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Health Care Reform or Labor Market Reform? A Quantitative Analysis of the Affordable Care Act

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Health-Care Reform or Labor Market Reform? A Quantitative Analysis of the Affordable Care Act*

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Abstract

An equilibrium model with firm and worker heterogeneity is constructed to analyze labor market and welfare implications of the Patient Protection and Affordable Care Act, commonly called the Affordable Care Act (ACA). Our model implies a significant reduction in the uninsured rate from 22.6 percent to 5.6 percent. The model predicts a moderate positive welfare gain from the ACA because of the redistribution of income through health insurance subsidies at the exchange as well as the Medicaid expansion. About 2.1 million more part-time jobs are created under the ACA at the expense of 1.6 million full-time jobs, mainly because the link between full-time employment and health insurance is weakened. The model predicts a small negative effect on total hours worked (0.36 percent), partly because of the general equilibrium effect.

Keywords: health insurance, health-care reform, Affordable Care Act, labor market, heterogeneous agents
JEL Classification: D91, E24, E65, I10

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1 Introduction

We construct an equilibrium islands model with firm and worker heterogeneity to analyze labor market, health insurance, and welfare implications of the Patient Protection and Affordable Care Act, commonly called the Affordable Care Act (ACA). The ACA, which was signed into law in 2010 with the aim of achieving near-universal health insurance coverage, is one of the biggest reforms to the U.S. health-care system. The ACA is expected to affect not only health insurance decisions of firms and individuals, but also labor market outcomes because a unique characteristic of the U.S. health insurance market is a tight link between employment and health insurance — a majority of individuals obtain health insurance from their employers. The richness of our equilibrium model not only captures all important features of the ACA and thus serves as a laboratory, but it also allows us to study the interaction between health insurance and the labor market.

The ACA's impact on the labor market has been debated. Under one component of the ACA (employer mandate), firms with 50 or more full-time equivalent employees (FTE) are considered *large* and they are required to offer health insurance to the full-time (FT) employees to avoid being penalized. Therefore, there are concerns that firms might respond by cutting employment or replacing FT workers with part-time (PT) workers. With his series of influential work, Mulligan (2014) argues that the employer mandate effectively taxes FT employment, and thus will cause a large decline in labor demand. Mulligan (2014) estimates that total hours worked will be reduced by 3.0 percent due to the ACA. The Congressional Budget Office (2014) (CBO) estimates a slightly smaller, but still a significant decline in total hours of 1.5-2.0 percent. However, the CBO emphasizes that the decline in total hours is due to workers voluntarily reducing hours worked, as a result of the ACA. Under the ACA, the existing strong link between (mostly FT) employment and health insurance provided by employers is weakened, and workers have better access to fully or partially subsidized health insurance. As a result, workers do not need to cling to jobs that come with employer-provided health insurance (EHI). In spite of the importance of the issue, research on the ACA's impact on the labor market is limited. Our study is intended to fill this gap. In particular, our equilibrium model allows us to analyze the shift from FT to PT employment and to distinguish supply-side and demand-side effects of changes in total hours worked.

We construct a general equilibrium islands model with heterogenous firms and heterogenous individuals who make decisions on labor demand and labor supply as well as providing and obtaining health insurance. Firms differ in productivity and benefits/costs of providing health insurance to workers. Similar to Brügemann and Manovskii (2010) and Aizawa and Fang (2013), we model firms' hiring and health insurance offering decisions explicitly. Moreover, unlike these earlier studies, we distinguish between FT and PT employment. Firms hire both PT and FT workers and decide whether to offer health insurance to FT workers. Workers are subject to productivity and medical expense shocks, decide whether to work FT or PT, and can obtain EHI (if offered), private health insurers (PHI), or the government (if eligible), or remain uninsured. Equilibrium of our model can be used to analyze the aggregate outcome of the labor and health insurance markets.

There are six main findings. The first and most important result is that the ACA achieves the goal of near-universal health insurance coverage. The uninsured rate in the labor force drops from 22.6 percent to 5.6 percent after the implementation of the reform. This is in line with the CBO's recent estimate, which predicts the uninsured rate will drop to 7 percent among the nonelderly population by 2018.[1] In our model, the uninsured rate drops across all age groups, but the decline

[1] https://www.cbo.gov/sites/default/files/cbofiles/attachments/43900-2015-03-ACAtables.pdf.

is the largest among the young (ages 16-25), mostly due to five-times higher enrollment in Medicaid post-reform. Similar to Brügemann and Manovskii (2010), we find that forcing pooling among individuals purchasing PHI alone does not achieve near-universal coverage. In order for the pooling to work, healthier individuals must be either forced or incentivized into obtaining PHI. In this sense, our model implies that various components of the ACA work effectively together.

Second, the ACA is found to improve social welfare, equivalent to a 0.5 percent increase in flow consumption. The gain is coming from increased redistribution from higher-income to lower-income as well as healthier to less-healthy individuals. We think the welfare gain is a conservative estimate, since our model does not incorporate features such as better health insurance coverage improving health, and better health inducing higher productivity, both of which are supported by various studies. This welfare implication is qualitatively and quantitatively in line with the finding in Pashchenko and Porapakkarm (2013). Expanding Medicaid to more lower-income individuals, and subsidizing health insurance purchased by lower-income individuals are obviously important. Moreover, more pooling in the PHI market contributes as well. Interestingly, although forcing pooling among individuals purchasing PHI alone can generate an even lower uninsured rate (2.1 percent), this mandate alone generates a small, but negative welfare effect (-0.1 percent) because it lacks redistribution that generates the welfare gain under the ACA. In other words, achieving a low uninsured rate alone is not associated with a positive welfare effect. We also find that removing the employer mandate from the ACA generates a higher welfare gain, as this alternative implies less distortion to firms' hiring decisions.

Third, in response to a popular claim that the ACA is turning the U.S. into a "part-time nation," we examine the effect of the ACA on the composition of PT and FT employment. The model predicts an increase from 15.1 percent to 16.4 in the proportion of the labor force working PT as a result of the ACA. This is equivalent to 2.1 million more PT jobs and 1.6 million fewer FT jobs. We show that expansion of Medicaid and subsidies offered at the PHI market contribute the most, indicating that the increase in PT employment is mostly related to labor supply rather than labor demand. We find that the employer mandate does not have a large effect on the composition of jobs, which is in contrast to the discussion in Mulligan (2014).

Fourth, although the model predicts a sizable shift from FT to PT employment, the ACA's impact on total hours is very modest. Our model indicates that total hours decline by 0.36 percent due to the ACA, which is qualitatively consistent with Mulligan (2014) and the CBO, but quantitatively significantly smaller. We find that one reason for the differences is the general equilibrium effect. As we discuss above, and as Mulligan (2014) argues, large firms that are subject to the employer mandate shift their employment from FT to PT and therefore reduce employment to avoid the employer mandate, but that response puts downward pressure on equilibrium wages, and induces other, especially smaller firms to increase employment. Therefore, the direct response of large firms that are subject to the employer mandate is mitigated by the response of other firms. In one of the counterfactual experiments, we shut down the general equilibrium channel and find that total hours decline by 0.88 percent instead of 0.36 percent.

Fifth, our model experiments suggest that leaving the so-called "coverage gap" while not expanding Medicaid has serious consequences. Individuals fall into the coverage gap when their income level is below 100 percent of the federal poverty level (FPL), but they do not qualify for Medicaid. When Medicaid is expanded under the ACA, individuals are eligible for Medicaid. However, in many states that opted out of expansion of Medicaid, individuals in the coverage gap cannot receive health insurance subsidies even though their income is lower than 100 percent of the FPL. Our

experiments suggest that, if the coverage gap is left open nationally, 2.0 million more workers (1.3 percent of the labor force) end up uninsured. The welfare gains of implementing the ACA become zero if Medicaid is not expanded and the coverage gap is left open. Although it is not straightforward to extrapolate our results to the actual situation in which only a subset of states decline expanding Medicaid, our experiments are suggestive about the serious consequences of leaving the coverage gap.

Finally, we find that the model's response to a stylized version of the 2006 Massachusetts Health Care Reform is consistent with what is observed during the post-reform (2007-2012) period in Massachusetts so far. This observation is considered one validation of our model. The 2006 Massachusetts Health Care Reform is often cited as the blueprint for the ACA, and there are many similarities between the two reforms. Both in our model and in the data, the uninsured rate drops significantly after the implementation of the reform, which is mostly related to increased enrollment in Medicaid. While the proportion of workers with PHI increases slightly, the proportion of workers with EHI declines. When comparing the two reforms, we find that, due to more generous premium subsidies and Medicaid eligibility under the Massachusetts reform, this reform achieves a lower uninsured rate compared with the ACA, and the welfare gain is larger with the Massachusetts reform than with the ACA.

The rest of the paper is organized as follows. Section 2 reviews the relevant literature. Section 3 discusses the elements of the U.S. health-care system pre- and post-ACA. Section 4 presents the key ingredients and an equilibrium of the theoretical model. Sections 5 lays out the calibration strategy. Section 6 investigates properties of the calibrated baseline model without the ACA. Section 7 presents the main results, namely quantitative analysis of the ACA. Section 8 provides a quantitative analysis of the Massachusetts Health Care Reform. Section 9 provides an analysis of a universal health-care system, which is implemented in many other developed economies. Lastly, Section 10 concludes.

2 Related Literature

Our paper contributes to five strands of literature. The first strand is the macroeconomic analysis of the health insurance system in the U.S. In this literature, a calibrated dynamic general equilibrium overlapping-generations model with medical expense shocks is usually used. Jeske and Kitao (2009) study the role of tax deductibility of employer-provided health insurance (EHI). Feng (2012) explores the macroeconomic effects of various reforms to the U.S. health insurance system. Hansen et al. (2014) study the effect of introducing an optional Medicare buy-in program for individuals close to retirement age.

The second strand of literature examines the implications and effects of previous health care reforms in the U.S. While there has not been sweeping health-care legislations since Medicare and Medicaid at the national level, several states have instituted reforms of their own. One prominent case is the 2006 Massachusetts Health Care Reform Act. Research on the 2006 Massachusetts reform is closely related to our paper because the Massachusetts reform is considered the blueprint of the ACA. Therefore, studying what happened as a result of the Massachusetts reform could tell a lot about what we should expect from the ACA. Hackmann et al. (2015) compute the change in welfare between pre- and post-reform using changes in coverage, premiums, paid claims, and mandate penalty and conclude that the Massachusetts reform was welfare-improving because it reduced adverse selection in the individual health insurance market in Massachusetts. Kolstad and Kowalski (2012) model and estimate the relationship between EHI and the labor market, and

find that the mandate-based health insurance reform is more efficient and thus achieves a higher welfare than the tax-based reform. Garthwaite et al. (2014) show that there has been a large increase in labor supply when Tennessee discontinued expansion of its Medicaid system in 2005. It is consistent with one of the key points of ours that many individuals work mainly to keep subsidized health insurance from their employers. The opposite of this case may occur with the ACA as all individuals will be able to purchase affordable health insurance without employers. This might cause some individuals to leave employment and even the labor force.

The third strand of the literature studies macroeconomic and welfare effects of size-dependent distortionary policies. Since the employer mandate of the ACA affects only large firms, the ACA can be thought as including a type-dependent distortionary policy. The papers in the literature usually extend a model developed by Hopenhayn and Rogerson (1993). Restuccia and Rogerson (2008) show that distortions by size-dependent policies can account for large observed differences in total factor productivity across countries. Guner et al. (2008) study distortionary effects of policy favoring smaller firms, which is a widespread size-dependent policy.

Finally, our paper is closely related to the newly emerging literature that investigates the consequences of the ACA in various dimensions. Within the literature, many researchers use a calibrated/estimated structural model to evaluate the macroeconomic effects of the ACA. Pashchenko and Porapakkarm (2013) use a general equilibrium life-cycle model that incorporates both medical expenses and labor income risk and study the macroeconomic and welfare implications of the ACA. They find that the reform introduces two channels of redistribution, one from the healthy to the sick and the other from the rich to the poor, but welfare gains are largely due to welfare gains of low-income individuals. Compared with our paper, they abstract from the decision of the firms' side, and they do not have the margin between PT and FT, which is one of our focus points. Feng and Zhao (2014) use a similar model, but with an endogenous labor supply decision, and argue that the employment-based health insurance system (pre-ACA) is an important reason why Americans work more hours than do Europeans who get universal health insurance from their governments. Their paper does not model firms' decisions of health insurance provision, but is related to our paper in the sense that they focus on the distortions to the labor market that the U.S. health insurance system creates. Janicki (2011) also analyzes the ACA using a similar model, but focusing on the role of asset-testing. Jung and Tran (2014) introduce human capital accumulation and study the interaction between a decision on health insurance and that on human capital accumulation.

Unlike our paper, the papers listed above abstract from the decisions on the firms' side. Brügemann and Manovskii (2010) and Aizawa and Fang (2013) are two studies that model labor market search along with firms' coverage decisions before and after the implementation of the ACA. In this sense, those papers are the closest to ours. However, we distinguish between PT and FT employment. Our focus is on this specific distinction because lately there has been a lot of discussion on how the employer mandate incentivizes firms to shift their workforce from FT workers to PT workers to avoid paying health insurance premiums and penalties. Brügemann and Manovskii (2010) use a calibrated model with firm and worker heterogeneity, and they analyze the macroeconomic consequences of the ACA. They find that the ACA achieves universal coverage, but if the pooling of the individuals participating in the exchange is implemented without other elements of the ACA, the health insurance market suffers from adverse selection. We also confirm their findings. However, their paper does not have the margin between PT and FT employment, and they restrict their attention to positive analysis. Aizawa and Fang (2013) also study the effects of the ACA as well as various alternative health-care reforms, using a model with firm and worker heterogeneity and

endogenous health. They also find that the uninsured rate declines significantly with the ACA. Surprisingly, Aizawa and Fang (2013) find if the employer mandate were removed from the ACA, average productivity and average wages in the economy would be higher, and the uninsured rate would be even lower. Their paper also abstracts from the margin between FT and PT employment.

In terms of the question that we would like to answer, our work is closest to Mulligan (2014), which is the only other study that considers the effect of the ACA on PT and FT employment. He argues that the ACA's employer penalty and the subsidies at the exchanges create FT employment taxes, which are avoided by PT workers and nonemployed individuals. FT workers are subject to these additional costs in two ways. If the employer is not offering health insurance, then the penalty to be paid by the employer is passed on to the FT worker as a wage reduction. If the employer offers health insurance, then the FT workers cannot receive subsidies at the exchanges, which Mulligan interprets as forgone gains. Based on his accounting exercise, the average FT taxes are equivalent to about six extra hours per week, which would depress aggregate work hours more than 2 percent. Even and Macpherson (2015) apply difference-in-difference approach to the recent data from Current Population Survey (CPS) and find that involuntary part-time employment has been increasing since 2010, possibly due to response of employers to the ACA. Their finding is consistent with Mulligan (2014). Different from the careful, but reduced-form accounting exercise in Mulligan (2014), we present a general equilibrium analysis with a rich macroeconomic model that features both firms and workers making optimal decisions. We consider all components of the reform, while he focuses on the employer mandate and health insurance subsidies. Moreover, he does not take into consideration the size distribution of firms in the economy and that large firms have offered health insurance to their employees pre-ACA as well. Lastly, different from all the studies mentioned above, our paper considers the welfare effect of the ACA.

3 The Affordable Care Act: An Overview

This section provides an overview of the U.S. health-care system, before (Section 3.1) and after (Section 3.2) the implementation of the ACA.

3.1 U.S. Health-Care System Pre-ACA

Health-care spending in the U.S. corresponds to more than 17 percent of GDP. This share is the highest among the major industrialized nations. Despite spending so much on health care, the U.S. is the only industrialized nation without universal coverage.

Pre-ACA, the majority of the nonelderly population was covered by health insurance provided by their employers. Employers that offered health insurance shared the cost of the health insurance premium with their employees. This type of insurance was provided by private insurers in the group insurance market. Health insurance provided through employers was purchased with pre-tax earnings, while insurance provided outside the employment setting was purchased with post-tax earnings. Therefore, for an employed individual, the former was a better choice than the latter.

There are also public insurance programs such as Medicare and Medicaid. Medicare is a national health-care program for individuals 65 years of age or older, who have worked and paid into the system. Medicaid is a government insurance program for individuals of all ages whose income and resources are insufficient to pay for health care. It is the largest source of funding for medical and health-related services for low-income individuals, their children, and some individuals with disabilities.

Table 1: Distribution of Health Insurance Choice Pre-ACA[1]

Type of Health Insurance	Percent
Employer-provided health insurance (EHI), policyholder	49.3
Employer-provided health insurance (EHI), dependent	17.2
Private health insurance (PHI), policyholder	3.3
Private health insurance (PHI), dependent	0.9
Medicaid	4.6
Other public health insurance	2.0
Uninsured	22.7

[1] Source: Current Population Survey (CPS), Annual Social and Economic Supplement (ASEC). Averages during 2004-2006 among individuals in the labor force and between the ages of 16 and 64 are shown. See Section 5.1 for a detailed description of the data source.

