRRA utility function, then it is essential to impose a positive consumption floor (presumably coming from an unmodeled social safety net). If one were to adopt the CARA utility function, then such a restriction is not necessary though empirically it may still be useful to impose a consumption floor or to assume a finite support for the medical expenditure distribution so as to bound the value of the insurance.

In this formulation, the individuals value health insurance partly because health insurance helps them reduce the consumption risk resulting from health expenditure shocks. Specifically, individuals experience *random* health expenditure shocks denoted by $\tilde{m}^x_{\chi h}$, whose distribution depends on their demographic type χ, their health status $h \in \mathcal{H} \equiv \{H, U\}$ where H denotes "healthy" and U denotes "unhealthy,"

[34]Notice that in this formulation, the value of health insurance can be made to depend on the workers' health by making ξ to be health dependent.

and their health insurance status $x \in \{0, 1\}$. Motivated by the well-known empirical regularities, the literature typically models the health expenditure process as follows: with some positive probability $p^x_{\chi,h}$, an individual's health expenditure will be zero; with the complimentary probability $1 - p^x_{\chi,h}$, the medical expenditure is represented by a random variable with positive support, denoted by $m\,|(\chi, h, x)$. Note that an individual's health insurance status is allowed to affect the medical expenditure distributions to capture possible *moral hazard* effect in health care.

The discussion above is for individuals. In the U.S., spousal health insurance benefits are heavily used by married couples. In both the Survey of Income Program Precipitation (SIPP) and the Medical Expenditure Survey (MEPS) data, 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 own employers separately. Furthermore, if only one spouse is employed and offered ESHI, over 90 percent of the insured couples obtain health insurance offered by the employer of the employed spouse. There is no law in the United States that would require firms to provide health insurance coverage to spouses of employees, either before or after the ACA. Of course, there were many reasons that firms were incentivized to bundle the employee insurance with spousal coverage. First, the tax exemption of employer sponsored health insurance includes the premium payment for spousal coverage; second, the dysfunctional individual private health insurance market before the ACA made the spousal coverage provided by employers particularly valuable. ACA, by establishing a community-rated health insurance exchange with tax subsidies, provides a more affordable option for health insurance for spouses outside of the ESHI. This may significantly change firms' incentives to offer spousal coverage under the ACA. To study these issues more formally, however, one would have to specify a household labor supply model, where couples make their labor supply decisions jointly. In household search models, it is common to assume that the couples have instantaneously utility functions that depend on *equivalized joint consumption*, that is, the husband and wife pool their incomes in the household consumption. For example, Fang and Shephard (2019) assumes that the couple's utility from consumption is give by preferences assumed constant absolute risk aversion (CARA)

$$U_\chi(c) = -\exp(-\psi(\chi) \cdot c), \tag{34}$$

where $\psi(\chi) > 0$ is the coefficient of absolute risk aversion, c is household consumption.

Firms. Firms hire workers to produce. They rely on wages and amenities, including tax-exempted offering of ESHI, to attract and/or retain workers. In the United States, most of the large firms form health insurance risk pools of their own employees and only sign "administrative services only" (ASO) contracts with an insurer to administer the health insurance claims and access the insurers' provider networks. Small firms, however, may join the small business risk pools of a large insurance company.

The fact that the United States has an employment-based health insurance system is not based on any grand design, rather, it is a historical accident resulting from the labor shortage in World War II. In 1942, the US faced severe labor shortage as many eligible workers were in military service. President

Roosevelt signed Executive Order 9250 which established the Office of Economic Stabilization, froze wages and prevented businesses from raising wages to attract workers. Offering health insurance benefits became the tool for firms to compete for workers, a practice that became institutionalized in 1943 by the War Labor Board ruling that contributions to insurance and pension funds did not count as wages, and the Internal Revenue Service (IRS) decision that ESHI premiums should be exempt from taxation.

Firms offer health insurance to their workers because it is a tax-subsidized tool to attract and retain workers; also the workers' improved health as a result of having access to health insurance also means that workers are more productive, say, as a result of taking fewer sick days.

To capture these, one requires a model where firm size, i.e., the number of employees of different health status a firm has in the steady state, is affected by its compensation packages. Aizawa and Fang (2020) proposes an extension of Burdett and Mortensen (1998)'s classic paper to incorporate health insurance and health into a frictional labor market model with on-the-job searches. More specifically, consider a firm with productivity p. A worker with health status h working for the firm can produce $d_h \cdot p$ units of output, with $d_H = 1, d_U = d \in (0,1)$ where $d \in (0,1)$ captures the workers' productivity loss from being unhealthy.

A firm's compensation package is denoted by (w, I) where w is wage and $I \in \{0,1\}$ is an indicator for whether the firm offers ESHI. Let us denote the steady-state level of workers of health status $h \in \{H, U\}$ and with demographic characteristic χ for a firm that offers package (w, I) as $n_h(w, I; \chi)$. Then the firm's steady state profit flow is given by:

$$\sum_{h \in \{H,U\}} \sum_{\chi} \left[d_h p - (1+\tau_p) w - I \cdot m^1_{\chi h}\right] n_h(w, I; \chi) - C \cdot I \tag{35}$$

where $m^1_{\chi h} \equiv E\left[\tilde{m}^1_{\chi h}\right]$ is the expected medical expenditure for an insured worker with health h and demographic type χ, $\tau_p \in [0,1]$ is the payroll tax firms pay on workers' wages, and C is the fixed cost of providing ESHI, and it is drawn from, say, a Type-I extreme value distribution.

In the population, firms' productivity p is drawn from a distribution Γ. A firm with productivity p will choose (w, I) to maximize its steady state profit flow (35).

Labor Market. As is clear from firm's steady state profit function (35), firms' optimal choices of the compensation packages (w, I) very much depends on how the firms' worker size and composition, i.e. $n_h(w, I; \chi), h \in \{H, U\}$, depend on (w, I). Of course, $n_h(w, I; \chi)$ is determined by the workers' optimal search decisions and the steady state labor market conditions. The labor market models in the literature that endogenizes the firm sizes are quite limited, and the Burdett and Mortensen (1998) model is one of the exceptions.[35] Burdett and Mortensen (1998) provides an equilibrium explanation for how ex ante identical workers may receive different wages, i.e., a model of equilibrium wage dispersion, in a frictional

[35] There are also also some papers in the literature that model the labor market friction using the random matching framework of Mortensen and Pissarides (1994), for example, See (2019). A firm in Mortensen and Pissarides (1994) model is synonymous with a worker-vacancy match, as such, a firm always has a single worker; thus, these papers do not endogenize firm sizes. See (2019) investigates the macroeconomic and welfare consequences of Medicare-for-all reform in an incomplete asset market model where workers make their labor market and health insurance decisions jointly, and he focuses on the reform?s labor market effects.

labor market model with on the job search. In the equilibrium, equally productive firms are indifferent between posting the wages in the support of the equilibrium wage distribution: a higher wage does mean that the firm makes less profit from each worker, but it is exactly compensated by the larger firm size in equilibrium; a firm posting a higher wage will have larger firm size in equilibrium because it attracts more workers via job-to-job transitions (due to on the job search) and loses fewer workers from moving to higher paying firms. An additional desirable implication of Burdett and Mortensen (1998) is that it also explains the positive correlation between firm size and wage, a well-known empirical pattern of the labor market that we described in Section 4.1. Extensions of Burdett and Mortensen (1998) to incorporate the heterogeneity of firm productivity first appear in Bontemps *et al.* (1999, 2000).[36]