Pre-ACA, a majority of individuals obtained health insurance through their employers or public health-care programs. For individuals of working age who were not offered insurance through an employer and were not eligible for Medicaid, the only option was to seek health insurance in the private nongroup insurance market. A major problem with this market was the exclusions based on pre-existing health conditions. Private insurers often denied coverage or offered only limited coverage with high premiums to those with pre-existing conditions.

Table 1 shows the distribution of health insurance choice pre-ACA (averages of 2004-2006) among individuals in the labor force between the ages of 16 and 64.[2] As we discuss above, in the pre-ACA U.S., health insurance was mainly provided by employers. When taking policyholders and dependents into consideration, 66.5 percent of the individuals in the labor force obtained employer-provided health insurance (EHI). Only 4.2 percent obtained private health insurance (PHI) and 4.6 percent obtained Medicaid, while 2.0 percent benefited from other publicly provided health insurance. The uninsured rate was high, at 22.7 percent. As such, the main goal of the ACA is to lower this number significantly.

3.2 U.S. Health-Care System Post-ACA

The ACA signed into law in 2010, is the most recent health reform legislation that aims to reduce the uninsured rate in the nation by expanding access to affordable health insurance for everyone. The ACA affects all individuals and employers. In 2014, the health-care system started changing with the following the mandates of the reform.[3]

3.2.1 Individual Mandate

The individual mandate requires every U.S. citizen or legal resident to have health insurance that qualifies as minimum essential coverage starting on January 1, 2014.[4] The reform doesn't change

[2] See Section 5.1 for a detailed description of the data source.

[3] More detailed information can be found at www.healthcare.gov.

[4] The essential health coverage includes at least the following items and services: Ambulatory patient services (outpatient care individuals receive without being admitted to a hospital); emergency services; hospitalization (such as surgery); maternity and newborn care (care before and after a baby is born); mental health and substance use disorder services, including behavioral health treatment (this includes counseling and psychotherapy); prescription

the way insurance is obtained. Individuals can purchase PHI, obtain EHI, or obtain insurance through a government program such as Medicaid or Medicare. If an individual chooses not to have health insurance coverage, the individual is required to pay a fee that is either $95 per person or 1 percent of the individual's annual income in 2014, whichever number is higher. The fee will be gradually increased until 2016, at which time the fee will be either $695 per person or 2.5 percent of the individual's annual income, whichever is higher.[5]

3.2.2 Health Insurance Exchange

The ACA mandates the creation of state-based marketplaces (exchanges) through which individuals can purchase health insurance. Each state is allowed to choose whether to manage its own exchange or defer to federal management. On these exchanges, all individuals can shop for different plans based on cost and coverage. Plans are presented in five categories: bronze, silver, gold, platinum, and catastrophic, to make comparison easier. Cost assistance, which includes tax credits and cost-sharing subsidies, is available through the exchanges and can be used only on health insurance purchased at the exchanges.

States that set up their own exchanges determine which providers can participate in their exchange and negotiate benefits and prices. In a federal exchange, the U.S. Department of Health and Human Services (HHS) makes these decisions. In a joint-run exchange any provider that meets the minimum federal and state requirements can compete.

The ACA also mandates changes for the private insurance market, most notably removing the previous practice of denying coverage or charging higher rates for people with pre-existing conditions.[6] The law establishes a medical loss ratio and reviews for premium rate increases. Insurance companies are no longer allowed to discriminate against customers by charging higher premiums based on gender or health status. However there are certain factors such as age, tobacco use, family size, and geography that can be used to determine insurance costs to the consumer. All health insurance plans offered under the ACA must meet certain minimum coverage requirements and provide certain basic services (minimum essential coverage).

3.2.3 Health Insurance Subsidies

In order to assist individuals in purchasing health insurance, the ACA provides a number of subsidies for individuals and families with incomes up to 400 percent of the FPL when they purchase insurance on the health insurance exchanges. The FPL was $11,670 for an individual and $23,850 for a family of four in 2014. Cost-sharing reduction subsidies lower out-of-pocket costs (deductibles, coinsurance, copayments, and prescriptions) for silver plans bought on an exchange and are offered to individuals and families with incomes between 100-250 percent of the FPL. There are also premium tax credits offered to individuals and families with incomes between 100-400 percent of the FPL. The amount of the credit varies with income, while the monthly premium is capped between 2-9.5 percent of total income. Tax credits can be paid in advance to lower the premium upfront (this is called an advanced premium tax credit) or can be deducted from federal income taxes at the end of the year.

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drugs; rehabilitative and rehabilitative services and devices (services and devices to help people with injuries, disabilities, or chronic conditions gain or recover mental and physical skills); laboratory services; preventive and wellness services; chronic disease management; and pediatric services.

[5] There will be some exceptions for financial hardship, religious objections, individuals of American Indian descent, and individuals who have been uninsured for less than three months.

[6] The only exception is for grandfathered individual health insurance plans that are not bought through an employer.

Individuals with an option to obtain EHI are not eligible for subsidies.

3.2.4 Medicaid Expansion

Pre-ACA, Medicaid provided free or low-cost care for low-income individuals, families with children, pregnant women, and people with disabilities. Although the purpose of the ACA was intended for every state to expand Medicaid coverage to all individuals whose income is below 133 percent of the FPL, a Supreme Court ruling gave states an option to accept or decline the expansion.[7] As a result, only 30 states and the District of Columbia have accepted the expansion.[8] The states that did not adopt the expansion have retained their eligibility criteria for Medicaid and the Children's Heath Insurance Program (CHIP).[9] Unemployed individuals in some states may qualify for Medicaid and/or CHIP, or they may benefit from lower premiums on the exchanges.

Whether a state decides to expand Medicaid is very important due to the "coverage gap." Pre-ACA, there were some states in which Medicaid eligibility was as low as 50 percent of the FPL and factors such as gender and pregnancy affected eligibility. In most states, CHIP covered most low-income children, so the Medicaid gap mainly affected adults. Note that the ACA's health insurance subsidies are available only for individuals with incomes above 100 percent of the FPL. In states in which Medicaid eligibility is lower than 100 percent of the FPL, lower-income individuals who are ineligible for Medicaid will also be ineligible for subsidies at the exchanges, which means they will fall into a coverage gap. According to a report by the Kaiser Family Foundation, nearly four million poor, uninsured adults will fall into the coverage gap that results from state decisions not to expand Medicaid. These individuals would have been newly eligible for Medicaid had their state allowed for the Medicaid expansion.[10]

3.2.5 Employer Mandate

The employer mandate requires all *large* firms (those with 50 or more FTE employees) to provide health insurance to their FT employees and dependents up to age 26 or pay a penalty. All employees working more than 30 hours per week are considered FT employees, while those working fewer than 30 hours per week are considered PT. To calculate the number of FTE employees the total of monthly PT hours are divided by 120 and added to the number of FT workers. Firms with 100 or more FTE employees are required to insure at least 70 percent of their FT workers by 2015 and 95 percent of their FT workers by 2016. Firms with 50-99 FTE employees will need to start offering insurance to FT workers by 2016. The mandate does not apply to employers with 49 or fewer FTE employees.

If a firm doesn't provide health insurance coverage, provides coverage that doesn't offer minimum essentials, or provides coverage that is unaffordable, then it must make a per-employee, per-month "employer shared responsibility payment." If an employee's share of the premium costs for employee-

[7] The threshold is also often denoted as 138 percent because of how income is defined under the ACA.

[8] The states that have currently accepted the Medicaid expansion are Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Hawaii, Illinois, Indiana, Iowa, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, Vermont, Washington, and West Virginia. Utah is still debating.

[9] The CHIP program provides free or low-cost coverage to children and other family members. Children whose parents have too much income to qualify for Medicaid can qualify for CHIP.

[10] http://kff.org/health-reform/issue-brief/the-coverage-gap-uninsured-poor-adults-in-states-that-do-not-expand-medicaid-an-update/.

only coverage is more than 9.5 percent of her yearly household income and if the plan's share of the total costs of covered services is less than 60 percent, then the coverage is not considered affordable.[11]

The amount of the annual employer shared responsibility payment is based partly on whether the firm offers health insurance. If no health insurance is provided, then the annual payment is $2,000 per FT employee excluding the first 30 employees. If health insurance is provided, but the insurance doesn't meet the minimum requirements, the fee is either $3,000 per FT employee receiving subsidies or $2,000 per FT employee (minus the first 30 employees), whichever is less. Unlike employer contributions to employee premiums, the employer shared responsibility Payment is not tax deductible.

Small firms, those with fewer than 50 FTE employees, are exempt from the employer shared responsibility payment. Moreover, a small firm may qualify for the small business health care tax credit if it has fewer than 25 FTE employees making an average of about $50,000 a year or less. Firms with 10 or fewer FTE employees with average annual wages of less than $20,000 qualify for the full credit of up to 50 percent of their share of employer premiums. To obtain the tax credit, the firm needs to pay at least half of the total premium cost premium or half of a benchmark premium (second lowest cost silver plan). Starting in 2014, the tax credit became available only when the firm offered coverage through the Small Business Health Options Program (SHOP), which is a new program that simplifies the process of buying health insurance for small businesses. Beginning in 2016, all SHOPs will be open to firms with up to 100 FTE employees.

4 Model

This section first provides a description of the model pre-ACA. Section 4.1 sets up the problem of firms. Section 4.2 describes the problem of workers. Sections 4.3 and 4.4 describe the health insurance sector and the government, respectively. Section 4.5 defines the equilibrium of the model economy without the ACA. Section 4.6 describes how the stylized version of the ACA is introduced into the model, and Section 4.7 discusses some assumptions we make to simplify the model.

4.1 Firms

There are measure one of firms. All firms are atomless. For simplicity, we assume that firms are owned by capitalists. The capitalists receive the profits of all firms as dividends each period and consume.[12] A firm is characterized by (a, z), where z is the individual productivity. a represents the idiosyncratic preference for offering health insurance to employees and is assumed to be fixed and multiplicative to a firm's profits.[13] As will be shown, the mean is calibrated to be greater than one, which is consistent with the tax benefits of offering health insurance. The type distribution of firms is denoted by $\chi_{a,z}$. Each period, a firm (a, z) decides whether to offer insurance ($h = 2$)

[11] Since the firm will not know the household income of its employees, it will need to make sure the employee's share of the premium for employee-only coverage doesn't exceed 9.5 percent of her wages for that year in order to avoid paying the employer shared responsibility payment.

[12] Alternatively, we can assume that firms are jointly owned by workers and that workers receive the same amount of profits as dividends each period. However, since dividends turn out to be too large, especially for low-income workers, the differences in income across different workers, which is our focus, turned out to be tainted by dividends. The assumption of capitalists holding all the firms is meant to capture the fact that, in the U.S., wealth holdings are extremely concentrated.

[13] Alternatively, we could assume that a is additive to firm's profits. We chose multiplicative a because it is consistent with the fact that more of the larger firms offer health insurance to their employees.

to its FT workers or not ($h = 1$) and how many FT workers (n) and PT workers (m) to hire. For simplicity, we assume that firms do not offer health insurance to PT workers.

Current profits for a firm (a, z) that hires (n, m), but does not offer health insurance to FT workers $(h = 1)$ are as follows:

$$f(a, z, n, m; h = 1) = z\left[\alpha(p_1 n)^{\epsilon} + (1-\alpha)(\psi p_3 m)^{\epsilon}\right]^{\frac{\theta}{\epsilon}} - w_1 p_1 n - \psi w_3 p_3 m, \tag{1}$$

where $y = z\left[\alpha(p_1 n)^{\epsilon} + (1-\alpha)(\psi p_3 m)^{\epsilon}\right]^{\frac{\theta}{\epsilon}}$ is the production technology. Notice that there is a constant elasticity of substitution (CES) between FT labor and PT labor. The elasticity of substitution between FT and PT workers is $\frac{1}{1-\epsilon}$. α is the share parameter of the CES aggregation function. $\theta \in (0, 1)$ represents the decreasing returns to scale of the production technology. w_1 is the wage per unit of time and efficiency unit for a FT worker without insurance, while w_3 is the wage for a PT worker. p_1 and p_3 are the average productivities (efficiency units) of FT workers (without health insurance) and PT workers, respectively. To avoid different firms having different compositions of workers, we assume that all firms hire from the same pool of workers every period, and thus the average productivities of workers of each type is the same across all firms. In other words, because of this assumption, p_1 and p_3 are the same across all firms, and thus we do not keep track of different productivity of workers across different firms. $\psi \in (0, 1)$ is a parameter that represents the working hours of a PT worker. The working hour of a FT worker is normalized to one.

Similarly, current profits for a firm that offers health insurance $(h = 2)$ are as follows:

$$f(a, z, n, m; h = 2) = a\left\{z\left[\alpha(p_2 n)^{\epsilon} + (1-\alpha)(\psi p_3 m)^{\epsilon}\right]^{\frac{\theta}{\epsilon}} - w_2 p_2 n - \psi w_3 p_3 m - q_0 - \gamma q_2 n k\right\}. \tag{2}$$

Since a firm that offers health insurance to its FT workers hires these FT workers from a different pool, p_2 represents the average productivity of FT workers in the pool for firms that offer health insurance, and w_2 is the wage for those workers. q_0 is the fixed cost of providing health insurance to its FT workers, and q_2 is the variable cost, which is proportional to the number of FT workers covered by health insurance. γ is the proportion of the variable portion of the premium paid by the firm. k is the fraction of FT workers who actually purchase employer-provided health insurance (EHI). Since we assume that the composition of workers is the same across all firms offering health insurance, k is the same for all firms that offer health insurance as well. a represents the idiosyncratic preference shock of a firm for providing health insurance to its FT workers.

Since there is no dynamic aspect for the firm's decision problem, given prices, the decision of a firm of type (a, z) can be characterized as follows:

$$f(a, z) = \max\left\{\max_{n,m} f(a, z, n, m; h = 1),\ \max_{n,m} f(a, z, n, m; h = 2)\right\}. \tag{3}$$

The optimal decision rules of firms can be denoted by $n = g_n(a, z)$, $m = g_m(a, z)$, and $h = g_h(a, z)$. Notice that the optimal combination of (n, m) is conditional to the choice of insurance coverage h. $f(a, z)$ is the optimal profit.

4.2 Workers

There is measure $\overline{\mu}$ of workers. A worker is characterized by (i, d, x, s, e), where i is age, d is preference for leisure (disutility for work), x is the medical expenditure in the previous period,

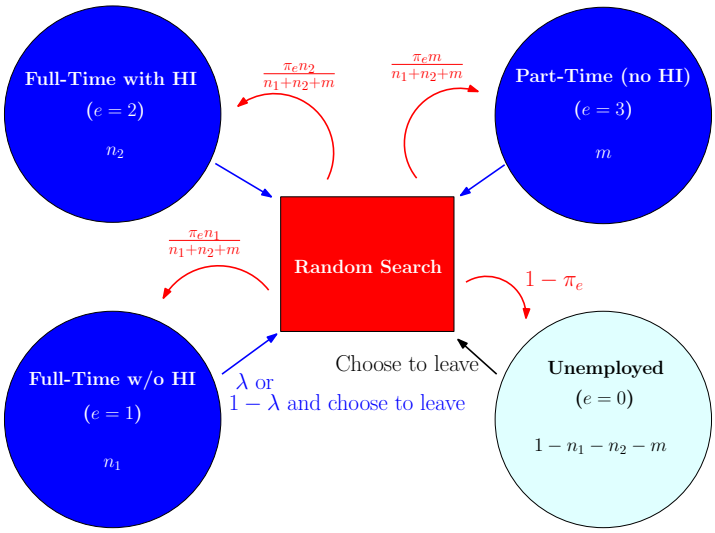

Figure 1: Labor market Transitions in the Model

s is the individual productivity, and e denotes the *island* that the worker is currently in.[14] We denote the type distribution of workers by $\mu_{i,d,x,s,e}$. For now, we assume $d \in \mathbb{R}^+$ is drawn once and does not change over time, but $s \in \mathbb{R}^+$ and $x \in \mathbb{R}^+$ changes over time with persistence. Both are assumed to follow respective first-order markov processes.[15] Because of the persistence of the medical expenditure, x in the previous period, together with age i, provides information about the medical expenditure in the current period, which is realized after the decision about health insurance purchase is made.

There are I stages of life, and workers age and die stochastically. A worker is born at age 1. Workers of age $i = 1, 2, .., I-1$ become age $i+1$, with probability π_i, and they remain age i with probability $1-\pi_i$. For a worker of age I, π_i is the probability of death, and $1-\pi_i$ is the probability of survival. Workers who died are replaced by newborns (age $i = 1$), implying that the total measure of workers is constant over time. The type of a newborn is drawn from the stationary type distribution of workers. The age of a worker affects the average productivity ξ_i and distribution of medical expenses.