Aizawa and Fang (2020) extends Burdett and Mortensen (1998) in many dimensions to make it suitable to study the equilibrium of the labor market integrated with health and health insurance.[37] First, to appropriately quantify the willingness-to-pay for health insurance, which is important to evaluate the welfare consequences of the ACA reform, workers' (or households') preferences must exhibit risk aversion instead of risk neutrality as assumed in Burdett and Mortensen (1998) and subsequent literature. Second, workers' health and its evolution, as well as the random health expenditures, must also be explicitly modeled. In particular, the health evolution process must be endogenous to the individual choices, in one way or another. Aizawa and Fang (2020) allows the health transitions to depend on the health insurance status, which is an endogenous choice. Cole *et al.* (2019) instead endogenizes health investment decisions. These elements are necessary in order to evaluate the impact of the ACA on health expenditures, health insurance premiums, and government budgets. Third, to the extent that the US health insurance market is a mixture of both private health insurance, including ESHI – either from one's own employer or from the spouses – and individual private health insurance, and public health insurance options such as Medicaid (see Figure 1), one would like to include these options in the model for the workers, together with other safety net protections afforded to Americans. Fourth, health is not only important for workers because more healthy individuals are less likely to incur health shocks, and even if health shocks do occur they are likely less expensive, but also important for firms because healthy workers are more productive, say, because they will be taking less sick leaves for example. Fifth, there are many regulatory feature of the US labor market and health insurance market that one would like to incorporate, for example, Americans with Disabilities Act (ADA) and Employee Retirement Income Security Act (ERISA) laws prevent employers from offering health insurance options that are dependent on workers' disability status and wage levels; however, at the same time the compensation contracts are still sufficiently incomplete to leave open the possibility of adverse selections.

Relative to the competitive labor market models in Section 3, this class of frictional labor market models can be more readily integrated to study the endogenous firm responses, and are particularly suited

[36] Moscarini and Postel-Vinay (2013) further extended these models to allow for aggregate uncertainty to study interesting and empirically relevant properties about firm size and wage adjustment over the business cycles.

[37] Dizioli and Pinheiro (2016) also extended Burdett and Mortensen (1998) to incorporate health insurance as a productivity factor, and show that firms that offer health insurance are larger and pay higher wages in equilibrium. But in their basic model, workers are risk neutral and their demand for health insurance is due to the difference in utility cost parameters between when one is sick with health insurance versus that without health insurance.

to study some of the important ACA provisions such as the size-dependent employer mandate. It also provides a convenient vehicle to study the impact of the ACA on labor market dynamics, including job-to-job transitions, unemployment, the firm size distribution, and aggregate productivity effects of the ACA.

Government. The government plays an important role in the labor and health insurance market even before the implementation of the ACA. In the labor market, first and foremost, government taxes individuals and firms via personal and corporate income taxes respectively, but at the same time, exempts the ESHI premium from personal income taxation. Indeed the exemption of ESHI premiums is the largest tax expenditure on the US tax code, in an amount estimated to be over 200 billion dollars in fiscal year 2021.[38]

Government also plays an important role in the health insurance and health care market. As seen in Figure 1, about 34% of the US population are insured under Medicaid and Medicare. Fully modeling Medicaid and Medicare in equilibrium search models is difficult, however. Medicaid eligibility often includes both income and assets, and to model Medicaid asset eligibility would require the modeling of savings decisions, which is challenging due to both the computational complexity and the fact that the typical labor market data sets do not have detailed asset information. The challenge from modeling Medicare comes from its age dependent nature: Medicare is available for those older than 65, thus accurately modeling Medicare would require a finite horizon model, which will complicate the computation of the labor market steady state in search models. As a comprise, Aizawa and Fang (2020) models Medicaid availability as a probability function of income, and justifies it with the low assets levels in their study population of males with high school or less educations.

Equilibrium. The equilibrium of the model consists of (i) workers' labor market decisions regarding whether to accept offers they receive, both when they are unemployed and when they are employed, and whether they will purchase private health insurance if their jobs do not offer ESHI; (ii) firms' decisions regarding which compensation package, including wages and health insurance menus, to offer to their workers, such that the workers' decisions are optimal given the distribution of compensation packages offered by the firm, and the firms' decisions are optimal given the steady state labor market workers distributions implied by the workers' job market decisions. Notice that when individuals are married, as in Fang and Shephard (2019), the couples' labor market decisions are dependent on each other.

Model Estimation. The model sketched above are typically estimated using method of simulated moments, with data moments obtained from a variety of data sets. The often-used worker level data include Medical Expenditure Panel Survey (MEPS),[39] Survey of Income and Program Participation (SIPP),[40] Current Population Survey (CPS), and American Community Survey (ACS); while the firm side data is typically Kaiser Family Employer Health Insurance Benefit Survey (Kaiser).[41]

[38]See https://www.taxpolicycenter.org/briefing-book/what-are-largest-tax-expenditures

[39]See https://www.meps.ahrq.gov/mepsweb/.

[40]https://www.census.gov/programs-surveys/sipp/tech-documentation/questionnaires.html.

[41]See https://www.kff.org/health-costs/report/employer-health-benefits-annual-survey-archives/

Mechanisms. It is useful to explain the mechanisms of how the Burdett and Mortensen (1998)-style equilibrium search model of the labor market is able to explain the well-documented facts described in Section 4.1. Consider two sets of firms respectively with low and high productivities in the productivity distribution.[42] When the two sets of firms offer health insurance, both will be subject to adverse selection in terms of the fraction of unhealthy among the new hires, but the adverse selection problem is less severe for high-productivity firms than for low-productivity firms. The reason is that, the high-productivity firms offering health insurance can at the same time offer higher wages; in contrast, low-productivity firms can only offer low wages if they were to offer health insurance. As a result, high productivity firms can poach a larger fraction of healthy workers from a much wider range of firms than the low productivity firms. We refer to this as the *adverse selection* effect among new hires.

In addition, the adverse selection effect that a firm offering health insurance suffers in terms of the unobserved health component of their new hires can be mitigated by the positive effect of health insurance on the improvement of health. We refer to this as the *health improvement effect* of health insurance;

Thirdly, the positive effect of health insurance on health, which leads to an increased productivity of the workers, is better captured by high productivity firms. This is because the job-to-job transition rate for workers in high-productivity firms, regardless of their health status, is significantly lower than that in low-productivity firms. After all, workers in a more productive firm have a lower chance of receiving an offer from an even more productive firm than workers in a less productive firm. Thus, high-productivity firms are more likely to retain their workers as the workers' health is improved by insurance, which allows the firms to capture both the increased productivity and the reduction in the expected health care cost resulting from the health improvement effect of health insurance. We refer to this as the *retention* effect (see also Fang and Gavazza 2011). These three effects also can explain why in the steady state, firms that offer health insurance may have healthier workers than those that do not offer it, despite the adverse selection among the new hires.

Counterfactual Policy Simulations. There are several key advantages of the structural modeling approach described so far in this section.[43] First, once the baseline model is estimated, simulations can be used to evaluate the *long-run equilibrium* causal impacts of the ACA. It is often difficult to interpret the reduced-form pre- and post-ACA comparisons for policy impact evaluation as the causal and "long-run equilibrium" policy impact for several reasons. First, as described in Section 2, the implementation of the ACA has been phased in, not in wholesale; for example, it took several years for the full individual mandate penalty as stipulated in the ACA, \$695 or 2% of one's taxable income, to be enforced by the IRS, and it was voided by the 2017 Trump tax cut; and the employer mandate penalty was not fully implemented in the first two years of the ACA. In addition, many features of the ACA, including the employer mandate, individual mandate, and the premium subsidy, have all been challenged in court. Thus, the reduced-form policy evaluations are likely to capture at best the short-term policy impacts. Moreover, to the extent that the ACA is a federal law, the credibility of the reduced-form policy evaluation as causal impact depends

[42]The discussion is illustrated in Table 15 of Aizawa and Fang (2020).

[43]See Todd and Wolpin (2010) for related discussions.

crucially on the credibility of the parallel trend assumption between the control and treatment groups.

As previously illustrated, the structural approach can also shed light on the *mechanisms* of the overall policy effects, and allows one to consider not just impact of the policy on individual or firm behavior, but also the welfare impacts of the reform on individuals and firms. Even for the individual or firm outcomes, the structural approach allows us to simulate a variety of other outcomes of interest that are difficult to measure directly in the data. For example, one may be interested in knowing the fraction of individuals who would have been offered ESHI if not for the ACA, which would capture the substitution effect of the ACA on ESHI; such an outcome would be difficult to measure directly in the data but easy to simulate using the structural model.

Finally, and probably most importantly, the structural approach allows us to simulate the impact of *variations* of the ACA, to the extent that the ACA may be subject to future reforms. For example, we can simulate the impact of the ACA without the individual mandate, the ACA without the employer mandate, or the ACA without the tax exemption of the ESHI premiums.

Specifically, Aizawa and Fang (2020) consider a stylized version of the ACA that incorporates all the main components, except for the young adult dependent coverage extension, as described in Section 2: first, all individuals are required to have health insurance or have to pay a penalty; second, all firms with more than 50 workers are required to offer health insurance, or have to pay a penalty; third, the pre-ACA health-rated private individual health insurance market is replaced by a health insurance exchange where individuals can purchase health insurance at community rated premium; fourth, the participants in the health insurance exchange can obtain income-based subsidies; fifth, individuals whose income is below 138% of the Federal Poverty Level are eligible for Medicaid regardless of their demographic status. In particular, the introduction of the health insurance exchange represents a substantial departure from the baseline model sketched above because the premium in the health insurance exchange needs to be endogenously determined in equilibrium. The other three components of the ACA are, to a large extent, modifications to the individual (or households') budget constraints, or the firm's profit flows.

Aizawa and Fang (2020) evaluates the long-run equilibrium impact of the ACA, as well as the contributions of the various components of the ACA; they also evaluate a number of interesting modifications. Noticing that the employer mandate requires that firms offer ESHI to their workers, but does not require that they offer ESHI to the workers' spouses, Fang and Shephard (2019) simulates the impact of another provision of the ACA regarding premium subsidy, namely, one's eligibility to receive federal premium subsidy depends on whether they are *offered* the option to join ESHI including that from the spouse's employer, on firms' decision to offer spousal benefits. We will describe some of the key findings from these simulations below.

4.3 Summary of Key Results

Benchmark vs. the Full ACA. Table 4, abridged from Table 16 of Aizawa and Fang (2020), presents the results from the simulations under various policy environments. Column (1) shows that the steady state of the estimated benchmark (pre-ACA) economy exhibits the patterns we discuss in the introduction.

	Benchmark	ACA	ACA w/o IM	ACA w/o EM	ACA w/o Prem. Sub.
	(1)	(2)	(3)	(4)	(5)
A. Labor Market Statistics:					
Fraction of Firms Offering ESHI	0.525	0.459	0.419	0.438	0.564
... if firm size is at least 50	0.935	0.989	0.965	0.918	0.998
...if firm size is less than 50	0.480	0.400	0.357	0.383	0.515
Unemployment Rate	0.079	0.079	0.079	0.079	0.078
Average Wages of the Employed	0.989	0.992	0.997	0.995	0.969
... among firms offering ESHI	1.070	1.110	1.126	1.109	1.045
... among firms not offering ESHI	0.798	0.766	0.798	0.797	0.701
B. Distribution of Health Insurance Status:					
Uninsured	0.213	0.066	0.114	0.075	0.157
ESHI	0.595	0.580	0.536	0.555	0.681
Individual Insurance	0.034	0.112	0.098	0.121	0.000
Medicaid	0.050	0.099	0.102	0.101	0.037
Spousal Insurance	0.108	0.143	0.150	0.147	0.125
Premium in EX ($10,000)	N/A	0.150	0.175	0.151	0.419

Table 4: Counterfactual Policy Experiments: Key Statistics under the Benchmark Model, the ACA and Other Health Care Reform Proposals.
Note: Wages and premiums are for four months.
Source: Table 16 in Aizawa and Fang (2020).

It shows that 93.5% of the firms with more than 50 workers offer ESHI to their workers, in contrast to 48.0% of the firms with fewer than 50 workers. Overall, 52.5% of the firms will offer ESHI to their workers. The average four-month wage of the employed workers working in firms offering ESHI is about $10,700, while that for workers in firms not offering ESHI is $7,980. The steady state unemployment rate is 7.9%. It also shows that, the uninsured rate among the population they study is about 21.3% overall; the fractions of individuals who have own ESHI, private individual insurance, Medicaid, and spousal coverage are respectively, 59.5%, 3.4%, 5.0%, and 10.8%. These patterns match those in the data.

Column (2) reports the counterfactual results from the full implementation of the ACA. It shows that overall the fraction of firms offering ESHI declines from 52.5% under the benchmark to about 45.9% under the ACA. Of course, due to the employer mandate for firms with 50 or more workers, the ESHI offering rates for these large firms increase from 93.5% in the benchmark to over 98.9% under the ACA; however, the ESHI offering rate for firms with fewer than 50 workers decreases significantly from 48.0% under the benchmark to 40.0% under the ACA. The steady state unemployment rate stays about the same under the ACA as that under the benchmark. The average four-month wage of the workers in firms offering ESHI has a slight increase from $10,700 to $11,100, while that for workers in firms not offering ESHI experiences a slight decrease from $7,980 to $7,660; overall, the average wage of the employed worker has a slight increase from $9,890 to $9,920.