A worker is in one of the four islands. $e \in \{0, 1, 2, 3\}$ denotes the island that a worker is currently in. $e = 0$ means that the worker is in the unemployment island; i.e., the worker is currently unemployed. A worker in the island $e = 1$ is hired as FT by a firm that does not offer health insurance. A worker in the island $e = 2$ is hired as FT by a firm that offers health insurance. A worker in the island $e = 3$ is hired by a firm as PT. PT workers are not offered health insurance by assumption.

Figure 1 illustrates the labor market transitions in the model. Each period, with probability λ, a worker with a job is separated from her job and has to leave the current island. By assumption, unemployed workers are not subject to this shock. When a worker leaves the current island, with probability $1-\pi_e$, the worker arrives in the unemployment island ($e = 0$). With probability π_e, the worker arrives in one of the islands with employment opportunities. In particular, with probability $\pi_e \frac{N_1}{N_1+N_2+M}$, the worker arrives in the island of FT jobs without insurance ($e = 1$), where N_1, N_2, and

[14] We introduce preference for leisure in addition to individual productivity in order to have a preference for both FT and PT work in the model.

[15] We assume that shocks to x and s are not correlated, for simplicity.

M are the number of FT jobs without health insurance, number of FT jobs with health insurance, and the number of PT jobs, respectively. With probability $\pi_e \frac{N_2}{N_1+N_2+M}$, the worker arrives in the island of FT jobs with health insurance ($e = 2$). With probability $\pi_e \frac{M}{N_1+N_2+M}$, the worker arrives in the island of PT jobs ($e = 3$). Intuitively, relative probabilities of finding jobs depend on the relative number of jobs available. Taken together, the expected value of leaving an island and moving randomly to a different island can be characterized as follows:

$$\widetilde{V}(i,d,x,s) = (1-\pi_e)\overline{V}(i,d,x,s,0) + \pi_e \frac{\left(N_1\overline{V}(i,d,x,s,1) + N_2\overline{V}(i,d,x,s,2) + M\overline{V}(i,d,x,s,3)\right)}{N_1+N_2+M}, \tag{4}$$

where $\overline{V}(i,d,x,s,e)$ is the expected value with respect to aging. Specifically, $\overline{V}(i,d,x,s,e)$ is characterized as follows:

$$\overline{V}(i,d,x,s,e) = \pi_i V(i+1,d,x,s,e) + (1-\pi_i)V(i,d,x,s,e), \tag{5}$$

with $V(I+1,d,x,s,e) = 0$. With probability $(1-\lambda)$, the worker is not forced to leave the current island. In this case, the worker can stay in the current island or can leave the island. If the worker chooses to leave, the worker arrives in a randomly assigned island as is the case with a separation shock.

The period utility of a worker takes the following log-linear form:

$$u(d,c,\ell) = \log c - d\ell, \tag{6}$$

where c is current consumption and ℓ denotes hours worked. Workers are risk-averse, which makes health insurance valuable for workers, but we also assume, for simplicity, that workers cannot save. In other words, workers are hand-to-mouth consumers.[16] We also assume a discount factor of β.

4.2.1 Unemployed Worker

An unemployed worker ($e = 0$) chooses whether to buy private health insurance (PHI, $j = 2$), obtain Medicaid ($j = 1$), or not obtain health insurance at all ($j = 0$). Medicaid is available only when current before-tax income is below a certain threshold $\overline{w}$. The unemployed worker also chooses whether to leave the current island. The health insurance decision is made *before* the medical expenditure in the current period x' is drawn. After x' is drawn, the worker receives unemployment benefits, pays for a PHI premium and out-of-pocket medical expenditures, and consumes, before the new productivity shock s' is drawn and the worker potentially moves to a different island. Consumption of a worker with $(i,x,x',s,e=0)$, conditional on the insurance decision $j \in \{0,1,2\}$, is as follows:

$$c(i,x,x',s,e=0;j=0) = (1-\tau_w)\min\{\xi_i s w_1 b, \overline{b}\} - x' \tag{7}$$

$$c(i,x,x',s,e=0;j=1) = (1-\tau_w)\min\{\xi_i s w_1 b, \overline{b}\} - (1-\phi_m)x' \tag{8}$$

$$c(i,x,x',s,e=0;j=2) = (1-\tau_w)\min\{\xi_i s w_1 b, \overline{b}\} - q_{1,i,x} - (1-\phi_1)x', \tag{9}$$

where τ_w is the individual income tax rate, ξ_i is the age component of individual productivity, s is the individual productivity shock, w_1 is the wage for a FT worker without health insurance, b is the

[16] Obviously, this assumption crucially affects the value of insurance. Exploring the implications of allowing workers to save is a topic for future research.

replacement rate for unemployment insurance benefits, $\bar{b}$ is the limit of unemployment insurance benefits, and $q_{1,i,x}$ is the PHI premium for a worker of age i and with the medical expenditure of x in the previous period. ϕ_1 and ϕ_m are the coverage ratios for PHI and Medicaid, respectively. These are assumed to be parameters. For an unemployed worker, $\ell = 0$ by definition. Remember that Medicaid ($j = 1$) is available only when $\min\{\xi_i s w_1 b, \bar{b}\} \leq \overline{w}$.

Now we can define the value for a worker in the unemployment island with type $(i, d, x, s, e = 0)$ as follows:

$$V(i,d,x,s,0) = \begin{cases} \max_{j\in\{0,2\}} V_j(i,d,x,s,0) & \min\{\xi_i s w_1 b, \bar{b}\} > \overline{w} \\ \max_{j\in\{0,1,2\}} V_j(i,d,x,s,0) & \text{otherwise} \end{cases} \tag{10}$$

$$V_j(i,d,x,s,0) = \sum_{x'}\sum_{s'} \pi_{i,x,x'}\pi_{s,s'} \left\{ u(d, \max\{\underline{c}, c(i,x,x',s,0;j)\}, 0) + \beta \max\{\overline{V}(i,d,x',s',0), \widetilde{V}(i,d,x',s')\} \right\}, \tag{11}$$

where equation (10) represents the optimal insurance decision. Equation (11) represents the values conditional on the insurance decision j. $\pi_{i,x,x'}$ and $\pi_{s,s'}$ are the Markov transition probabilities of x and s, respectively. Notice that the transition probabilities of x depend on age i as well. Also notice that there is a consumption floor $\underline{c}$. Following Hubbard et al. (1995), we assume that the government offers a welfare program that basically guarantees a minimum consumption level $\underline{c}$. This welfare program captures, in a parsimonious manner, SNAP, housing assistance, SSI, TANF, etc. Finally, the worker can choose between remaining unemployed or leaving the island and randomly arriving to a different island. The second max operator represents such a decision.

Let $g_e(i,d,x,s,e) \in \{0,1\}$ denote the decision of a worker to stay ($g_e = 0$) on the current island or leave ($g_e = 1$) the island. Also let $g_j(i,d,x,s,e) \in \{0,1,2\}$ denote the decision to purchase PHI. $g_j(i,d,x,s,e) = 2$ means purchasing PHI, $g_j(i,d,x,s,e) = 1$ means obtaining Medicaid, and $g_j(i,d,x,s,e) = 0$ means not obtaining any health insurance.

Note that we focus only on the labor force and do not have an out-of-labor-force state in the model. This is because (1) many insured individuals not in the labor force are dependent on their family members' health insurance plans, and we abstract from dependents in the model; (2) we do not have any retirement or self-employment decisions that are a big component of flows in and out of the labor force.

4.2.2 FT Worker Without Employer-Provided Health Insurance

A worker with $e = 1$ (FT employment without health insurance) first chooses whether to purchase PHI, obtain Medicaid (when eligible), or not obtain any health insurance. After the current medical expenditure x' is realized, the worker works FT, pays for the out-of-pocket medical expenses and health insurance premiums, and consumes. After the individual productivity in the next period s' is realized, with probability λ, the worker is forced to leave the current island and moves to a randomly assigned new island. With probability $1-\lambda$, the worker is not forced to leave the island and can choose between staying on the current island or leaving the island and randomly moving to a different island. Consumption of a worker with $(i, x, x', s, e = 1)$, conditional on the insurance

purchase decision j, is as follows:

$$c(i,x,x',s,e=1;j=0) = (1-\tau_w-\tau_u)\xi_i s w_1 - x' \tag{12}$$
$$c(i,x,x',s,e=1;j=1) = (1-\tau_w-\tau_u)\xi_i s w_1 - (1-\phi_m)x' \tag{13}$$
$$c(i,x,x',s,e=1;j=2) = (1-\tau_w-\tau_u)\xi_i s w_1 - q_{1,i,x} - (1-\phi_1)x', \tag{14}$$

where w_1 is the wage for a FT job without health insurance and τ_u is the payroll tax to finance the unemployment insurance program. Remember that Medicaid ($j=1$) is available only when a worker's current before-tax income is below a certain income threshold ($\xi_i s w_1 \leq \overline{w}$ is satisfied). Although there are firms of different types on the island, it is assumed that wages are determined to clear the labor markets on the islands. In other words, all firms offer the same wage. A worker on this island is assumed to work for one unit of time, which means FT.

The value for a worker with type $(i,d,x,s,e=1)$ can be similarly defined as follows:

$$V(i,d,x,s,1) = \begin{cases} \max_{j\in\{0,2\}} V_j(i,d,x,s,1) & \xi_i s w_1 > \overline{w} \\ \max_{j\in\{0,1,2\}} V_j(i,d,x,s,1) & \text{otherwise} \end{cases} \tag{15}$$

$$\begin{aligned} V_j(i,d,x,s,1) = \sum_{x'}\sum_{s'} \pi_{i,x,x'}\pi_{s,s'} \{ & u(d, \max\{\underline{c}, c(i,x,x',s,1;j)\},1) \\ & +\beta\left(\lambda \widetilde{V}(i,d,x',s') + (1-\lambda)\max\{\overline{V}(i,d,x',s',1), \widetilde{V}(i,d,x',s')\}\right)\Big\}. \end{aligned} \tag{16}$$

Among the terms representing the continuation value (last line of equation (16)), $\overline{V}(i,d,x',s',1)$ is the value of leaving the current island and randomly moving to a different island, which happens with probability λ. With probability $1-\lambda$, the worker can choose between staying on the current island or leaving the island and moving to a randomly assigned island. The max operator represents such a decision.

4.2.3 FT Worker With Employer-Provided Health Insurance

A worker that works FT for a firm that offers health insurance can accept EHI ($j=3$) or obtain health insurance from one of the other sources already described above ($j=0,1,2$). Consumption of a worker with $(i,x,x',s,e=2)$, conditional on the insurance purchase decision j is as follows:

$$c(i,x,x',s,e=2;j=0) = (1-\tau_w-\tau_u)\xi_i s w_2 - x' \tag{17}$$
$$c(i,x,x',s,e=2;j=1) = (1-\tau_w-\tau_u)\xi_i s w_2 - (1-\phi_m)x' \tag{18}$$
$$c(i,x,x',s,e=2;j=2) = (1-\tau_w-\tau_u)\xi_i s w_2 - q_{1,i,x} - (1-\phi_1)x' \tag{19}$$
$$c(i,x,x',s,e=2;j=3) = (1-\tau_w-\tau_u)\xi_i s w_2 - (1-\gamma)q_2 - (1-\phi_2)x', \tag{20}$$

where w_2 is the equilibrium wage for a FT job with health insurance, q_2 is the variable part of the EHI premium, $(1-\gamma)$ is the proportion of the EHI premium paid by the employee, and ϕ_2 is the EHI insurance coverage. A worker on this island is assumed to work for one unit of time, which means FT.

The value for a worker with type $(i,d,x,s,e=2)$ is as follows:

$$V(i,d,x,s,2) = \begin{cases} \max_{j\in\{0,2,3\}} V_j(i,d,x,s,2) & \xi_i s w_2 > \overline{w} \\ \max_{j\in\{0,1,2,3\}} V_j(i,d,x,s,2) & \text{otherwise} \end{cases} \tag{21}$$

$$V_j(i,d,x,s,2) = \sum_{x'}\sum_{s'} \pi_{i,x,x'}\pi_{s,s'} \{u(d, \max\{\underline{c}, c(i,x,x',s,2;j)\}, 1) \\ +\beta\left(\lambda \widetilde{V}(i,d,x',s') + (1-\lambda)\max\{\overline{V}(i,d,x',s',2), \widetilde{V}(i,d,x',s')\}\right)\Big\}. \quad (22)$$

4.2.4 PT Worker

A worker with $e = 3$ (PT job) first chooses whether to purchase PHI, obtain Medicaid (if eligible), or not obtain any health insurance. After the current medical expenditure x' is realized, the worker works PT, pays for out-of-pocket medical expenses and PHI premiums, and consumes. After the individual productivity in the next period s' is realized, with probability λ, the worker is forced to leave the current island and randomly move to a new island. With probability $1-\lambda$, the worker can decide whether to remain on the current island or move to a randomly assigned island. The consumption of a worker with $(i,x,x',s,e=3)$, conditional on the insurance purchase decision j is as follows:

$$c(i,x,x',s,e=3;j=0) = (1-\tau_w-\tau_u)\psi\xi_i s w_3 - x' \quad (23)$$
$$c(i,x,x',s,e=3;j=1) = (1-\tau_w-\tau_u)\psi\xi_i s w_3 - (1-\phi_m)x' \quad (24)$$
$$c(i,x,x',s,e=3;j=2) = (1-\tau_w-\tau_u)\psi\xi_i s w_3 - q_{1,i,x} - (1-\phi_1)x', \quad (25)$$

where w_3 is the wage for a PT job. $\psi \in (0,1)$ represents the hours that a PT worker works. Remember that a worker is eligible for obtaining Medicaid ($j=1$) only when $\psi\xi_i s w_3 \leq \overline{w}$.

The value for a worker with type $(i,d,x,s,e=3)$ can be defined as follows:

$$V(i,d,x,s,3) = \begin{cases} \max_{j\in\{0,2\}} V_j(i,d,x,s,3) & \psi\xi_i s w_3 > \overline{w} \\ \max_{j\in\{0,1,2\}} V_j(i,d,x,s,3) & \text{otherwise} \end{cases} \quad (26)$$

$$V_j(i,d,x,s,3) = \sum_{x'}\sum_{s'} \pi_{i,x,x'}\pi_{s,s'} \{u(d, \max\{\underline{c}, c(i,x,x',s,3;j)\}, \psi) \\ +\beta\left(\lambda \widetilde{V}(i,d,x',s') + (1-\lambda)\max\{\overline{V}(i,d,x',s',1), \widetilde{V}(i,d,x',s')\}\right)\Big\}. \quad (27)$$

4.3 Health Insurance Market

We describe here the environment surrounding the health insurance industry pre-ACA. First, in the PHI market, insurance premiums depend on the individual characteristics of each worker. We also assume a perfectly competitive market, which implies zero profit from health insurance for each type of worker. In other words, cross-subsidization across different types of workers is not possible in the equilibrium. Therefore, the current premium of the PHI $q_{1,i,x}$ for a worker of age i and with the medical expenditure of x in the previous period can be characterized as follows.

$$q_{1,i,x} = \sum_{x'} \pi_{i,x,x'}\phi_1 x' + \kappa_1. \quad (28)$$

The premium in the PHI market depends on workers' characteristics (i,x), because x' depends on age i and medical expenditures x from the previous period. Notice that there is no need to take expectation regarding stochastic aging because the medical expense shocks are realized within a

period and before stochastic aging occurs. κ_1 is an additional cost of PHI. κ_1 is later calibrated to match the take-up rate of PHI.

On the contrary, when an employer offers health insurance to its FT employees, it cannot discriminate employees depending on individual characteristics (community rating). In other words, all the employees are pooled. Since the composition of a worker's type is the same across all firms regardless of the firm's size, by assumption, insurance premiums for workers can be characterized by the distribution of (i, x) among workers in the island of $e = 2$ and the insurance decision of those workers on the island. Moreover, we assume that a fraction κ_2 of the total costs is covered by the fixed cost q_0 that each firm providing health insurance has to pay. The remaining fraction $1 - \kappa_2$ is paid by each employee working for the participating firms. The insurance premium per worker is q_2. Under these assumptions, the following equations characterize the zero-profit conditions for EHI.

$$q_0 = \frac{\kappa_2 \int \mathbb{1}_{g_j(i,d,x,s,2)=3} \sum_{x'} \pi_{i,x,x'} \phi_2 x' d\mu_{i,d,x,s,2}}{\int \mathbb{1}_{g_h(a,z)=2} d\chi_{a,z}} \tag{29}$$

$$q_2 = \frac{(1-\kappa_2) \int \mathbb{1}_{g_j(i,d,x,s,2)=3} \sum_{x'} \pi_{i,x,x'} \phi_2 x' d\mu_{i,d,x,s,2}}{\int \mathbb{1}_{g_j(i,d,x,s,2)=3} d\mu_{i,d,x,s,2}}, \tag{30}$$

where $\mathbb{1}$ is an indicator function that takes the value 1 (0) if the condition attached is true (false). $g_j(i, d, x, s, 2) = 3$ means that the worker of type $(i, d, x, s, 2)$ chooses to take EHI. Notice that, because of the pooling, the premium is independent of i or x of an individual worker in the pool.