The uninsured rate under the full implementation of the ACA is predicted to be 6.6%, significantly lower than the benchmark of 21.3%. Notably the fraction of the population with individual insurance increased from 3.4% in the pre-ACA benchmark to 11.2% under the ACA.[44] This represents the biggest

[44] To reconcile these statistics with those reported in Figure 1, it is useful to note that the study population of Aizawa and Fang (2020) has high school or less in education and aged between 26 and 46.

source of the drop in the uninsured rate under the ACA. The second important source for the reduction in the uninsured rate is Medicaid, as the fraction of the population covered by Medicaid increases from 5.0% in the benchmark to 9.90% under the ACA. Notably, the fraction of individuals covered by their own ESHI slightly dropped from 59.5% in the benchmark to 58.5% under the ACA. The sizable drop of ESHI offer rate among small firms shifts insurance status of their married employees from their own ESHI coverage toward the spousal coverage, contributing to an increase in the overall spousal coverage from 10.8% in the benchmark to 14.3% under the ACA. Thus, the overall impact on the ESHI coverage is very small: it is 72.4% under the ACA while it is 70.3% in the benchmark.

The more interesting findings are from the simulation of the modifications to the ACA. We summarize some of these results below.

ACA without the Individual Mandate. ACA without individual mandate essentially corresponds to the actual case after the Tax Cut and Jobs Act of 2017, which repeals the individual mandate penalty but keeps the other components of the ACA intact. Column (3) of Table 4 shows that, surprisingly, ACA without the individual mandate would still significantly reduce the uninsured rate to be about 11.4%, which is about 4.8 percentage points higher than under the ACA, yet still represents 9.9 percentage points reduction from the 21.3% uninsured rate predicted in the benchmark.

This is consistent with the findings in Lurie *et al.* (2021), who estimate the effect of the ACA's individual mandate on insurance coverage using regression discontinuity and regression kink designs with tax return data. Even though they find statistically significant responses to both extensive margin exposure to the mandate and to marginal increases in the mandate penalty, their estimates imply fairly small quantitative responses to the individual mandate, especially in the health insurance exchanges.[45] However, the reduced-form estimates tend to estimate the marginal treatment effects of the group impacted by the discontinuity or kinks (as in Lurie *et al.* (2021)) or the average treatment effect of the population (as in Frean *et al.* (2017)), moreover, it does not account for the equilibrium effects of the individual mandate. Thus, the finding from the counterfactual simulation that, even after accounting for the equilibrium effects the ACA without individual mandate can still achieve significant reduction in the uninsured rate is an important addition to the existing reduced-form literature, and is consistent with the observed performance of the ACA after 2018 when the 2017 Tax Cut and Jobs Act effectively eliminated the individual mandate penalty.

The reason why there is still a sizable reduction in the uninsured rate in the absence of individual mandate is related to the generous premium subsides stipulated under the ACA. Since individuals are risk averse they would like to purchase insurance if the premium they need to pay out of pocket is sufficiently small; and the individual mandate penalty in the ACA acts as the "stick", and the premium subsidy as the "carrot", to further incentivize individuals to buy insurance. As we will show later, the "carrot" is much powerful than the "stick." However, the equilibrium effects of the repeal of individual mandate can be ascertained in the simulations as well: the workers who decide to forego health insurance when

[45] Frean *et al.* (2017), using the 2012-2015 American Community Survey data and a triple difference estimation strategy that exploits variation by income, geography, and time, also found that individual mandate's exemptions and penalties had little impact on coverage rates.

the individual mandate is repealed, tend to be those who work in firms with medium-wages and who are healthy. These account for the 1.4 percentage points decline in the individual insurance coverage under "ACA w/o IM" relative to the full ACA. Because those who decided to go uninsured when there is no individual mandate are precisely those who are healthy, their absence in the exchange exacerbates the adverse selection problem, leading to a substantial increases in the premium in the exchange (from $1,500 under the ACA to $1,750 in "ACA w/o IM").

ACA without Employer Mandate. What would happen to the ACA without employer mandate? Column (4) of Table 4 reports the results from the counterfactual experiment "ACA w/o EM". It finds that, surprisingly, employer mandate is not essential for the ACA at all, and the uninsured rate only has a slight increases relative to the full version of ACA: the uninsured rate under this "ACA w/o EM" system would be about 7.5%, just 0.9 percentage point higher than the 6.6% uninsured rate predicted under the full ACA. Large firms' incentives to offer health insurance is mostly related to the fact that health insurance is a more economical way to compete for and/or retain workers than wages, because it allows the firms to exploit the risk premiums the risk averse workers are willing to pay for health insurance. Thus, the set of firms whose health insurance offering decisions are affected by whether or not there is an employer mandate is relatively small. In addition, the reduction in the fraction of individuals who obtain insurance from ESHI is mostly compensated by the increase in individual insurance via the exchange (with premium subsidy), Medicaid, and spousal insurance. This finding is consistent with reduced-form evidence reported in Lyons (2017), which employed a triple-differences identification strategy and a synthetic control group approach to analyze the impact of the employer mandate in the Massachusetts Health Care and Insurance Reform Law of 2006 on insurance coverage. The paper finds that roughly half of those newly taking up ESHI in large firms subject to the mandate would have enrolled in subsidized coverage had their employer been exempted or subjected to a more lenient employer mandate, while almost all of those obtaining ESHI from medium sized firms because of the levied mandate would have obtained subsidized coverage.

Bruegemann and Manovskii (2010) also develop a search and matching model to study firms' health insurance coverage decision, and show that the insurance market for small firms suffers from adverse selection problem because those firms try to purchase health insurance when most of their employees are unhealthy. Nakajima and Tuzeman (2017) study the impact of the ACA on a firm's demand for part-time as opposed to full-time workers in response to the employer mandate and workers' willingness to work part time in response to the weakening of the linkage between full-time employment and health insurance. They predict that about 2.1 million more part-time jobs are created under the ACA at the expense of 1.6 million full-time jobs.[46]

[46] Mulligan (2018) shows that the income-based premium subsidy and the employer mandate both act as taxes on full-time employment, and predicts that the ACA will lead to a 3.0-percent reduction in total hours worked, though the effects are heterogeneous across groups. See also Mulligan (2013, 2015), Gallen and Mulligan (2018) and Mulligan (2015), which extensively investigate the various labor market impacts of the ACA via its effect on marginal tax rates. These papers do not explicitly model the worker and firm behavior, nor health evolution and medical expenditures.

ACA without Premium Subsidy. Both the Medicaid expansion and premium subsidies in the ACA were challenged in Court. Column (5) of Table 4 reports counterfactual simulation results when we remove both premium subsidies in the exchange and the Medicaid expansion. Relative to the full ACA results reported in Columns (2), the uninsured rate is much larger, at 15.7%. Importantly, essentially no one participates in the health insurance exchange without premium subsidy due to the adverse selection "death spiral".[47] These results demonstrate that the premium subsidies are the key to solve the adverse selection problem in the insurance exchange and contribute importantly to the substantial reduction of the uninsured rate achieved under the full ACA. Moreover, we find that employers respond to the non-functioning of the health insurance exchange by offering ESHI at a much higher rate, both for large and small firms.

Notice that currently the ACA premium subsidy an individual is eligible to receive is based on his/her income and the second lowest Silver plan premium in the marketplace. To the extent that individual's price elasticity of demand for health insurance may be heterogeneous, the optimal premium subsidy should be contingent on such heterogeneity. Indeed, there is a small but growing literature in industrial organization literature that studies the optimal design of premium subsidy in the health insurance exchange. For example, Tebaldi (2017) found that in the California ACA marketplace, younger households are significantly more price sensitive and cheaper to cover than older households. He argues that the optimal subsidy should be dependent on age and the subsidy for the young households should be higher, and moreover, higher participation of the young in the exchange can drive down the equilibrium premium for older participants; this in turn lowers the premium subsidy for the old, and the savings from the reduced premium subsidy for the old can be used to pay for the higher subsidy for the young; in fact, he shows that such a premium subsidy policy in favor of the young can raise enough revenues to reduce the overall cost of the program. Aizawa (2019) studies the optimal joint design of major policies in the ACA and the implications of targeting these policies to certain individuals. He also find that, compared with the health insurance system under the ACA, the optimal structure lowers the tax benefit of ESHI and makes individual insurance more attractive to younger workers. Under the optimal tax and subsidy policies, firms will change their insurance provisions endogenously, and a greater number of younger workers sort into individual markets, which contributes to improving the risk pool in individual insurance and lowering the uninsured risk. As in Aizawa and Fang (2020), a key feature of Aizawa (2019) is that the risk pool of the individuals in the health insurance exchange is *endogenous* to the labor market decisions by the firms and workers.

Role of the Tax Exemption of the ESHI Premium. The US tax codes exempts ESHI premiums from personal income taxation. Many attribute the fact that most firms offer ESHI to their workers to this exemption. Aizawa and Fang (2020) also simulate the counterfactual equilibrium outcomes when the ESHI tax exemption is eliminated both under the benchmark and under the ACA. They find that, the elimination of the tax exemption for ESHI premium would reduce, but not eliminate, the incentives of firms, especially the larger ones, to offer health insurance to their workers. They find that the uninsured rate

[47] This is consistent with the widely reported statistics that, between 2017 and 2020, 84%-87% of those who purchased insurance from the health insurance exchange received premium subsidy. See https://www.kff.org/other/state-indicator/effectuated-marketplace-enrollment-and-financial-assistance/, accessed on August 25, 2021.

would increase from 21.3% to 31.8% when the ESHI tax exemption is removed in the benchmark economy; and it will increase from 6.6% to 12.4% under the ACA. Interestingly, they also experimented with the effect of *prohibiting* firms from offering ESHI in the post-ACA environment, and find that it would lead to a large increase in the uninsured rate. In fact, they find that prohibiting firms from offering ESHI also decreases the total welfare and increases the overall government expenditure. Thus, these findings suggest that ESHI may *complement*, instead of hinder, the smooth operations of the health insurance exchange.

Spousal Insurance. Spousal health insurance benefits were and are still not required by any existing law. Nonetheless, prior to the ACA almost all firms that offered employee health insurance also offered spousal benefits. How would the ACA affect the firms' decision to offer spousal benefits to their employees? Interestingly, according to a survey conducted by Towers Watson National Business Group on Health titled "Employer Survey on Purchasing Value in Health Care" (2013), 12% of the respondent firms 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 (page 19).

As mentioned previously, Fang and Shephard (2019) integrates a multi-person household search model (e.g., Dey and Flinn, 2008 and Guler *et al.*, 2012), similar to the model outlined above, into such an equilibrium framework. Their simulation imply that while the provisions in 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 was almost completely absent in the pre-ACA equilibrium, emerges among low productivity firms. Interestingly, these equilibrium responses are closely related to the availability of non-employer sponsored insurance purchase option from the health insurance 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. Fang and Shephard (2019) further uses their model to examine how the ACA affects job mobility, and shows that it reduces the extent to which job transition events depend upon the insurance coverage status of an individual and their spouse. They also use the model to calculate households' valuation of spousal health insurance both before and after the ACA reform, and show that the ACA considerably reduces this value.

Effects of Young Adult Dependent Coverage Extension. The equilibrium models discussed above do not incorporate the extension of the young adult dependent coverage, which is the first major provision of the ACA to be implemented (see Section 2); instead a reduced-form literature evaluated the effects of this provision. Heim *et al.* (2014, 2018) studies the impact of the ACA's young adult dependent coverage provision on the youth labor market-related outcomes, including measures of employment status, job characteristics, and post-secondary education, using a data set of U.S. tax records spanning 2008-2013. Using a difference-in-difference strategy where those aged between 27 and 29 act as the control group, and those aged between 24 and 25 as the treatment group, they find that the ACA provision did not result in substantial changes in labor market outcomes.[48] In particular, they show that employment and self-employment were not statistically significantly affected, though there is some evidence of extremely small increase in the likelihood of young adults earning lower wages, not receiving fringe benefits, enrolling as full-time or graduate students, and being self-employed.

5 Conclusion and Outlook

The Affordable Care Act was signed into law a decade ago. In this paper we reviewed the structural-quantitative literature studying its short- and potential long run effects on the labor market and the macro economy. We conclude with a brief discussion about what we see as fruitful avenues for future research on the less immediate and less direct impacts of the ACA on the labor market and the macro economy.

ACA and Other Insurance Programs. The ACA expands Medicaid and dramatically extends access of affordable, community-rated and premium-subsidized private health insurance to close to 20 million Americans. While some papers we reviewed in Sections 3 and 4 touched upon the impact of the ACA on public finances,[49] more research needs to be done to investigate the interactions between the ACA and other social insurance programs, such as Social Security, Medicare, and Disability Insurance, as well as other insurance products such as the long-term care insurance.[50] The expansion of health insurance access has positive consequences on the population health of the working-age, which in turn affect life expectancy and health upon retirement.[51] Better population health can also affect the timing of retirement. Thus, even though the ACA mostly expanded access to health insurance for the working age population, it is bound to have important implications for old-age social insurance programs such as Social Security and Medicare. The interactions between the labor and health insurance market, and the interactions between different segments of the health insurance market are the focus of Aizawa and Fu (2020), who develop and estimate an equilibrium model of competitive labor and health insurance markets, but with rich heterogeneity across local markets, households, and firms. They use their estimated model to quantify the welfare loss from the segregation of risk pools across ESHI, individual health insurance exchange (HIX), and Medicaid.

ACA, Economic Recessions and Health Crises. In this paper we have focused on idiosyncratic income and health shocks. However, it is during adverse aggregate shocks, both regular business cycles as well as economic depressions, especially when induced by health crises such as the Spanish flu of 1918-19 or the Covid-19 crisis that access to health insurance is particularly valuable. Furthermore, in a system where most individuals gain access to health insurance through employment, the elevated incidence of unemployment in economic downturns might have profound consequences on the demand for medical treatment,

[48]They exclude 26 year olds, since such individuals could be in the treatment group (under 26) in some months of the year and in the control group (26 and over) in the other months.

[49]For a comprehensive study on the long-run fiscal consequences of entitlement programs, and Medicare and Medicaid specifically, see Gokhale and Smetters (2006).

[50]See Ameriks *et al.* (2020) for a quantitative analysis of long-term care insurance.

[51]French *et al.* (2017) use a dynamic discrete choice model of consumption/saving and labor supply to assess the impact of the Medicaid and private non-group insurance provisions of the ACA on the labor supply and saving of older Americans.

the population health distribution and household consumption and finances in the short- and long-run. Integrating analyses of the ACA with quantitative business cycle studies therefore seems promising.