Finally, there is no insurance premium for Medicaid. Medicaid is financed by the general government budget, which is described in the next section.

4.4 Government

In the environment without the ACA, the government administers three kinds of social insurance programs. First, the government provides unemployment insurance benefits to all unemployed workers. The amount of benefits is proportional (with a replacement rate of b) to labor income that the worker would have earned if the worker had worked FT (without health insurance), and it is subject to a limit $\bar{b}$. Second, the government guarantees a consumption floor $\underline{c}$ for all workers. Third, the government provides Medicaid, which covers a fraction ϕ_m of medical expenses for those whose current before-tax income is below an income threshold of $\overline{w}$. The government finances the unemployment insurance benefits using a payroll tax of rate τ_u applied to all employed workers. The remaining two programs are financed using a proportional income tax with a tax rate of τ_w. Assuming that the government satisfies its budget balance each period, the government's budget constraints can be expressed as follows:

$$\int \left[\mathbb{1}_{e=0} \min\{\xi_i s w_1 b, \bar{b}\}\right] d\mu_{i,d,x,s,e} = \tau_u \int \left[\mathbb{1}_{e=1} \xi_i s w_1 + \mathbb{1}_{e=2} \xi_i s w_2 + \mathbb{1}_{e=3} \psi \xi_i s w_3\right] d\mu_{i,d,x,s,e} \tag{31}$$

$$\begin{aligned} &\int \sum_{x'} \pi_{i,x,x'} \left[\max\{\underline{c} - c(i,x,x',s,e; g_j(i,d,x,s,e)), 0\}\right] d\mu_{i,d,x,s,e} \\ &+ \int \sum_{x'} \pi_{i,x,x'} \left[\mathbb{1}_{g_j(i,d,x,s,e)=2} \phi_m x'\right] d\mu_{i,d,x,s,e} \\ &\qquad = \tau_w \int \left[\mathbb{1}_{e=0} \min\{\xi_i s w_1 b, \bar{b}\} + \mathbb{1}_{e=1} \xi_i s w_1 + \mathbb{1}_{e=2} \xi_i s w_2 + \mathbb{1}_{e=3} \psi \xi_i s w_3\right] d\mu_{i,d,x,s,e}. \end{aligned} \tag{32}$$

Equation (31) represents the government's budget constraint associated with the unemployment insurance program. The left-hand side of equation (32) represents the costs of the two government programs, respectively. The last line shows how the two programs are financed, using a proportional tax with a rate of τ_w.

4.5 Equilibrium

The total demand for FT labor with health insurance (N_2^d) and without health insurance (N_1^d) as well as PT labor (M^d), can be computed as follows:

$$N_1^d = \int \mathbb{1}_{g_h(a,z)=1} g_n(a,z)\ d\chi_{a,z} \tag{33}$$

$$N_2^d = \int \mathbb{1}_{g_h(a,z)=2} g_n(a,z)\ d\chi_{a,z} \tag{34}$$

$$M^d = \int g_m(a,z)\ d\chi_{a,z}. \tag{35}$$

Meanwhile, the total supply of the three types of labor can be computed as follows:

$$N_1^s = \int \xi_i s\ d\mu_{i,d,x,s,1} \tag{36}$$

$$N_2^s = \int \xi_i s\ d\mu_{i,d,x,s,2} \tag{37}$$

$$M^s = \int \xi_i s\ d\mu_{i,d,x,s,3}. \tag{38}$$

The proportion of workers who are offered EHI and purchase it, k, can be calculated as follows:

$$k = \frac{\int \mathbb{1}_{g_j(i,d,x,s,2)=3} d\mu_{i,d,x,s,2}}{\int d\mu_{i,d,x,s,2}}. \tag{39}$$

Definition 1 (Steady-state equilibrium without the ACA) *A steady-state equilibrium without the ACA consists of $\chi_{a,z}$, $\mu_{i,d,x,s,e}$, $g_h(a,z)$, $g_n(a,z)$, $g_m(a,z)$, $V(i,d,x,s,e)$, $g_e(i,d,x',s',e)$, $g_j(i,d,x,s,e)$, $q_{1,i,x}$, q_0, q_2, w_1, w_2, w_3, p_1, p_2, p_3, k, N_1, N_2, M, τ_u, and τ_w such that:*

1. *$g_h(a,z)$, $g_n(a,z)$, and $g_m(a,z)$ are the optimal decisions of the firm.*
2. *$V(i,d,x,s,e)$ is the solution to the optimization problem of the worker. $g_e(i,d,x',s',e)$ and $g_j(i,d,x,s,e)$ are the associated optimal decision rules.*
3. *$\chi_{a,z}$ is time-invariant.*
4. *$\mu_{i,d,x,s,e}$ is time-invariant and consistent with the worker's optimal decision rules.*
5. *Insurance premium $q_{1,i,x}$, q_0, and q_2 are characterized by equations (28), (29), and (30), respectively.*
6. *w_1, w_2, and w_3 clear the labor market on islands of FT jobs without and with insurance, and PT jobs, respectively. N_1, N_2, and M are the market clearing supply of each type of labor.*

7. *p_1, p_2, and p_3 are the average productivities of workers on the respective islands.*

8. *The proportion of workers who are offered health insurance from their employers and obtain it, satisfies equation* (39).

9. *τ_u satisfies the government's budget constraint* (31).

10. *τ_w satisfies the government's budget constraint* (32).

4.6 The Affordable Care Act

In order to investigate the effects of the ACA on the U.S. economy, a stylized version of the ACA is introduced in the baseline model described above. The stylized version of the ACA consists of five components as in the actual ACA: (i) an individual mandate (IM), (ii) the establishment of the health insurance exchange (EX), (iii) health insurance premium subsidies (SU), (iv) the Medicaid expansion (ME), and (v) an employer mandate (EM). Furthermore, the additional expenses under the ACA are financed through proportional income taxes (TX). We will describe the modeling strategy of the six components in detail below.

4.6.1 Individual Mandate (IM)

When the ACA is fully implemented, workers will have to either obtain health insurance or have to pay an annual penalty of $695 or 2.5 percent of their income, whichever is greater.[17,18]

4.6.2 Health Insurance Exchange (EX)

We assume that the PHI market in the model without the ACA is replaced by the exchange, in which health insurance providers cannot offer different premiums to different workers depending on past medical expenses (x). For simplicity, we also assume that there is no discrimination based on age (i).[19] We assume that there is a representative health insurance provider that pool all the workers who purchase from the exchange, and offers the same fair premium to everybody. In the exchange, the PHI premium, q_1, no longer depends on the age i or the current medical expenses x and satisfies the following zero-profit condition.

$$q_1 \int \mathbb{1}_{g_j(i,d,x,s,e)=2} d\mu_{i,d,x,s,e} = \int \mathbb{1}_{g_j(i,d,x,s,e)=2} \pi_{i,x,x'} \phi_1 x' d\mu_{i,d,x,s,e} \tag{40}$$

In an equilibrium with the ACA, q_1 satisfies the condition (40) instead of (28).

4.6.3 Health Insurance Premium Subsidies (SU)

Under the ACA, when a worker purchases health insurance at the exchange, the worker can receive subsidies if her income is between 100 percent and 400 percent of the FPL, and the employer does

[17] The size of punishment gradually rises until 2016. In 2014, the penalty $95 or 1 percent of income, whichever is greater. In 2015, the penalty is $325 or 2 percent of income, whichever is greater.

[18] There is no penalty if the health insurance premium exceeds 8 percent of household income, coverage lapses less or equal to 3 months, income is below the income tax filing threshold, or the person is Native American. However, we abstract from these details, for simplicity.

[19] Under the ACA, premiums do depend on age; for example, old individuals can pay premiums up to three times for young individuals. For simplicity, we abstract from this type of discrimination for now. Similarly, tobacco use is another factor that adds to the amount of the premiums. Individuals cannot be discriminated based on health history or gender.

not offer health insurance. However, as we discussed above, if the income is below 133 percent of the FPL, the worker is eligible for Medicaid, meaning that the worker does not need to pay health insurance premiums. If the worker's income is at 400 percent of the FPL, she does not need to pay more than 9.5 percent of her income for health insurance premiums. The difference is subsidized by the government. If the worker's income is between 100 percent and 133 percent, the maximum health insurance premium that the worker is liable for is 2 percent. This rate benefits individuals even in a state that opts out of the Medicaid Expansion in the U.S. economy, but no worker takes this option in the model because every worker whose income is below 133 percent of FPL is eligible for Medicaid. The maximum health insurance premium that the workers whose income is between 100 and 400 percent of the FPL have to pay is linearly interpolated between 3 and 9.5 percent.[20]

4.6.4 Medicaid Expansion (ME)

Historically, Medicaid covered low-income children, pregnant women, elderly and disabled individuals, and some parents, but excluded other low-income adults. Under the ACA, Medicaid eligibility is simplified and expanded such that individuals whose income is below 133 percent of the FPL can obtain Medicaid.[21] We include Medicaid in the baseline model, where eligibility is income based for simplicity. When the ACA is introduced, the Medicaid expansion is modeled as raising the income threshold $\overline{w}$ to be eligible for Medicaid. We interpret the Medicaid expansion as workers with current before-tax incomes below $\overline{w}$ (which is calibrated to be 133 percent of the FPL) can now obtain health insurance that covers ϕ_m of the realized medical expenses for free.

As discussed earlier, an interesting feature is called the coverage gap, which turns out to be a problem in states that opt out of Medicaid.[22] The health insurance subsidies are available for individuals with incomes between 100 and 400 percent of the FPL. However, Medicaid without the expansion does not always cover individuals with incomes below 100 percent of the FPL. There are individuals who cannot be eligible for either health insurance subsidies or Medicaid (without the expansion under the ACA), even though their income is below 100 percent of the FPL. These individuals fall in a coverage gap. We will come back to this issue when we investigate the counterfactual in which the Medicaid expansion is not implemented, and therefore the coverage gap appears.

4.6.5 Employer Mandate (EM)

Under the ACA, firms with 50 and more FTE employees have to offer health insurance to their employees or pay a penalty.[23] Regarding PT workers, there are interesting features associated with the employer mandate. First, the ACA does not require any firm to offer health insurance to PT employees, even if it is a large firm. However, hours of PT employees are counted when a firm's size is calculated (in terms of FTE employees). Since we assume that a PT employee works a fraction ψ of FT workers, the employment size of a firm that hires n FT workers and m PT workers can be

[20] The actual formula for the maximum health insurance premium takes the form of a step function, between 3 percent and 9.5 percent.

[21] The threshold is also often denoted as 138 percent, because of how income is defined under the ACA. Our quantitative results are not significantly affected by the choice between 133 percent or 138 percent.

[22] See, for example, `http://obamacarefacts.com/medicaid-gap/` for more details of the coverage gap.

[23] As mentioned earlier, firms with fewer than 50 FTE employees are exempt from the penalty. Moreover, small firms with fewer than 25 FTE employees earning an average of about $50,000 a year or less may qualify for a small business health care tax credit. Firms with 10 or fewer FTE employees with average annual wages of less than $20,000 qualify for the full credit of up to 50 percent of their shares of the employer premiums. Since small firms employ a small share of the workforce, we abstract from these subsidies for now.

calculated as follows:

$$\text{Employment size in FTE} = n + \psi m \tag{41}$$

The penalty $\zeta(n, m)$ for a firm that hires n (m) FT (PT) workers is defined as follows:

$$\zeta(n, m) = \begin{cases} 0 & \text{if } n + \psi m > 50 \\ \$2000(n - 30) & \text{if } n + \psi m \geq 50 \end{cases} \tag{42}$$

Notice that whether a firm is subject to the employer mandate depends on its employment size in FTE employees, but the actual penalty depends only on the number of FT workers, since PT workers do not need to be offered health insurance under the employer mandate.

4.6.6 Financing the ACA (TX)

For simplicity, the government still maintains a period-by-period budget balance, and the additional expenses under the ACA are financed by raising the proportional labor income tax by the rate of τ_w.

4.7 Assumptions of the Model

Before closing the description of the model, let us address six assumptions we make here. First, we abstract from saving. Of course, with risk-averse preferences, workers would like to save and self-insure if allowed. However, the model is already rich and it is unfeasible to solve a model with a saving decision on top of what we already have in the model. Relaxing this assumption is definitely interesting. Both Aizawa and Fang (2013) and Brügemann and Manovskii (2010) assume hand-to-mouth workers as well.

Second, firms are owned by capitalists who consume dividends every period. It would definitely be interesting to have realistic inequality in income and wealth holdings so that we could discuss redistribution in a more realistic manner.

Third, firms offer health insurance only to FT employees. This simplifies the firms' decisions. We think it is not the first-order concern because many PT workers do not obtain health insurance from their employers in the pre-ACA period, and the ACA does not obligate large firms to offer health insurance to PT workers.

Fourth, there are spot labor markets, and as a result, all firms have the same composition of heterogeneous workers. In both Aizawa and Fang (2013) and Brügemann and Manovskii (2010), heterogeneity in the employees' health across different firms plays an important role. We abstract from this feature so that we can introduce richer heterogeneity in other dimensions, such as PT and FT employment.

Fifth, we focus on individuals in the labor force. This assumption is related to the fact that we abstract from life after retirement and dependents. Introducing those features in an analysis of the ACA would definitely be an interesting path.

Sixth, we assume that the distribution of medical expense shocks is exogenous. This is for simplicity. In particular, there are studies that argue being insured improves health in general, because access to preventive care is cheaper if an individual is insured. This feature is expected to increase the benefits of the ACA if the ACA achieves a better health insurance coverage.

Table 2: Calibration: Baseline Model Without the ACA[1]

Parameter	Description	Value
Firm		
ϵ	CES: Elasticity of substitution=2.0	0.5000
α	Share parameter of production function	0.7610
$\overline{a}$	Mean of distribution of a	1.2180
$\widetilde{a}$	Range of distribution of a	0.2000
θ	Curvature of production function	0.6400
σ_z	Standard deviation of productivity shock	1.0000
$\underline{z}$	Threshold level of productivity shock	1.1000
Worker		
β	Time discount factor	0.9600
η	Disutility of leisure	1.4000
$\overline{d}$	Step of preference shock	0.2400
ψ	Hours for a PT job	0.5400
ρ_s	Persistence of productivity shock	0.9000
σ_s	S.D. of productivity shock	0.1000
λ	Probability of leaving island	0.2000
π_e	Probability of employment	0.8547
$\overline{\mu}$	Total measure of workers	23.0966
$\pi_{i=1}$	Survival probability (young)	0.8932
$\pi_{i=2}$	Survival probability (prime-age)	0.9655
$\pi_{i=3}$	Survival probability (old)	0.8067
$\xi_{i=1}$	Average productivity (young)	13,131
$\xi_{i=2}$	Average productivity (prime-age)	32,500
$\xi_{i=3}$	Average productivity (old)	33,500
Insurance		
ϕ_1	Insurance coverage ratio (PHI)	0.7500
ϕ_2	Insurance coverage ratio (EHI)	0.7500
γ	Proportion of EHI premium paid by employer	0.8000
κ_1	Extra cost of PHI	0.0038
κ_2	Proportion EHI premium covered by fixed cost per employer	0.1800
Government		
b	UI replacement rate	0.1440
$\overline{b}$	Upperbound of UI benefits ($\times$ median wage income)	0.1920
$\underline{c}$	Consumption floor	0.0680
ϕ_m	Insurance coverage ratio (Medicaid)	0.7500
$\overline{w}$	Income threshold for receiving Medicaid ($\times$ FPL)	0.6300

[1] Annual values. α, $\overline{a}$, $\widetilde{a}$, σ_z, $\underline{z}$, η, $\overline{d}$, π_e, κ_1, and $\overline{w}$ are calibrated to match closely related targets. See Section 5.4 for the calibration procedure. Other parameters are exogenously set. See Section 5.3 for a description.

5 Calibration

In this section, the baseline model without the ACA is calibrated to match the characteristics of the U.S. economy before the ACA was introduced. In particular, whenever possible, we use the 2004-2006 averages of the U.S. data, in particular, for labor market statistics. In Section 5.1, we discuss how the data from the Current Population Survey (CPS) are modified so that the data

Table 3: Life-Cycle Statistics: CPS[1,2]

Age	16-64	16-25	26-54	55-64
Proportion	100.00	21.51	66.61	11.88
Employment Status				
Full-time (FT) employed	79.17	54.53	86.55	82.44
Part-time (PT) employed	15.19	32.87	9.92	12.74
Unemployed	5.64	12.60	3.53	4.82
Health Insurance				
Employer-provided health insurance (EHI)	56.16	27.06	63.81	65.95
Private health insurance (PHI)	14.49	26.71	10.38	15.44
Medicaid	6.69	10.47	5.58	6.09
Uninsured	22.65	35.76	20.23	12.51

[1] Source: Current Population Survey (CPS) Annual Social and Economic Supplement (ASEC), average statistics for 2004-2006.

[2] The following adjustments were made to make the data consistent with the model: (1) FT workers receiving EHI as dependents are reclassified as FT-EHI policyholders, (2) individuals receiving PHI as dependents are reclassified as PHI policyholders, (3) individuals working PT or who are unemployed and receiving EHI either as a policyholder or a dependent are reclassified as PHI policyholders, and (4) individuals receiving other public HI are reclassified as individuals receiving Medicaid.

are consistent with the structure of our model. In Section 5.2, we discuss how we construct the medical expense shocks using the Medical Expenditure Panel Survey (MEPS). We also obtain data on labor income for different age groups from the MEPS. Section 5.3 covers the parameters that are exogenously set, while Section 5.4 discusses parameters calibrated by matching closely related targets. Table 2 summarizes the calibration of the baseline model without the ACA.

5.1 Current Population Survey (CPS)

We use several data sources to compute our calibration targets. The Current Population Survey (CPS), sponsored jointly by the U.S. Census Bureau and the U.S. Bureau of Labor Statistics (BLS), is the primary source of labor force statistics for the population of the United States. Every month, 60,000 households are surveyed to collect information on a representative population's demographic characteristics and detailed labor force status. While the monthly CPS does not have any information about workers' health insurance status, there is an annual supplement called the Annual Social and Economic Supplement (ASEC), which collects additional information from a set of CPS respondents about sources of income, earnings, and health insurance during the previous calendar year. ASEC data allow us to determine the insurance rate among the private-sector employees. There are four types of insurance: Medicaid, other types of public insurance (Medicare, Veterans insurance), employer-provided private health insurance (EHI), and directly purchased private health insurance (PHI). Some individuals report having several types of insurance; in that case, we adjust their survey weights by dividing the number of insurance types they have. Some individuals report having Medicaid and PHI; we drop their Medicaid insurance if they also report annual income above $50,000.

We use 2004-2006 averages of the CPS (ASEC) to create calibration targets for the baseline model.

We chose these three years because during this time there was no recession and no discussion of a national health-care reform. We include all workers 16 to 64 years of age in the labor force. The age cutoff is at 64 because we do not have retirement in the model. We also exclude those who were employed in agriculture or in the military. In addition, we restrict our sample to the private sector, meaning employed individuals are currently working in private-sector jobs and unemployed individuals are looking for jobs in the private sector. We chose to focus on the private sector because we are interested in understanding how the changes associated with the ACA will affect the decisions made by the firms and individuals in the private sector. Individuals working 10-34 hours are considered PT employees, while those working 35 hours and more are considered FT employees.

We divide workers that satisfy the criteria into three age groups — young workers (ages 16-25), prime-age workers (ages 26-54), and old workers (ages 55-64). We focus on these three groups because each group has distinct characteristics: (1) young workers tend to work PT and have lower income, but have medical expenditure risks that are smaller, (2) prime-age workers tend to exhibit strong labor market attachment, typically working FT, and have higher income, but have medical expense risks that are also higher, and (3) old workers tend to work FT less frequently than prime-age workers, but have higher medical expense risks.

Table 3 summarizes some statistics from the CPS. About 21.5 percent of the labor force are young workers, 66.6 percent are prime age, and 11.9 percent are old workers. The overall unemployment rate is 5.6 percent, which is used as a calibration target. The unemployment rate is higher for young workers (12.6 percent) than prime-age workers (3.5 percent) and old workers (4.8 percent). In the labor force, 79.2 percent work FT, while 15.2 percent work PT. This allocation also varies across age groups. Among young workers, 32.9 percent work PT, while this ratio is lower for prime-age workers (9.9 percent) and old workers (12.7 percent).

Regarding the health insurance related statistics, in order to make the statistics from the CPS consistent with the model, we need to make some adjustments for three reasons. First, there are no dependents in the model. Second, we assume PT workers do not receive health insurance from their employers, although some PT workers do in the data. Third, there are public health insurance programs other than Medicaid that are not included int he model. In order to account for those differences, we make adjustments to the CPS data so that the data are consistent with the model making sure that we do not to drop workers out of the sample. We decided to keep all workers when computing statistics because we would like to have the same aggregate uninsured rate as in the data. Four adjustments that we made are as follows:

1. FT workers receiving EHI from an employer as dependents are reclassified as FT workers receiving EHI from their employers as policyholders.

2. Workers receiving directly purchased PHI as dependents are reclassified as workers purchasing PHI as policyholders.

3. Unemployed or PT workers receiving EHI either as a policyholder or a dependent are reclassified as purchasing PHI as policyholders.

4. Workers receiving other public health insurance are reclassified as workers receiving Medicaid.

The last four rows of Table 3 show the insurance choices of workers, after making the adjustments listed above. All are divided by the number of individuals in the labor force. Overall, 56.2 percent of

Table 4: Life-Cycle Statistics: MEPS[1]

Age	16-64	16-25	26-54	55-64
Proportion (%)	100.00	15.91	69.72	14.37
Wage				
Wage income, mean	36,409	16,202	39,922	41,733
Wage income, median	30,000	13,131	32,500	33,500
Medical Expense Distribution				
Medical expense, mean	2,638	1,498	2,429	4,913
Medical expense, median	730	374	669	2,026
Standard deviation	7,495	3,953	6,871	11,733
Proportion of zero (%)	18.67	25.13	19.14	9.28
90 percentile	6,073	3,828	5,481	9,894
99 percentile	27,613	14,086	25,788	48,765

[1] Source: Medical Expenditure Panel Survey (MEPS) Longitudinal Data, 2004-2005. The statistics in the table are constructed based on the distribution of medical expenses in 2005.

the individuals in the labor force receive EHI as FT workers, while 14.5 percent purchase PHI, and 6.7 percent receive Medicaid. The uninsured rate, which is the remaining part of the labor force, is 22.7 percent. However, one can see that there is significant heterogeneity across age groups. For example, young workers have a higher uninsured rate (35.8 percent). They also rely more on PHI (26.7 percent) as well as Medicaid (10.5 percent). Prime-age workers have a slightly lower uninsured rate (20.2 percent). They rely more on EHI (63.8 percent) and less on PHI (10.4 percent) or Medicaid (5.6 percent). The uninsured rate is significantly lower for older workers (12.5 percent) because more of them obtain EHI (66.0 percent).

5.2 Medical Expenditure Panel Survey (MEPS)

In this section, we describe how we construct medical expense shocks using the Medical Expenditure Panel Survey (MEPS).[24] We use the MEPS Longitudinal Data for 2004-2005. We include only individuals whose wage income was positive in both 2004 and 2005, and who were between 16 and 64 years of age. We document statistics of all individuals who satisfy the criteria, and consider young workers (ages 16-25), prime-age workers (ages 26-54), and old workers (ages 55-64) separately.

Table 4 summarizes some statistics that are of interest to us. The first row shows the proportion of each age group. These numbers are generally consistent with the numbers from the CPS presented in Table 3. The next two rows show the means and medians of the wage income. The median wage income was \$30,000 for the whole sample. However, it was lower for young workers (\$13,131) and higher for older groups (\$32,500 for prime-age workers and \$33,500 for old workers). The means are higher because the distributions are skewed to the right.

The bottom panel shows the statistics for the distribution of medical expenses in 2005. The mean and median are \$2,638 and \$730, respectively, but there is a large dispersion within and across age groups. Among all workers, even though the median is only \$730 and 18.7 percent pay nothing, the standard deviation is \$7,495, and the 99th percentile of the medical expense distribution pays

[24] We would like to thank Sagiri Kitao for letting us use her cleaned-up MEPS data for 2009-2010 in an earlier draft.

$27,613. In terms of across age-group heterogeneity, both the average of and the dispersion of medical expenses increase with age. The median medical expense is only $374 among young workers, but it is $2,026 among old workers. The standard deviation also increases with age, from $3,953 for the young to $6,871 for the prime age and $11,733 for the old. The 99th percentile among young workers pays $14,086. while the 99th percentile among old workers pays $48,765.

We create a medical expense shock based on the longitudinal data from the MEPS in the following manner.

1. We create grid points $x_1, x_2, ..., x_N$ for medical expense shocks.[25] We set $x_1 = 0$ because there are a significant number of workers who pay zero each year.

2. We construct the Markov transition matrix, $\pi_{i,x,x'}$, using the following three steps.

   - First, we compute the probability that a worker of age group i whose medical expenses were not zero in 2004 had zero medical expenses in 2005. We assign the probability of π_{i,x_n,x_1} with $n = 2, 3, ..., N$.
   - Second, we compute the probability that a worker of age group i whose medical expenses were zero in 2004 and also had zero medical expenses in 2005. We assign the probability of π_{i,x_1,x_1}.
   - Using only workers of age group i who report strictly positive medical expenses in both 2004 and 2005, we estimate the following AR(1) process:

     $$\log x_{2005} = (1 - \rho_{x,i})\mu_{x,i} + \rho_{x,i} \log x_{2004} + \epsilon' \qquad \epsilon' \sim N(0, \sigma^2_{x,i}). \tag{43}$$

     Then we approximate the estimated AR(1) process with a discrete first-order Markov process using the method of Tauchen (1986). After taking into account the probability of zero medical expenses, the Markov process gives π_{i,x_n,x_m} with $n = 2, 3, ..., N$ and $m = 2, 3, ..., N$.

3. As for π_{i,x_1,x_n} with $n = 2, 3, ..., N$, we assume that, if the medical expenses are zero in the current period, but are not zero in the next period, medical expenses are distributed according to the ergodic distribution of the Markov process obtained in the previous step.

5.3 Parameters Exogenously Set

On the firm's side, we assume that a firm-specific productivity shock is distributed following a truncated log-normal distribution with standard deviation of σ_z and that the truncation threshold is $\underline{z}$. Without truncation, the model generates far more smaller firms than in the data. The truncation can be interpreted as a fixed cost of operation that prevents firms with low productivity from operating. Preference shock to offering health insurance is assumed to be uniformly distributed over $[\overline{a}-\widetilde{a}, \overline{a}+\widetilde{a}]$. Both shocks are discretized. Together with ϵ, the elasticity of substitution between the FT and PT workers, α, the share parameter between FT labor and PT labor in CES production function, and θ, the curvature parameter representing decreasing returns of production, there are seven parameters on the firms' side. Among the seven, α, σ_z, $\underline{z}$, $\overline{a}$, and $\widetilde{a}$ are calibrated to match closely related targets. We will come back to these parameters later. ϵ is calibrated to be 0.5 based

[25] We create the grids based on the method of Tauchen (1986) applied to workers 55-64 years of age, because they incur the highest medical expenses.

on the elasticity of substitution between FT and PT labor supply, which is 2.0. Mulligan (2014) also uses the elasticity of 2.0 in his calculations. Montgomery and Cosgrove (1993) estimate a range of 1.7 to 2.6 for the elasticity of substitution in production between FT and PT workers. Following Boedo and Mukoyama (2012), we set the curvature of the production function θ to 0.64.

On the workers' side some parameters are chosen using the CPS (ASEC) and the MEPS that are described in the previous sections. In particular, the aging and survival probabilities ($\pi_{i=1,2,3}$) are set to satisfy (1) the average time spent as prime age (26-54) is 29 years, (2) the proportion of young workers is 21.5 percent, and (3) the proportion of old workers is 11.9 percent. These proportions are taken from the CPS. The age component of labor productivity ($\xi_{i=1,2,3}$) is taken from median wage income in the MEPS. We use the MEPS data instead of the CPS because we construct the medical expense shocks based on the MEPS, too.

The discount factor, β, is set at 0.96, corresponding to an annual 4 percent interest rate. This is a standard value in the literature. The proportion of time worked by PT workers, ψ, is set at 0.54. This is the ratio of average hours among PT workers (23 hours) and those of FT workers (42.5) in 2004-2006.[26] This is consistent with Montgomery and Cosgrove (1993), who report that the average weekly hours of PT workers are close to 20 hours, which is about half of the average weekly hours of FT workers (40 hours). We assume that the worker-specific productivity shock s follows an AR(1) process with a persistence parameter of ρ_s, and a standard deviation of σ_s. The persistence of the individual labor productivity shock, ρ_s, is set at 0.90, while the standard deviation of the shock, σ_s, is set at 0.10. These are the values in the middle of various estimates using micro-level data. The probability of leaving an island λ is set at 0.20. This is based on the fact that the average duration of a job is about 5 years. The total measure of workers, $\overline{\mu}$, is set at 23.1, which is computed based on the average employment size across all firms according to the Business Employment Dynamics (BED) statistics.[27] The remaining three parameters — the disutility of labor (η), the step of preference shock d ($\overline{d}$), and the probability of employment after leaving an island (π_e) are calibrated to match closely related targets. We will come back to those parameters in Section 5.4.

There are five parameters related to the health insurance market before the ACA. As for the insurance coverage ratio for PHI (ϕ_1) and EHI (ϕ_2), we set both to be 0.75. According to Jeske and Kitao (2009), for the middle quintile of individuals in terms of medical expenses, 59.4 percent of their medical expenses are covered by health insurance. However, the coverage ratio is increasing in medical expenses. According to the authors, the top 1 percent in terms of medical expenses enjoy the coverage ratio of 84.5 percent. $\phi_1 = \phi_2$ is set at higher than 0.59 to take into account the higher coverage at the top end of the medical expense distribution. The proportion of health insurance premiums of EHI paid by the employer γ is set at 80 percent, again following Jeske and Kitao (2009). The proportion of costs associated with EHI that are covered by fixed costs per participating firm, κ_2, is motivated by some evidence that smaller firms are less likely to offer health insurance because of administrative costs of offering health insurance. Lee (2002) reports that total administrative costs make up 40.0 percent of incurred claims for firms with 1-4 employees, while the proportion is 18.0 percent for firms with 50-99 employees and 5.5 percent for firms with more than 10,000 employees. We calibrate κ_2 to be 0.18, since the focus of our exercises are firms with an employment size of about 50. The additional cost of PHI, κ_1, is calibrated together with other

[26] In the data, PT workers are those who work fewer than 35 hours. This is the definition of PT workers pre-ACA.

[27] The average employment size during 2004-2006 is 21.8. We divide the number by the target employment rate (= 1−unemployed rate) to recover the size of the labor force.

Table 5: Calibration: Summary of Moments

Target[1]	Data	Model
% of unemployed workers	5.64	5.64
% of FT workers	79.17	79.25
% of PT workers	15.19	15.11
% of uninsured workers	22.65	22.64
% of workers receiving Medicaid	6.69	6.61
% of workers purchasing private health insurance (PHI)	14.49	14.45
% of FT workers with employer-provided health insurance (EHI)	56.16	56.30
% of firms offering health insurance	61.33	61.15
% of firms with less than 5 employees	54.37	54.19
% of firms with more than 1,000 employees	0.20	0.21
% of FT wage / PT wage	1.000	1.000
% of job-to-job transition	0.300	0.299

[1] All the worker-related proportions are shares out of the total labor force.

parameters.

As for the parameters associated with government programs, the replacement rate for unemployment insurance benefits, b, is set at 0.144. Although the UI replacement ratio is typically 0.40 in the U.S. (Shimer (2005)), b is set at 0.144, taking into account that the take-up rate of UI benefits is around 36 percent. This smaller b can also be justified with the observation that the duration of UI benefits is 26 weeks in normal times.[28] In the model, since workers have a choice between a PT job and unemployment, having b close to 0.5 (proportion of hours worked by PT workers relative to FT workers) makes it difficult to obtain a high fraction of workers working PT instead of being unemployed. The upper bound of UI benefits, $\overline{b}$, is set at 0.192 of the average wage income. The cross-state average of the maximum amount of UI benefits is about \$420 per week, which is about 0.53 of the median weekly wage income. We make the same adjustment for the replacement rate. The consumption floor is computed based on the evidence provided by Nakajima (2012). It is reported that the average weekly benefits under the food stamp program (Supplemental Nutrition Assistance Program) is \$50, which is about 0.068 of the median weekly wage income.

The insurance coverage ratio of Medicaid is set at the same rate as PHI, i.e., $\phi_m = 0.75$. The income threshold for receiving Medicaid, $\overline{w}$, is calibrated together with other parameters to match the proportion of workers receiving Medicaid in an equilibrium before the ACA. In reality, prior to the ACA, Medicaid provided public insurance to low-income individuals, with a focus on children, pregnant women, seniors, and individuals with disabilities. Since our model does not have those different categories of individuals, we assume that all workers whose income was below a certain (calibrated) threshold $\overline{w}$ were eligible for Medicaid pre-ACA. The change in the eligibility criteria for Medicaid under the ACA correspond to a higher income threshold.