ACA, Technological Innovation and Economic Growth. An important open area for research is the interaction between the ACA and the adoption of new technology (such as robots and automation) and technological innovation. As we discussed earlier, even though the ACA is a reform of the health insurance sector, it nonetheless is a reform of the labor market as well due to the strong nexus between the health and the labor markets in the United States. To the extent that the reform may, on the margin at least, increase the cost of hiring workers (due to say the employer mandate), firms may be more incentivized to adopt robots or other automation technology to replace workers.[52]

Improvements in health, driven by innovations in medical procedures, drugs, biologics, devices, and the services associated with delivering health care, have been a major source of the overall gain in economic welfare. Medical innovations in the United States are mostly funded by for-profit private companies, and their incentives to invest in R&D is sensitive to both the expected size of the market (Finkelstein 2007) and the government intervention risks in the health care sector (Koijen *et al.* 2016). The ACA, by significantly expanding the health insurance access, especially for the non-elderly population, may change the firms' incentives to invest in new drugs, devices and other innovation to treat the ailments more prevalent among the population whose ability to pay for care is most improved by the ACA. These innovations, in turn, might spur economic growth, and endogenously direct it towards the medical sector.[53]

ACA and Other Behavioral Margins. The young adult dependent coverage extension in the ACA may potentially affect individuals' incentive to attend college and borrow student loans, which in turn may affect the occupation and self-employment decisions of young adults. The papers by Heim *et al.* (2014, 2018) focus on labor supply of the young adults, but the young adult dependent extension of the ACA might reduce the incentive to be a full-time student among those age 19-23, as those individuals can now stay on their parent's plan even if they are not enrolled as a full-time student.[54] On the other hand, it is also possible that the ACA allows students to more freely pursue majors of their choice and pursue careers with less concerns about health insurance coverage.

ESHI from spouse's employer is an important source of the health insurance for married couples in the United States. Indeed, prior to the ACA, one of the most important indirect benefit of marriage is the ability to obtain insurance offered by the spouse's employer. This linkage is weakened by the ACA, as the health insurance exchange provides a place to purchase affordable community rated insurance, with premium subsidy for low income individuals. This dilution of the value of the ESHI spousal benefits has been demonstrated by Fang and Shephard (2019). It is then natural to examine how the ACA differentially affects the marriage and divorce decisions of individuals with different socioeconomic status.

[52]See Fang *et al.* (2021) for an attempt in modeling and quantifying the impact of the ACA on firms' technological choices.

[53]Chandra and Skinner (2012), Ehrlich and Yin (2013), Frankovic and Kuhn (2019) and Frankovic and Wrzaczek (2020) link health spending and technological progress.

[54]Jung and Shrestha (2018) show empirically, using SIPP data, that this effect on full-time college enrollment is likely sizable.

ACA and Political Economy. The ACA was passed along partisan line in both the House and the Senate. Post-enactment public opinion remains sharply divided.[55] Numerous court challenges and Republican attempts to repeal and replace the ACA have so far failed. It is important to examine the political-economic implications of the ACA through its direct impacts on political elections and the indirect consequences through changes in inequality and preferences for redistribution.

The ACA represents a large expansion of the social insurance programs in the United States, particularly the Medicaid expansion and the premium subsidy for people who buy health insurance from the exchange. To the extent that one of the most important roles of unions is to negotiate non-wage benefits on behalf of their members (Freeman and Medoff, 1984), it is possible that ACA may contribute to a further decline of unions.[56] It is an interesting direction to study the interaction of the ACA and other social insurance programs on the unionization rate, as well as on the overall welfare impacts of unions.[57]

References

AIYAGARI, S. R. (1994). Uninsured idiosyncratic risk and aggregate saving. *Quarterly Journal of Economics*, **109**, 659–684.

AIZAWA, N. (2019). Labor market sorting and health insurance system design. *Quantitative Economics*, **10** (4), 1401–1451.

— and FANG, H. (2020). Equilibrium labor market search and health insurance reform. *Journal of Political Economy*, **128** (6), 4258–4336.

—, — and KOMATSU, K. (2021). Union and insurance. Work in Progress, University of Wisconsin-Madison and University of Pennsylvania.

— and FU, C. (2020). Interaction of the labor market and the health insurance system: Employer-sponsored, individual, and public insurance. National Bureau of Economic Research Working Paper No. 26713.

AMERIKS, J., BRIGGS, J., CAPLIN, A., SHAPIRO, M. and TONETTI, C. (2020). Long-term-care utility and late-in-life saving. *Journal of Political Economy*, **128**, 2375–2451.

ATTANASIO, S. K., O. and VIOLANTE, G. (2010). Financing medicare: A general equilibrium analysis. *in: J.B. Shoven (ed.), Demography and the Economy.*

BAICKER, K. and SOMMERS, B. (2020). Insuranc access and health care outcomes. *in E. Emanuel and A. Gluck, The Trillion Dollar Revolution: How the Affordable Care Act Transformed Politics, Law and Health Care in America*, Chapter 12, 209–224.

BENABOU, R. (2002). Tax and education policy in a heterogeneous-agent economy: What levels of redistribution maximize growth and efficiency? *Econometrica*, **70**, 481–457.

BEWLEY, T. (1986). Stationary monetary equilibrium with a continuum of independently fluctuating consumers. *in: W. Hildenbrand and A. Mas-Colell, eds., Contributions to Mathematical Economics in Honor of Gerard Debreu*, pp. 79–102.

BONTEMPS, C., ROBIN, J.-M. and VAN DEN BERG, G. J. (1999). An empirical equilibrium job search model with search on the job and heterogeneous workers and firms. *International Economic Review*, **40** (1), 1039–1074.

[55] See, e.g., Pacheco *et al.* (2020).

[56] The fraction of union workers was about 20% in 1980, it is now smaller than 10%.

[57] See Aizawa, Fang and Komatsu (2021) for a model of the welfare effect of union in the presence of social insurance programs.

—, — and Van den Berg, G. J. (2000). Equilibrium search with continuous productivity dispersion: Theory and nonparametric estimation. *International Economic Review*, **41** (2), 305–358.

Braun, K. K., A. and Koreshkova, T. (2017). Old, sick, alone and poor: A welfare analysis of old-age social insurance programs. *Review of Economic Studies*, **84**, 580–612.

Brown, C. and Medoff, J. (1989). The employer size-wage effect. *Journal of Political Economy*, **97** (5), 1027–59.

Bruegemann, B. and Manovskii, I. (2010). Fragility: A quantitative analysis of the us health insurance system. Working Paper, University of Pennsylvania.

Burdett, K. and Mortensen, D. T. (1998). Wage differentials, employer size, and unemployment. *International Economic Review*, **39** (2), 257–273.

Capatina, E. (2015). Life-cycle effects of health risks. *Journal of Monetary Economics*, **74** (1), 67–88.

Chandra, A. and Skinner, J. (2012). Technology growth and expenditure growth in health care. *Journal of Economic Literature*, **50** (3), 645–680.