5.4 Parameters Endogenously Set

Table 5 summarizes the calibration targets. Since we have 10 parameters that are endogenously calibrated, we pick 10 closely related targets to match. The table above contains 12 target statistics,

[28] We abstract from the fact that the duration of UI benefits was extended during severe recessions in the U.S.

but two — the proportion of FT workers and the uninsured rate — are obtained as residuals. Let us discuss the parameters and the corresponding targets.

The probability of employment, π_e, is mainly associated with the unemployment rate. We manage to match exactly the unemployment rate that we obtain from the CPS (ASEC). As discussed in Section 5.1, we use the average unemployment rate during 2004-2006. The proportion of PT workers and the job-to-job transition rate are closely related to the disutility of labor, η, and the size of the shock to it, $\overline{d}$. As can be seen from Table 5, we match those targets very closely. The proportion of workers purchasing PHI is closely related to the extra cost of such insurance, κ_1. The parameter helps the model replicate the target statistic at 14.5 percent. The proportion of workers receiving Medicaid is obviously closely related to the income threshold for Medicaid, $\overline{w}$. We find that $\overline{w}$ of 63.0 percent of the FPL enables us to match the target. Since the income threshold for Medicaid under the ACA is 133 percent of the FPL, the ACA implies relaxation of Medicaid eligibility. As a residual, the proportion of the uninsured workers in the data is 22.65 percent, and the model generates 22.64 percent.

There are two parameters that are closely related to the firms' incentives to offer health insurance, namely the mean and the range of the preference shock ($\overline{a}$ and $\widetilde{a}$). We choose two targets associated with the firm's insurance decisions. First, the proportion of firms offering health insurance to their FT employees is 61.3 percent according to the BED during 2004-2006. Second, the proportion of FT workers who are offered health insurance is 56.2 percent. Those numbers are averages for 2004-2006, obtained from the Employer Health Report of the Kaiser Family Foundation and Health Research and Education Trust. As can be seen from Table 5, we manage to match both targets. The two parameters associated with the firm size distribution — the standard deviation of productivity shock, σ_z, and the threshold level of productivity shock, $\underline{z}$— are calibrated to match two statistics regarding the firm size distribution. The two statistics are the proportion of firms with fewer than five employees and those with more than 1,000 employees. In the data, the former is 54.4 percent, while the latter is 0.20 percent. The model matches those statistics quite well. Those target statistics are obtained from the BED, as 2004-2006 averages. In the model, 54.2 percent of firms hire fewer than five employees, while 0.21 percent of the firms hire more than 1,000 employees.

Finally, we assume that the hourly wages of FT (without EHI) workers and PT workers are the same in the baseline. In the data, the unconditional average wage income for FT employees is significantly higher than that for PT workers, but the comparison is affected significantly by (different) compositions of FT and PT workers. Therefore, we set the ratio of hourly wages to one. This is closely related to the share parameter in the production function, (α). The model replicates the wage ratio as targeted.

6 Results: Properties of the Baseline Model Without the ACA

In this section, we compare various results from the model with the corresponding data from the U.S. economy before the ACA was implemented. Section 6.1 concerns the workers' side, while Section 6.2 discusses the firms' side.

6.1 Workers' Side

Table 6 compares the distribution across FT employed, PT employed, and unemployed individuals, for the overall labor force as well as the three age groups. The top panel is based on the 2004-2006 averages from the CPS (ASEC), while the bottom panel is the model's output. The first column

Table 6: Model vs. Data: Labor Market Outcomes

	All	Young	Prime Age	Old
Data (CPS 2004-2006)				
Full-time (FT) employed	79.17	54.53	86.55	82.44
Part-time (PT) employed	15.19	32.87	9.92	12.74
Unemployed	5.64	12.60	3.53	4.82
Baseline Model (Without the ACA)				
Full-time (FT) employed	79.25	71.12	80.79	85.34
Part-time (PT) employed	15.11	20.00	14.41	10.18
Unemployed	5.64	8.88	4.80	4.48

Table 7: Model vs. Data: Health Insurance Choices

	All	Young	Prime Age	Old
Data (CPS 2004-2006)				
Employer-provided health insurance (EHI)	56.16	27.06	63.81	65.95
Private health insurance (PHI)	14.49	26.71	10.38	15.44
Medicaid	6.69	10.47	5.58	6.09
Uninsured	22.65	35.76	20.23	12.51
Baseline Model (Without ACA)				
Employer-provided health insurance (EHI)	56.30	41.62	59.11	67.13
Private health insurance (PHI)	14.45	4.92	17.36	15.40
Medicaid	6.61	13.39	4.80	4.48
Uninsured	22.64	40.07	18.73	13.00

shows the numbers from the entire labor force (ages 16-64). In the data, 79.2 percent of the labor force works FT, while 15.2 percent works PT. The remaining 5.6 percent are unemployed. The corresponding numbers of the baseline model are close because they are targeted in the calibration procedure, as discussed in Section 5.4.

What are not targeted are the differences across different age groups, which are shown in the last three columns of the table. Although the only differences across different age groups are the average labor productivities and the distribution of medical expenditures, both of which are calibrated using observable data (MEPS), the model captures the salient characteristics of the data. More specifically, (i) the proportion of FT employment increases with age, (ii) the proportion of PT employment is significantly higher among young workers, and (iii) the unemployment rate is significantly higher among young workers. In the model, young workers are more likely to work PT or are unemployed because they have a lower average income, which lowers their incentives to work FT, and because they face smaller medical expense risks, which weakens their incentives to search for FT jobs with subsidized health insurance. On the other hand, the model does not replicate the following facts: (iv) the proportion of PT employment is higher among the old than among the prime age, and that (v) the unemployment rate is slightly higher among the old than among the prime age. In the model, the proportion of PT employment and the unemployment rate monotonically decline with age. The discrepancy is most likely because the model does not feature a transition from work to retirement among old workers.

Table 8: Baseline Model: Composition of Health Insurance Categories

	Total	Employer HI	Private HI	Medicaid	Uninsured
% of Total	100.00	56.30	14.45	6.61	22.64
% of Young	21.51	15.90	7.32	43.56	38.07
% of Prime age	66.61	69.93	80.01	48.39	55.11
% of Old	11.88	14.17	12.66	8.05	6.82
Mean medical expenses (2005$)	2,638	3,240	3,225	2,315	1,110

Let us move on to the health insurance choices. Table 7 compares the health insurance choices between the data (top panel) and the model (bottom panel). The data are compiled based on the 2004-2006 averages from the CPS (ASEC). Again, the first column shows the distribution of health insurance choices among all workers 16-64 years of age. In the data, 56.2 percent obtain employer-provided health insurance (EHI), 14.5 percent obtain health insurance from private health insurance providers (PHI), 6.7 percent obtain Medicaid, and 22.7 percent are uninsured. Those numbers are closely matched by the model pre-ACA because they are targeted in the calibration.

The last three columns show the distribution of the health insurance choices for the three age groups, which are not targeted in the calibration procedure. The model replicates the features of the data that (i) the uninsured rate significantly declines with age, (ii) the proportion of workers obtaining health insurance from their employers increases with age, and (iii) the take-up rate of Medicaid is higher among the young. In particular, the uninsured rate declines from 35.8 percent among the young to 12.5 percent for the old in the data, while it declines from 40.1 percent for the young to 13.0 percent for the old in the model. On the other hand, the model fails to replicate (iv) the proportion of workers purchasing PHI is lower among prime-age workers, and that (v) Medicaid take-up rate is lowest among the prime-age workers. As for (iv), the discrepancy is mainly due to the fact that there are no dependents in the model. In the data, many young workers obtain health insurance as a dependent of a policyholder of EHI, but we reclassify these individuals as obtaining PHI. This reclassification helps us to keep the overall uninsured rate the same as in the data, but it inflates the number of workers obtaining PHI, especially among the young. As for (v), the discrepancy is due to the difference in Medicaid eligibility between the U.S. economy and the model economy. In the pre-ACA U.S., Medicaid eligibility depended on various factors other than income, which results in more old workers qualifying than they do in the model, in which the only criteria is low income. Overall, the model's performance is satisfactory in the sense that the model replicates (i) and (ii), which are the most important features in the data, despite the model lacks dependents and the Medicaid eligibility is simplified.

Table 8 shows the heterogeneity in insurance choices in the baseline model with a different perspective. In particular, the first column reports the proportions of young, prime age, and old workers among all workers. The last row of the first column shows the mean medical expenses among all workers. The remaining four columns show the same statistics for all health insurance categories. The last item in the first column shows the overall mean medical expenses as $2,638, which is taken from the MEPS 2005.

The young correspond to a smaller share and the prime age make up a larger share among those who obtain either private health insurance (PHI) or employer-provided health insurance (EHI). Naturally, the mean medical expenses among those who obtain PHI ($3,225) or EHI ($3,240) are higher than the mean medical expenses among Medicaid recipients. In addition, 43.6 percent of

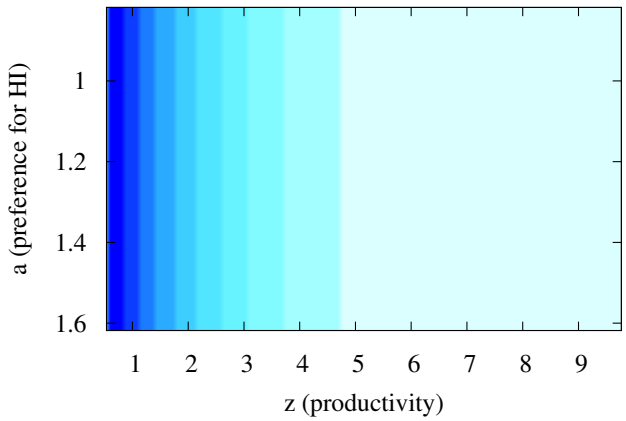

Figure 2: Firm Type Distribution

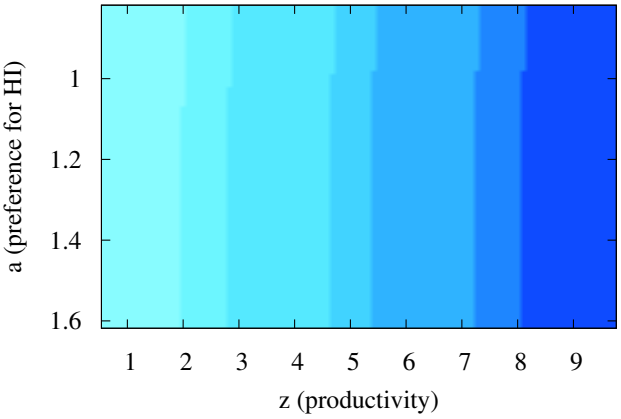

Figure 3: Optimal Employment Decisions by Firms

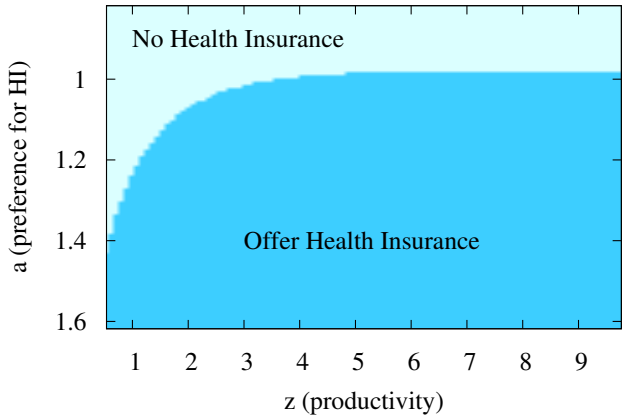

Figure 4: Optimal Health Insurance Decision by Firms

Medicaid recipients are young workers. This is because the young tend to have lower income and thus are more likely to be eligible for Medicaid. The mean medical expense among Medicaid recipients is \$2,315. Similarly, among the uninsured workers, the young make up a larger share compared with the overall proportion, because they face smaller medical expense risks in general and are more likely uninsured. Not surprisingly, the mean medical expense among the uninsured is the lowest at \$1,110.

6.2 Firms' Side

Before comparing the model's implications with data, let us look at the nature of the firms' optimal decisions regarding employment and health insurance provision. Figure 2 summarizes the type distribution of firms. The x-axis represents productivity of individual firms, z, while the y-axis

Table 9: Model vs. Data: Firm Size Distributions

	Data (BED 2004-2006)		Baseline Model	
Firm size	% Firm	% Employment	% Firm	% Employment
1-4	54.37	5.21	54.19	6.75
5-9	20.35	6.14	18.44	5.96
10-19	12.35	7.62	11.90	7.66
20-49	7.94	10.96	8.80	12.51
50-99	2.61	8.23	3.36	10.74
100-249	1.51	10.46	2.11	14.82
250-499	0.46	7.21	0.68	10.74
500-999	0.21	6.82	0.31	9.69
1,000-	0.20	37.36	0.21	21.13
1-49	95.01	29.92	93.32	32.88
50-	4.99	70.08	6.67	67.12

represents the preference shock for offering health insurance, a. The darker the color means the higher the frequency. Since we assume a uniform distribution with respect to a, the firm type distribution is uniform in the direction of a. However, because we assume a truncated log-normal distribution for z a large measure of firms is concentrated around a very low productivity. Figure 3 summarizes the optimal employment decisions by firms of different types. We use the same x- and y-axis as in the previous figure. Firm size is measured as the total employment in FTE employees. The darker the color means the bigger the size. The darkest color represents firms with more than 500 FTE employees, while the lightest color represents fewer than five FTE employees. The two figures together imply that there are many small firms, but only a few large firms. Figure 4 summarizes the optimal health insurance provision decisions by firms. Not surprisingly, firms with a low a do not offer health insurance, while firms with a high a offer health insurance. Moreover, larger firms are more likely to offer health insurance than smaller firms. This property is obtained with the fixed cost component of health insurance premiums paid by firms offering health insurance.

Now let us compare the implications of the model for pre-ACA. Table 9 compares firm size distribution in the U.S. data and in the baseline model without the ACA. The U.S. data are obtained from the BED for 2004-2006. The first column shows the proportion of firms in each size category. For example, the proportion of firms which employ 1-4 workers is 54.4 percent of all firms. The second column shows the proportion of employment by the firms in each size category. Total employment by the firms that employ 1-4 workers corresponds to 5.2 percent of total employment. The third and the fourth columns show the model counterparts. The proportion of firms that hire fewer than five workers (54.4 percent) and those that hire more than 1,000 workers (0.2 percent) are targeted in the calibration procedure together with the average employment size per firm. Therefore, it is not surprising that these two statistics are closely matched. The model also matches the other parts of the firm size distribution reasonably well. Generally speaking, the model replicates the fact that a large majority of firms are small, but a very small fraction of large firms generate the majority of employment. For example, the last two rows of the table shows the statistics for firms that hire fewer than 50 workers and those which hire more than 50 workers.[29] In the data, firms that hire

[29] We chose 50 as the threshold because the employer mandate of the ACA affects firms that hire more than 50 FTE employees differently than firms that hire fewer than 50 FTE employees.

Table 10: Model vs Data: % of Firms Offering Employer-Provided HI

Firm Size	Data (Kaiser 2004-2006)	Baseline Model
9 or less	49.0	54.8
10-24	73.0	76.8
25-49	87.0	78.9
50-199	92.3	80.0
200 or more	98.3	80.7
49 or less	58.2	59.8
50 or more	94.0	80.2
Overall	61.3	61.1

less than 50 workers make up 95 percent of all firms, but they hire only 29.9 percent of workers. On the other hand, firms that hire more than 50 workers generate 70.1 percent of total employment, although those firms make up only 5.0 percent of all firms. In the baseline model, 93.3 percent of firms hire fewer than 50 workers, but their contribution to employment is only 32.9 percent. On the other hand, 6.7 percent of firms that hire more than 50 workers generate 67.1 percent of the total employment.

Table 10 compares the proportion of firms that offer employer-provided health insurance (EHI) to employees between the U.S. data and the baseline model. The U.S. data are the 2004-2006 averages of the proportions computed by the Kaiser Family Foundation and Health Research and Educational Trust (2004-2006).[30] The overall proportion of firms offering EHI is 61.3 percent, which is closely matched by the model because it is one of the calibration targets. Moreover, the model replicates the fact that this proportion increases with firm size. If we consider small firms (firms that hire fewer than 50 employees) and large firms (firms with more than 50 employees) separately, 58 percent of small firms offer EHI, while 94 percent of large firms offer EHI, although the differences are not as stark as in the data. In the model, 60 percent of small firms offer EHI, while 80 percent of large firms offer EHI. As discussed earlier, one reason behind such a difference is the fixed cost of offering health insurance. Lee (2002) reports that the proportion of total administrative expenses out of incurred claims is 40.0 percent of incurred claims for firms with 1-4 employees, while the proportion is 5.5 percent for firms with more than 10,000 employees. The model successfully generates the correlation between the EHI offer rate and firm size because we introduce a fixed component of the health insurance premiums when firms offer health insurance. The fact that the model undershoots the EHI offer rate among large firms could imply that the effects of introducing the ACA might be overestimated. Large firms that do not offer health insurance are affected by the employer mandate directly and the model has more firms in this category than in the data.

7 Results: The Affordable Care Act

This section presents the main results of the paper — the effects of introducing the stylized version of the ACA as discussed in Section 4.6 into the baseline economy. Section 7.1 investigates the implications on the health insurance market. Section 7.2 focuses on the effects of the reform on the composition of PT and FT employment, while Section 7.3 discusses at the reform's effect on total

[30] In Kaiser Family Foundation and Health Research and Educational Trust (2004-2006), the smallest size of firms is three employees.

Table 11: Effects of the ACA on the Health Insurance Market

	All	Young	Prime Age	Old
Baseline Model (Without the ACA)				
Employer-provided health insurance (EHI)	56.30	41.62	59.11	67.13
Private health insurance (PHI)	14.45	4.92	17.36	15.40
Medicaid	6.61	13.39	4.80	4.48
Uninsured	22.64	40.07	18.73	13.00
Model with the ACA				
Employer-provided health insurance (EHI)	54.89	12.46	66.11	68.78
Private health insurance (PHI)	14.37	3.38	17.09	19.07
Medicaid	25.18	77.69	11.11	9.02
Uninsured	5.56	6.47	5.70	3.14

hours worked. Section 7.4 studies the macroeconomic and welfare implications of implementing the ACA.

7.1 Effects on the Health Insurance Market

Table 11 compares the choices regarding health insurance in the model pre- and post-ACA. The top panel, which is associated with the baseline model without the ACA, is the same as in Table 7. The bottom panel summarizes health insurance choices in the alternative model with the ACA. Let us point out five major differences.

First and most important, the uninsured rate drops from 22.6 percent pre-ACA to 5.6 percent post-ACA. According to the model simulations, the ACA achieves its goal of near-universal health insurance coverage. Second, the uninsured rate drops across all age groups, but the decline is the largest among the young. Their uninsured rate declines from 40.1 percent pre-ACA to 6.5 percent post-ACA. This is mainly achieved by the Medicaid expansion. The proportion of the young enrolling in Medicaid jumps up from 13.4 percent to 77.7 percent. Since Medicaid is available to every individual whose income is below 133 percent of the FPL, a majority of young workers, whose income tends to be low, qualify for Medicaid even if they are working FT. Table 12 shows how the age composition of each health insurance category changes because of the ACA. In the last row of each panel, the average medical expenses within each health insurance category are shown. As expected, because a larger number of young workers are covered under Medicaid, the age composition of Medicaid recipients shifts significantly towards the young. As a result, the average medical expenses among Medicaid recipients decline from \$2,315 to \$1,973. Third, the proportion of workers covered by employer-provided health insurance (EHI) declines from 56.3 percent to 54.9 percent after the ACA is introduced. This is mainly due to the low-income young workers who receive Medicaid even if they are offered EHI from their employers. Indeed, the proportion of workers with EHI increases among prime-age and old workers. Fourth, interestingly, the average medical expenses among workers with EHI declines with the introduction of the ACA, from \$3,240 to \$2,913, even though many young workers opt to receive Medicaid instead of EHI. Since young workers tend to have lower medical expenses, this is counterintuitive. What seems to be happening is that less-healthy (those who expect higher medical expenses) prime-age and old workers do not need to cling to EHI under the ACA, because they can also receive subsidized health insurance from the exchange, and thus they leave EHI under the ACA, making the average pool of workers

Table 12: Effects of the ACA: Composition of the Health Insurance Categories

	Total	Employer HI	Private HI	Medicaid	Uninsured
Baseline Model (without the ACA)					
% of Young	21.51	15.90	7.32	43.56	38.07
% of Prime age	66.61	69.93	80.01	48.39	55.11
% of Old	11.88	14.17	12.66	8.05	6.82
Mean medical expenses (2005$)	2,638	3,240	3,225	2,315	1,110
Model with the ACA					
% of Young	21.51	4.88	5.06	66.37	25.03
% of Prime age	66.61	80.23	79.18	29.38	68.26
% of Old	11.88	14.89	15.76	4.25	6.71
Mean medical expenses (2005$)	2,638	2,913	3,361	1,973	1,066

Table 13: Effects of the ACA on the Health Insurance Market: Decomposition

	Employer HI	Private HI	Medicaid	Uninsured
Baseline (without ACA)	56.30	14.45	6.61	22.64
ACA	54.89	14.37	25.18	5.56
Only One Component of the ACA Implemented				
Only individual mandate	58.95	32.36	6.63	2.06
Only HI exchange	57.39	–	6.66	35.95
Only HI subsidies (with gap)	51.77	21.10	6.43	20.07
Only HI subsidies (without gap)	49.87	24.26	6.52	19.35
Only Medicaid expansion	47.28	12.66	25.16	14.91
Only employer mandate	61.58	11.31	6.80	20.32
One Component of the ACA Not Implemented				
No individual mandate	50.21	9.73	25.04	15.02
No HI exchange	52.70	20.82	25.11	1.37
No HI subsidies	60.64	–	24.81	14.55
No Medicaid expansion (with gap)	66.04	20.76	6.42	6.77
No Medicaid Expansion (without gap)	63.26	24.57	6.65	5.52
No employer mandate	49.49	17.72	25.08	7.71
No tax increase	54.86	14.41	25.22	5.52

receiving EHI healthier. Fifth, the take-up rate of private health insurance (PHI) through the exchange does not change much before (14.5 percent) and after (14.4 percent) the introduction of the ACA. However, as we discussed above, the workers in the pool are less healthy under the ACA. The average medical expenses of workers purchasing PHI increases from $3,225 to $3,361.

Since the ACA is a collection of various components, an interesting question is how each component of the ACA affects the health insurance market. Table 13 provides a decomposition. The first panel compares the proportion of workers (1) obtaining EHI from their employers, (2) purchasing PHI from the exchange under the ACA, (3) obtaining Medicaid, and (4) remaining uninsured, pre- and post-ACA. In the second panel, only one of the five components of the ACA is introduced. Notice that, two cases are shown for health insurance subsidies. In the first case ("with gap"), the coverage

gap is left open. In other words, workers whose income is between 63 percent (calibrated income threshold for Medicaid pre-ACA) and 100 percent of the FPL are not eligible for either Medicaid or health insurance subsidies. In the second case ("without gap"), the gap is closed by offering those with incomes between 63 and 100 percent of the FPL the same (highest) amount of health insurance subsidies that individuals with incomes at 100 percent of the FPL enjoy. In the bottom panel, only one of the components of the ACA is *not* implemented. That is, one of the five components of the ACA is taken out one at a time. Same as the panel above, two cases are shown regarding the cases without the Medicaid expansion. Moreover, we implement an experiment under which the tax rates are kept at the baseline values. This is intended to highlight the effects of the ACA when the additional costs of the ACA are not financed through higher taxes.

Let us make six remarks. First, raising the tax rates to finance the ACA does not affect the health insurance choices much. In terms of the health insurance decisions, there is no significant difference between the model pre-ACA (second row) and the model with all of the components of the ACA are implemented except for an increase in the tax rate (bottom row).

Second, establishing the health insurance exchange and forcing pooling in the PHI market raises the uninsured rate. If the pooling in the exchange is enforced without introducing all the other components of the ACA, nobody participates in the PHI market, and the uninsured rate (36.0 percent) becomes higher than in the baseline model (22.6 percent). On the contrary, if the pooling in the exchange is excluded from the ACA, the uninsured rate becomes even lower (1.4 percent) than in the case in which all components of the ACA are introduced. Basically, enforced pooling in the PHI exchange drives away healthier workers who would subsidize less healthy in the pooled health insurance market. If so, would it be better not to introduce the forced pooling in the health insurance exchange? Surprisingly, the welfare effect is lower in this case even if the uninsured rate is lower. We will come back to this question in Section 7.4.

Third, the employer mandate, as expected, forces more firms to offer EHI and thus increases the proportion of workers covered by EHI. However, the overall effect to the uninsured rate is modest. Without the employer mandate, the uninsured rate rises from 5.6 percent in the case with all components of the ACA to 7.7 percent. Similarly, if the employer mandate alone is implemented, the uninsured rate drops from the baseline level of 22.6 percent to 20.3 percent. This is because the changes in the proportion of workers receiving EHI are accompanied by similar changes in workers obtaining PHI.

Fourth, the individual mandate is crucial in lowering the uninsured rate. Just by introducing the individual mandate, the uninsured rate drops from 22.6 percent to 2.1 percent. If the individual mandate is removed from the ACA, the uninsured rate rises from 5.6 percent to 15.0 percent. The changes in the uninsured rate occur together with changes in the proportion of workers purchasing PHI. The individual mandate keeps healthier workers in the PHI market.

Fifth, not surprisingly, the Medicaid expansion lowers the uninsured rate by allowing more workers to obtain Medicaid. However, if the ACA is implemented without the Medicaid expansion, the uninsured rate remains at 5.5 percent instead of 5.6 percent if the coverage gap is closed, while the uninsured rate goes up to 6.8 percent if the coverage gap is left open. The former case occurs because workers who are not eligible for expanded Medicaid purchase subsidized health insurance from the exchange. Remember that generous (health insurance premium does not exceed 2 percent of income) subsidies are available for those who do not qualify for expanded Medicaid. The uninsured rate is higher in the latter case because workers falling into the "coverage gap" cannot receive the subsidies. Therefore, they are discouraged from purchasing insurance from the exchange.

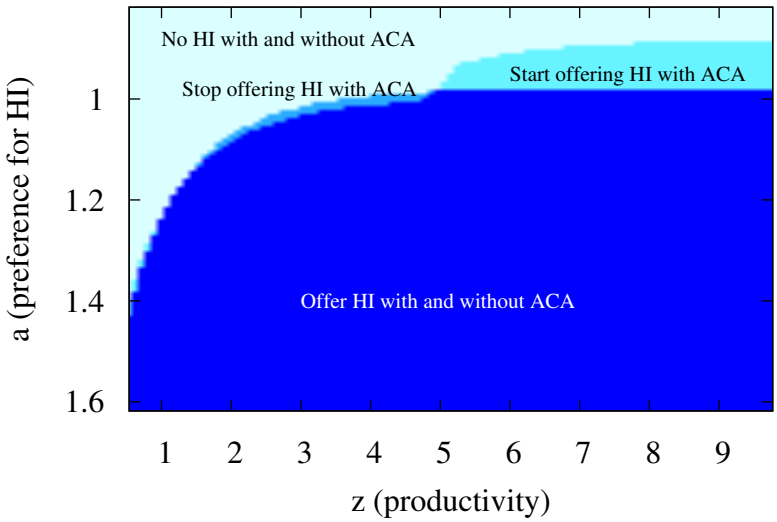

Figure 5: Effects of the ACA – Firms' Health Insurance Decision

These experiments are interesting because many states declined to expand Medicaid, creating a coverage gap in those states. Our experiments suggest that the coverage gap is a serious issue. According to our model, with the coverage gap, about 2.0 million (1.3 percent of the labor force) more workers end up uninsured. Therefore, whether a state accepts or declines the Medicaid expansion matters a lot in terms of the uninsured rate if there is a coverage gap. However, if the insurance gap is closed and health insurance subsidies are made available to those who cannot benefit from expanded Medicaid because the state opted out, health insurance subsidies through the exchange is enough to keep the uninsured rate as low as in the case with Medicaid expansion.

Finally, without health insurance subsidies, the exchange in which health insurance providers are forced to pool the medical expense risks of all participants does not function. No worker ends up participating in it without the health insurance subsidies. Naturally, without the subsidies, the uninsured rate under the ACA is 14.6 percent instead of 5.6 percent. On the other hand, if health insurance subsidies alone are introduced, the decline in the uninsured rate (22.6 percent to 19.4 percent) is limited. This generally just shifts workers from EHI to PHI without covering many workers who were uninsured without the subsidies.

Now let us look at the firms' side. Figure 5 summarizes the changes that the ACA causes to the firms' decisions regarding health insurance provision. The figure shares the same x- and y-axis as in Figure 2. Figure 5 shows that some large firms (high z) with relatively high a start offering health insurance under the ACA. This is the direct effect of the employer mandate. These firms hire more than 50 FTE employees, and thus are subject to penalties if they do not offer health insurance. Since they have a relatively high preference for offering health insurance, they start offering to avoid the penalty. At the same time, as we will discuss later, this direct effect causes wages for a job with health insurance to go up and thus crowds out smaller firms. Figure 5 also shows that some smaller firms stop offering health insurance after the ACA goes into effect.

Table 14 shows the effects of introducing the ACA on firms' decisions regarding offering health

Table 14: Effects of the ACA on Firms' Health Insurance Decisions[1]

	% ≥50 FTE	% offering HI (All firms)	% offering HI (<50 FTE)	% offering HI (≥ 50 FTE)
Baseline (without the ACA)	6.19	61.15	59.88	80.31
ACA	5.69	60.82	58.90	92.49
One Component of the ACA Not Implemented				
No individual mandate	5.66	58.36	56.39	91.20
No HI exchange	5.66	58.39	56.42	91.36
No HI subsidies	5.85	69.13	67.40	97.03
No Medicaid expansion (with gap)	5.73	58.39	56.28	93.01
No Medicaid expansion (without gap)	5.67	55.52	53.35	91.62
No employer mandate	6.17	62.91	62.02	76.55
No tax increase	5.72	60.81	58.88	92.50

[1] FTE = Full-time equivalent. One PT worker is counted as 0.54 FTE.

insurance. Specifically, the first column shows the proportion of firms with more than 50 FTE workers. These are the firms that are subject to the employer mandate under the ACA. The next three columns show the proportion of firms offering EHI. The second column is for all firms, while the last two columns are associated with firms with fewer and more than 50 FTE workers. The first two rows compare the baseline model pre-ACA and the model economy with all the components of the ACA. The second panel shows what happens if one of the components of the ACA is removed. By comparing the first two rows, it is easy to see that post-ACA (1) some firms reduce employment to stay below 50 FTE cutoff so that they are not subject to penalties under the employer mandate, (2) health insurance offer rate increases drastically among firms that hire more than 50 FTE workers because of the employer mandate, and (3) the proportion of firms that offer EHI declines among those that hire fewer than 50 FTE workers because wages of FT jobs with health insurance increase as more larger firms offer health insurance, and this drives away smaller firms. If we look at the bottom panel, most of the effects on the firms' side described above are due to the employer mandate. Without the employer mandate, the proportion of firms that hire more than 50 FTE workers, and the health insurance offer rate among firms with various sizes revert back closer to those in the baseline model. It is also interesting to note that the health insurance offer rate goes up for all firms if health insurance subsidies are eliminated from the ACA.

7.2 Effects on the Labor Market: Part-Time Nation?

Since large firms that hire more than 50 FTE employees do not need to offer health insurance to their PT workers, there are concerns, especially in the mass media, that the ACA will turn the U.S. economy into a "part-time nation."[31] We use our model to evaluate these concerns. Table 15 summarizes the effects of the ACA on the labor market. Qualitatively, there is an increase in PT employment and a corresponding decline in FT employment as a result of the ACA. The magnitude of the shift from FT to PT jobs is about a 1.3-percentage-point increase in the PT employment

[31] For example, see "Is Obamacare Forcing You to Work Part-Time?" BloombergView, August 13, 2013, and "Who Can Deny It? Obamacare Is Accelerating U.S. Towards Part-Time Nation," Forbes, July 31, 2013. For an argument against such concerns, see "The Spectacular Myth of Obama's Part-Time America — in 5 Graphs," *The Atlantic*, February 7, 2014.

Table 15: Effects of the ACA on the Labor Market Outcomes

	All	Young	Prime Age	Old
Baseline Model (without the ACA)				
Full-time (FT) employed	79.25	71.12	80.79	85.34
Part-time (PT) employed	15.11	20.00	14.41	10.18
Unemployed	5.64	8.88	4.80	4.48
Model with the ACA				
Full-time (FT) employed	78.23	74.01	78.97	81.71
Part-time (PT) employed	16.42	17.94	16.31	14.26
Unemployed	5.35	8.05	4.72	4.03

Table 16: Effects of the ACA on the Labor market Outcomes: Decomposition

	FT Employed	PT Employed	Unemployed
Baseline (without ACA)	79.25	15.11	5.64
ACA	78.23	16.42	5.35
Only One Component of the ACA Implemented			
Only individual mandate	79.49	14.82	5.70
Only HI exchange	79.23	15.10	5.67
Only HI subsidies (with gap)	78.66	15.80	5.53
Only HI subsidies (without gap)	78.22	16.37	5.41
Only Medicaid expansion	78.32	16.25	5.43
Only employer mandate	79.25	15.13	5.62
One Component of the ACA Not Implemented			
No individual mandate	78.24	16.38	5.38
No HI exchange	78.25	16.37	5.37
No HI subsidies	78.51	16.09	5.40
No Medicaid expansion (with gap)	78.92	15.47	5.61
No Medicaid expansion (without gap)	78.09	16.47	5.45
No employer mandate	78.31	16.37	5.32
No tax increase	78.27	16.42	5.31

share. Using the most recent size of the labor force (157,037 thousand in June 2015), the ACA is expected to create 2.1 million more PT jobs. At the same time, there will be 1.6 million less FT jobs.