Chatterjee, S., Corbae, D., Nakajima, M. and Rios-Rull, V. (2007). A quantitative theory of unsecured consumer credit with risk of default. *Econometrica*, **75** (6), 1525–1589.

Chen, C., Feng, Z. and Gu, J. (2020). Health, health insurance, and inequality. *Working Paper*.

Chivers, D., Feng, Z. and Villamil, A. (2017). Employment-based health insurance and misallocation: Implications for the macroeconomy. *Review of Economic Dynamics*, **23**, 125–149.

Cole, H., Kim, S. and Krueger, D. (2019). Analysing the effects of insuring health risks: On the trade-off between short-run insurance benefits versus long-run incentive costs. *Review of Economic Studies*, **86**, 1123–1169.

Colla, C. and Skinner, J. (2020). Has the aca made health care more affordable? *in E. Emanuel and A. Gluck, The Trillion Dollar Revolution: How the Affordable Care Act Transformed Politics, Law and Health Care in America*, Chapter 14, 250–263.

Conesa, D. C., J., Kamali, P., Kehoe, T., Nygaard, V., Raveendranathan, G. and Saxena, A. (2018). Macroeconomic effects of medicare. *Journal of the Economics of Ageing*, **11**, 27–40.

Currie, J. and Madrian, B. C. (1999). Health, health insurance and the labor market. *Handbook of Labor Economics, Volume 3*, pp. 3309–3415.

Cutler, D. and Gruber, J. (1996). Does public insurance crowd out private insurance? *Quarterly Journal of Economics*, **111** (2), 391–430.

Davila, J., Hong, J., Krusell, P. and Rios-Rull, V. (2012). Constrained efficiency in the neoclassical growth model with uninsurable idiosyncratic shocks. *Econometrica*, **80** (6), 2431–2467.

De Nardi, M., French, E. and Jones, J. B. (2010). Why do the elderly save? the role of medical expenses. *Journal of Political Economy*, **118 (1)**, 39–75.

—, —, Pashchenko, S. and Porapakkarm, P. (2020). The lifetime costs of bad health. *Working Paper*.

Deaton, A. (1992). *Understanding Consumption*. Oxford: Clarendon Press.

Dey, M. S. and Flinn, C. J. (2005). An equilibrium model of health insurance provision and wage determination. *Econometrica*, **73** (2), 571–627.

— and — (2008). Household search and health insurance coverage. *Journal of Econometrics*, **145** (1), 43–63.

Dizioli, A. and Pinheiro, R. B. (2016). Health insurance as a productive factor. *Labour Economics*, **40**, 1–24.

Ehrlich, I. and Yin, Y. (2013). Equilibrium health spending and population aging in a model of endogenous growth: Will the gdp share of health spending keep rising? *Journal of Human Capital*, **7** (4).

Fang, H. (2016). Insurance markets for the elderly. Chapter 5 in *Handbook of the Economics of Population Aging,* edited by J. Piggott and A. Woodland, **1**, 237–309.

— and Gavazza, A. (2011). Dynamic inefficiencies in an employer-provided health insurance system: Theory and evidence. *American Economic Review*, **101** (7), 3047–3077.

—, Larroucau, T. and Shephard, A. (2021). The affordable care act and automation. Work in Progress, University of Pennsylvania.

— and Shephard, A. (2019). Joint labor search, spousal insurance, and health care reform. Natioinal Bureau of Economic Research Working Paper No. 26350.

Fehr, H. and Feldman, M. (2021). Financing universal health care: Premium or payroll taxes? Work Paper.

Feng, Z. and Zhao, K. (2018). Employment-based health insurance and aggregate labor supply. *Journal of Economic Behavior and Organization*, **154**, 156–174.

Ferreira, P. C. and Gomes, D. B. (2017). Health care reform or more affordable health care? *Journal of Economic Dynamics and Control*, **79** (C), 126–153.

Finkelstein, A. (2007). The aggregate effects of health insurance: Evidence from the introduction of medicare. *The Quarterly Journal of Economics*, **122** (1), 1–37.

Fonseca, R., Michaud, P.-C., Galama, T. and Kapteyn, A. (2021). Accounting for the rise of health spending and longevity. *Journal of the European Economic Association*, **19** (1), 536 – 579.

Frankovic, I. and Kuhn, M. (2019). Access to health care, medical progress and the emergence of the longevity gap: A general equilibrium analysis. *Journal of the Economics of Ageing*, **14** (C), 1 – 19.

Frankovic, M. K., Ivan and Wrzaczek, S. (2020). Medical innovation and its diffusion: Implications for economic performance and welfare. *Journal of Macroeconomics*, **66** (C), 1 – 24.

Frean, M., Gruber, J. and Sommers, B. D. (2017). Premium subsidies, the mandate, and Medicaid expansion: Coverage effects of the Affordable Care Act. *Journal of Health Economics*, **53** (C), 72–86.

Freeman, R. and Medoff, J. (1984). *What Do Unions Do?* N.Y.: Basic Books.

French, E. (2005). The effects of health, wealth, and wages on labour supply and retirement behaviour. *The Review of Economic Studies*, **72** (2), 395–427.

—, Jones, J. and von Gaudecker, H.-M. (2017). The effect of the affordable care act on the labor supply, savings, and social security of older americans. Working Paper, University of College London.

— and Jones, J. B. (2011). The effects of health insurance and self-insurance on retirement behavior. *Econometrica*, **79** (3), 693–732.

Galama, T., Kapteyn, A., Fonseca, R. and Michaud, P.-C. (2013). A health production model with endogenous retirement. *Health Economics*, **22** (8), 883–902.

Gallen, T. S. and Mulligan, C. B. (2018). Wedges, labor market behavior, and health insurance coverage under the affordable care act. *National Tax Journal*, **71** (1), 75–120.

Gokhale, J. and Smetters, K. (2006). Fiscal and generational imbalances: An update. *Tax Policy and the Economy*, **20**, 193–223.

Greenwood, J., Hercowitz, Z. and Huffman, G. (1988). Investment, capacity utilization, and the real business cycle. *American Economic Review*, **78** (3), 402–17.

Gross, T. and Notowidigdo, M. (2011). Health insurance and the consumer bankruptcy decision: Evidence from expansions of medicaid. *Journal of Public Economics*, **95** (7-8), 767–778.

Grossman, M. (1972). On the concept of health capital and the demand for health. *Journal of Political Economy*, **80** (2), 223–255.

Gruber, J. and Madrian, B. C. (1994). Health insurance and job mobility: The effects of public policy on job-lock. *Industrial and Labor Relations Review*, **48 (1)**, 86–102.

Guler, B., Guvenen, F. and Violante, G. L. (2012). Joint-Search Theory: New Opportunities and New Frictions. *Journal of Monetary Economics*, **59** (4), 352–369.

Hall, R. E. and Jones, C. I. (2007). The value of life and the rise in health spending. *The Quarterly Journal of Economics*, **122** (1), 39–72.

Halliday, T. J., He, H., Ning, L. and Zhang, H. (2019). Health Investment Over The Life-Cycle. *Macroeconomic Dynamics*, **23** (1), 178–215.

Handel, B. and Kolstad, J. (2022). The affordable care act after a decade: Industrial organization of the insurance exchange. *Annual Review of Economics*.

Hansen, G. D., Hsu, M. and Lee, J. (2014). Health insurance reform: The impact of a Medicare buy-in. *Journal of Economic Dynamics and Control*, **45** (C), 315–329.

Heathcote, J., Storesletten, K. and Violante, G. L. (2014). Consumption and labor supply with partial insurance: An analytical framework. *American Economic Review*, **104** (7), 2075–2126.

Heim, B., Lurie, I. and Simon, K. (2014). *The Impact of the Affordable Care Act Young Adult Provision on Labor Market Outcomes: Evidence from Tax Data*, University of Chicago Press, pp. 133–157.

—, — and — (2018). Did the affordable care act young adult provision affect labor market outcomes? analysis using tax data. *Insustrial and Labor Relations Review*, **71(5)**, 1154–1178.

Hsu, M. and Lee, J. (2013). The Provision Of Public Universal Health Insurance: Impacts On Private Insurance, Asset Holdings, And Welfare. *Macroeconomic Dynamics*, **17** (6), 1252–1280.

Huggett, M. (1993). The risk-free rate in heterogeneous-agent incomplete-insurance economies. *Journal of Economic Dynamics and Control*, **17** (5-6), 953–969.

Hugonnier, J., Pelgrin, F. and St-Amour, P. (2013). Health and (other) asset holdings. *Review of Economic Studies*, **80** (2), 663–710.

Hwang, H., Mortensen, D. and Reed, W. R. (1998). Hedonic wages and labor market search. *Journal of Labor Economics*, **Vol. 16, Issue 4**, 815–847.

Imrohoruglu, A. (1989). Cost of business cycles with indivisibilities and liquidity constraints. *Journal of Political Economy*, **97** (6), 1364–83.

Jeske, K. and Kitao, S. (2009). U.s. tax policy and health insurance demand: Can a regressive policy improve welfare? *Journal of Monetary Economics*, **56** (2), 210–221.

Jones, J. B. and Li, Y. (2018). The effects of collecting income taxes on social security benefits. *Journal of Public Economics*, **159**, 128–145.

Jung, J. and Shrestha, V. (2018). The affordable care act and college enrollment decisions. *Economic Inquiry*, **56** (4), 1980–2009.

— and Tran, C. (2016). Market inefficiency, insurance mandate and welfare: U.s. health care reform 2010. *Review of Economic Dynamics*, **20**, 132–159.

— and — (2017). Aging and health financing in the u.s.: A general equilibrium analysis. *European Economic Review*, **100**, 428–462.

— and — (2020). Health risk, insurance and optimal progressive income taxation. Towson University, Department of Economics, Working Paper No. 2017-01.

Kaiser Family Foundation and Health Research and Educational Trust (2009). Employer health benefits, 2009 annual survey. http://ehbs.kff.org/2009.html.

Khwaja, A. and White, M. (2021). Health insurance reform and the (re-)distribution of welfare: A dynamic structural analysis of heterogeneity in willingness to pay for the affordable care act. Work in Progress.

Koijen, R. S. J., Philipson, T. J. and Uhlig, H. (2016). Financial health economics. *Econometrica*, **84** (1), 195–242.

Krueger, D., Ludwig, A. and Villalvazo, S. (2021). Optimal taxes on capital in the olg model with uninsurable idiosyncratic income risk. *Journal of Public Economics*, p. forthcoming.

Li, Y. (2015). The affordable care act and disability insurance. *Working Paper, University at Albany.*

Lucas, R. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, **22**, 3–42.

Lurie, I., Sacks, D. W. and Heim, B. (2021). Does the individual mandate affect insurance coverage? evidence from tax returns. *American Economic Journal: Economic Policy*, **13(2)**, 378–407.

Lyons, S. (2017). Are employer mandates to offer health insurance effective in reducing subsidized coverage crowd-out of employer-sponsored insurance? *American Journal of Health Economics*, **3** (3), 370–391.

Madrian, B. C. (1994). Employment-based health insurance and job mobility: Is there evidence of job-lock? *Quarterly Journal of Economics*, **Vol. 109**, 27–54.

Mortensen, D. T. and Pissarides, C. A. (1994). Job creation and job destruction in the theory of unemployment. *The Review of Economic Studies*, **61** (3), 397–415.

Moscarini, G. and Postel-Vinay, F. (2013). Stochastic search equilibrium. *Review of Economic Studies*, **80 (4)**, 1541–1581.

Mulligan, C. B. (2013). Average marginal labor income tax rates under the affordable care act. NBER Working Paper No. 19365.

— (2015). The new full-time employment taxes. *Tax Policy and the Economy*, **29**, 89–132.

— (2018). The affordable care act and the new economics of part-time work. *Mercatus Center Research Paper Series.*

Nakajima, M. and Tuzeman, D. (2017). Health care reform or labor market reform? a quantitative analysis of the affordable care act. The Federal Reserve Bank of Kansas City Research Working Papers RWP 15-10.

Orzag, P. and Rekhi, R. (2020). Policy design: Tensions and tradeoffs. *in E. Emanuel and A. Gluck, The Trillion Dollar Revolution: How the Affordable Care Act Transformed Politics, Law and Health Care in America*, Chapter 2, 47–65.

Ozkan, S. (2017). Preventive vs. curative medicine: A macroeconomic analysis of health care over the life cycle. Working Paper.

Pacheco, J., Haselswerdt, J. and Michener, J. (2020). The affordable care act and polarization in the united states. *RSF: The Russell Sage Foundation Journal of the Social Sciences*, **6** (2), 114–130.

Palumbo, M. (1999). Uncertain medical expenses and precautionary saving near the end of the life cycle. *The Review of Economic Studies*, **66**, 395–421.

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

Prados, M. J. (2018). Health and earnings inequality over the life cycle: The redistributive potential of health policies. *Working Paper, USC.*

See, K. (2019). “Medicare for All”: The macroeconomic and welfare consequences of expanding public health insurance. Working Paper, Bank of Canada.

Selden, T. and Gray, B. M. (2006). Tax subsidies for employer-related health insurance: Estimates for 2006. *Health Affairs*, **25** (2), 1568–1579.

Tebaldi, P. (2017). Estimating equilibrium in health insurance exchanges: Price competition and subsidy design under the aca. Becker Friedman Institute for Research in Economics Working Paper No. 2017-05.

Todd, P. and Wolpin, K. I. (2010). Structural estimation and policy evaluation in developing countries. *Annual Review of Economics*, **2**, 21–50.

Tsujiyama, H. (2013). Implications of health care reform for inequality and welfare. Working Paper.

Yogo, M. (2016). Portfolio choice in retirement: Health risk and the demand for annuities, housing and risky assets. *Journal of Monetary Economics*, **80**, 17–34.

Zhang, Y. (2021). Cost-sharing reduction subsidy: Who benefits and how it should be financed. Working Paper, University of Pennsylvania.

Zhao, K. (2014). Social security and the rise in health spending. *Journal of Monetary Economics*, **64**.

— (2017). Social insurance, private health insurance and individual welfare. *Journal of Economic Dynamics and Control*, **78**, 102–117.