Looking at different age groups, the increase in PT employment is concentrated among prime-age and old workers, while PT employment declines among young workers. This is because prime-age and old workers with high disutility of labor are the ones who switch to PT jobs under the ACA. Note that, without the ACA, not many young workers qualify for Medicaid if they work FT, which makes PT jobs more attractive for some young workers. However, post-ACA, many young workers qualify for the expanded Medicaid even if they work FT. This causes a larger shift among the young workers to FT jobs.

Let us decompose the effects of the ACA into those from each component of the ACA. Table 16 offers decomposition of the effects of each component of the ACA on the composition of jobs. The first two

rows show the proportion of FT and PT employed workers and the unemployed individuals in the baseline model pre- and post-ACA, which are already shown in Table 15. The second panel shows the same set of statistics in cases in which only one of the components of the ACA is introduced. Again, as for health insurance subsidies cases with and without the coverage gap are shown. The last panel shows the same set of statistics when one of the components of the ACA is excluded. W

With the introduction of the ACA, the proportion of PT jobs increases from 15.1 percent to 16.4 percent, and there is a corresponding decline in the number of FT jobs from 79.3 percent to 78.2 percent of the labor force. If one looks at the second panel of the table, it is easy to see that the Medicaid expansion or health insurance subsidies (especially when the coverage gap is closed) generate such an increase in PT employment. Other components do not have any strong effects on the composition of jobs. This is interesting especially because the employer mandate, which Mulligan (2014) argues has a significant impact on the distribution between PT and FT employment, does not seem to be large. This seems to suggest that the effects of the ACA on hours worked are mostly through the labor supply channel; i.e., workers do not need to cling to FT jobs with health insurance when the ACA is introduced, and workers can work PT and still obtain subsidized health insurance through either the exchange or Medicaid.

The third panel shows that removing one of the components from the ACA does not have a strong effect on the composition of jobs, except for one case, in which the Medicaid expansion is removed when the coverage gap is present. Removing either the Medicaid expansion (with the coverage gap being closed) or health insurance subsidies does not have a significant effect because the two components cancel each other out. For example, when the Medicaid expansion is removed, many workers who could have received Medicaid under the Medicaid expansion can still obtain subsidized health insurance from the exchange instead. This substitution mitigates the effects of removing either the Medicaid expansion or health insurance subsidies. In other words, only when the coverage gap is left open, removing the Medicaid expansion brings the proportion of PT employment closer to the baseline level because health insurance subsidies cannot substitute for the unexpanded Medicaid while the gap is left open.

7.3 Effects on the Labor market: Aggregate Hours Worked

While the ACA is intended to achieve near-universal health-care coverage in the nation, there are concerns about its negative incentive effect, especially a negative effect on the labor market. Mulligan (2014) estimates that the ACA will reduce total hours worked by 3.0 percent, while the Congressional Budget Office (2014) estimates a total reduction in hours between 1.5 and 2.0 percent. While both estimates of the effect of the ACA on total hours worked are large, the main channels behind these numbers are very different. On the one hand, Mulligan (2014) focuses on the labor demand channel. He emphasizes that various components of the ACA are virtually additional taxes on employment, especially FT employment. Roughly speaking, his estimate is based on calculating various costs that the ACA adds to employers. On the other hand, Congressional Budget Office (2014) emphasizes the labor supply effect. It states that "the reason for the reduction in the supply of labor is that the provisions of the ACA reduce the incentive to work for certain subsets of the population."[32] Using our equilibrium model, we can evaluate both effects in a unified manner. Notice that, to answer the arguably more important question of whether the ACA will improve social welfare, we need to take into account both channels within a model. Moreover, the effect of

[32] Indeed, the CBO warns readers of its Outlook not to interpret its results that 2.0-2.5 million workers lose their jobs, according to the ACA in a lengthy qualifying statement. See `https://www.cbo.gov/publication/45096`.

Table 17: Effects of the ACA on Hours, Output, Wages, and Productivity[1]

	Baseline Model	Model with the ACA		Partial Equilibrium	
	Level	Level	% Change	Level	% Change
Total Hours Worked in FTE					
Total	20.19	20.12	−0.36	20.01	−0.88
FT total	18.30	18.07	−1.29	18.13	−0.97
FT with HI	14.28	14.99	+4.96	14.28	−0.00
FT without HI	4.03	3.08	−23.45	3.85	−4.40
PT	1.88	2.05	+8.69	1.88	+0.00
Output	7.154	7.126	−0.39	7.095	−0.83
Wage for FT with HI	0.2207	0.2232	+1.14	0.2207	–
Wage for FT without HI	0.2327	0.2310	−0.74	0.2327	–
Wage for PT	0.2326	0.2200	−5.39	0.2326	–
p_2 (FT with HI)	0.9832	0.9923	+0.93	0.9832	–
p_1 (FT without HI)	1.0121	0.9580	−5.34	1.0121	–
p_3 (PT)	0.9296	0.9444	+1.59	0.9296	–

[1] FTE = Full-time equivalent. One PT worker is counted as 0.54 FTE. p_e is the average productivity on island $e = 1, 2, 3$.

the resulting lower hours worked must be compared with the gains from a wider health insurance coverage. We try to provide our answer to this question in Section 7.4.

Table 17 shows how the ACA affects output, hours worked, wages, and average productivity in the model economy. The first column shows the levels in the baseline model pre-ACA. The second and the third columns show the levels and percent changes when the ACA is introduced. Changes in employment are shown in FTE, i.e., the size of PT employment is converted into the size of FT employment by multiplying the fraction of time that PT workers work relative to the working hours of FT workers (which is calibrated to be 0.54). Overall, total employment in FTE declines, but modestly, by 0.36 percent. FT employment declines by 1.29 percent, but PT employment increases by 8.69 percent. Among FT employment, jobs shift from those without EHI to those with EHI. The former decreases by 23.45 percent, while the latter increases by 4.96 percent. The change in total output is a 0.39-percent decline.

The third panel of Table 17 shows the changes in wages post-ACA. The wages for a FT job with health insurance increases by 1.1 percent, while the wages for a FT job without health insurance declines by 0.7 percent. These changes are consistent with the changes in the demand side — more firms, especially those that are subject to the employer mandate, start offering health insurance under the ACA. On the contrary, the wages for PT jobs decline, by 5.4 percent, even though some firms are expected to create more PT jobs to avoid being penalized by the employer mandate. Part of the decline reflects the subsidies that PT workers receive when they obtain health insurance either from the exchange or Medicaid. However, it also reflects a higher supply of PT workers. Workers with relatively high disutility of labor want to work PT rather than FT and obtain subsidized health insurance post-ACA.

The last panel of Table 17 compares the average productivities of workers on each island. The average productivity on island $e = 1$ (FT without insurance) declines significantly (−5.3 percent)

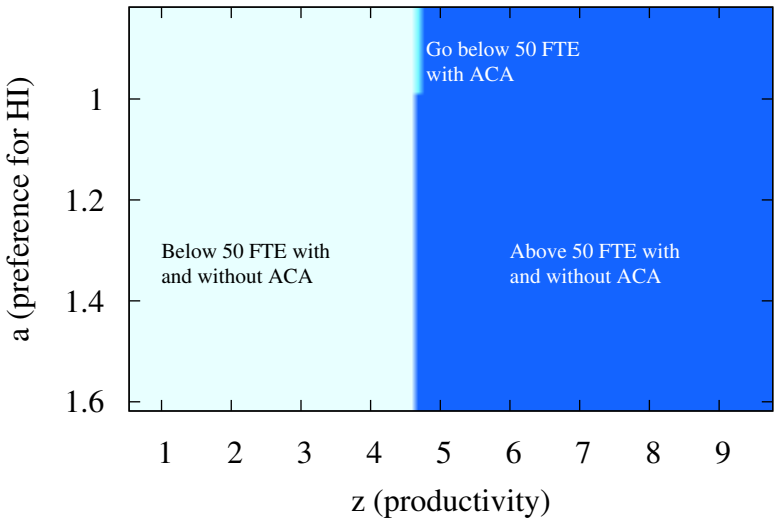

Figure 6: Effects of the ACA – Firms' Employment Sizes

from pre-ACA to post-ACA. However, the average productivities of island $e = 2$ (FT with HI) and $e = 3$ (PT) increase, by 0.9 percent and 1.6 percent, respectively. These changes reflect the changes in composition of workers on each island. The average productivity for PT workers increases because there are more prime-age and old workers working PT under the ACA. Many of the young workers who are crowded out from PT jobs end up getting FT jobs without EHI, pushing down the average productivity of such a job.

Figure 6 summarizes how firms' decisions regarding employment size are affected by the ACA. The figure uses the same x- and y-axis as Figure 2. In particular, the figure shows the firms that hire fewer than 50 FTE with and without the ACA, the firms that hire more than 50 FTE with and without the ACA, and the firms that hire more than 50 FTE without the ACA, but cut down employment to stay below 50 FTE under the ACA. The number of firms that move in the opposite direction turns out to be negligible. It is easy to see that firms that are close to 50 FTE and have a relatively weak preference for offering health insurance (a) lower employment to stay below the 50 FTE threshold. However, the number of firms that shed employment is small, especially because there are only few firms that are productive enough to hire 50 FTE from the beginning (remember Figure 2).

Table 18 decomposes the effects of each component of the ACA on total hours worked. The first and second columns show the total hours and total PT hours under different models. The third column shows the proportion of firms that hire more than 50 FTE employees. This is the proportion of firms that are subject to the employer mandate under the ACA. In the second panel in which only one of the components of the ACA is implemented, we can see that the Medicaid expansion and health insurance subsidies (without the coverage gap) have negative effects on total hours worked similar to the impact of all components of the ACA. This implies that the reduction in total hours is due to the labor supply channel — workers reduce hours when the ACA is introduced. Interestingly, the total hours worked declines even without a significant change in the proportion of large firms.

Table 18: Effects of the ACA on Hours Worked: Decomposition[1]

	Total Hours	PT Hours	% ≥ 50 FTE
Baseline (without ACA)	20.19	1.88	6.19
ACA	20.12	2.05	5.69
Only One Component of the ACA Implemented			
Only individual mandate	20.21	1.85	6.19
Only HI exchange	20.18	1.88	6.18
Only HI subsidies (with gap)	20.14	1.97	6.17
Only HI subsidies (without gap)	20.11	2.04	6.14
Only Medicaid expansion	20.12	2.03	6.17
Only employer mandate	20.19	1.89	5.78
One Component of the ACA Not Implemented			
No individual mandate	20.11	2.04	5.66
No HI exchange	20.12	2.04	5.66
No HI subsidies	20.14	2.01	5.85
No Medicaid expansion (with gap)	20.16	1.93	5.73
No Medicaid expansion (without gap)	20.09	2.05	5.67
No employer mandate	20.13	2.04	6.17
No tax increase	20.13	2.05	5.72

[1] Hours are shown in FTE. FTE = Full-time equivalent. One PT worker is counted as 0.54 FTE.

While the employer mandate induces some firms to stay below the 50 FTE threshold, the overall effect of the employer mandate on total hours worked is limited. The findings are also supported by experiments summarized in the third panel of Table 18, in which one of the components of the ACA is excluded. Removing one component of the ACA does not significantly change the negative effect of the ACA on total hours, except for the Medicaid expansion when there is a coverage gap. Without the employer mandate, the proportion of firms that hire more than 50 FTE increases, but the effect on total hours is limited. As we discussed already, removing either the Medicaid expansion or health insurance subsidies does not change the effect of the ACA on total hours because the two components are substitutes. However, as we discussed in the previous section, when the Medicaid expansion is removed, while the coverage gap left open, health insurance subsidies cannot substitute for the unexpanded medicaid.

We find that the effects of the ACA on aggregate hours worked is smaller than other estimates. Why? One possibility is the general equilibrium effect. To see how important the general equilibrium effect is, we implement an additional experiment in which all the components of the ACA are introduced, but the prices are fixed at the initial levels.[33] For the health insurance premium in the exchange, which doesn't exist under the baseline model since the pooled (community) rating is not offered, and the tax rates, we change to the equilibrium levels under the ACA. The last two columns of Table 17 show the results. The wages are the same as in the baseline levels by assumption. It is observed that the ACA without the general equilibrium effect has stronger negative effects on labor supply. Total employment in FTE declines by 0.88 percent. The number is bigger than in the experiment with the general equilibrium effect because the response of PT jobs or FT jobs with EHI

[33] Prices that are fixed include wages w_e and productivities p_e on each island $e = 1, 2, 3$.

Table 19: Welfare Effects of the ACA[1]

	Welfare	Uninsured Rate	Total Hours	τ_w (%)	τ_u (%)
Baseline (without the ACA)	–	22.64	20.19	0.80	0.83
ACA	+0.52	5.56	20.12	1.63	0.80
Only One Component of the ACA Implemented					
Only individual mandate	−0.08	2.06	20.21	0.65	0.83
Only HI exchange	−0.18	35.95	20.18	0.93	0.83
Only HI subsidies (with gap)	+0.15	20.70	20.14	1.71	0.81
Only HI subsidies (without gap)	+0.35	19.35	20.11	1.86	0.79
Only Medicaid expansion	+0.58	14.91	20.12	1.63	0.81
Only employer mandate	+0.02	20.32	20.19	0.54	0.83
One Component of the ACA Not Implemented					
No individual mandate	+0.44	15.02	20.11	1.81	0.80
No HI Exchange	+0.47	1.37	20.12	1.74	0.80
No HI subsidies	+0.56	14.55	20.14	1.10	0.80
No Medicaid expansion (with gap)	+0.00	6.77	20.16	1.02	0.82
No Medicaid expansion (without gap)	+0.26	5.52	20.09	1.15	0.80
No employer mandate	+0.64	7.71	20.13	1.97	0.79
No tax increase	+1.13	5.52	20.13	0.80	0.83

[1] Welfare is defined as the ex-ante expected lifetime utility of a newborn, and expressed as Consumption Equivalent Variations (CEV), relative to the baseline model.

does not exist to mitigate the decline in the number of FT jobs without EHI. However, the number without the general equilibrium effect is still smaller than the other estimates. We conjecture that features that we abstract from our model, such as (1) intensive labor supply adjustment, (2) labor force participation decision, and (3) richer heterogeneity are the reasons.

7.4 Welfare Implications of the ACA

In this section, we investigate the welfare effects of introducing the ACA. As for the welfare criteria, we use the ex-ante expected lifetime utility of a newborn in the steady-state of the model. In evaluating the welfare, we convert the welfare in an alternative model by computing the consumption equivalence variation (CEV), which is the percentage change in consumption in each period and state to make welfare in the baseline model (pre-ACA) equal to the welfare in the post-ACA model. If the CEV is positive (negative), a newborn is better off (worse off) by being born into the steady-state of the post-ACA model. This is a common criterion used in macroeconomics with heterogeneity.[34] To be more specific, the CEV associated with transitioning from the baseline model pre-ACA to the model post-ACA can be implicitly characterized as follows:

$$\int V^{\text{BASE}}(1,d,x,s,e)d\mu^{\text{BASE}}_{1,d,x,s,e} + \log(1+CEV) = \int V^{\text{ACA}}(1,d,x,s,e)d\mu^{\text{ACA}}_{1,d,x,s,e}, \tag{44}$$

$V^{\text{BASE}}(1,d,x,s,e)$ and $V^{\text{ACA}}(1,d,x,s,e)$ are the values of a newborn ($i=1$) in the baseline pre-ACA model and the post-ACA model, respectively. $\mu^{\text{BASE}}_{1,d,x,s,e}$ is the type distribution of newborns

[34] For example, see Conesa et al. (2009).

$(i = 1)$ in the baseline model. This is basically the type distribution of age-1 workers, and is the same as the type distribution of newborns by assumption. $\mu^{\text{ACA}}_{1,d,x,s,e}$ is the type distribution of newborns in the model post-ACA. Notice the term $\log(1 + CEV)$. This term can be separated from the rest of the left-hand side because the utility from consumption is assumed to take a log form, and thus the CEV, which is the growth rate of consumption in each period and state, can be separated out from the representation of the lifetime utility. It is easy to see that $CEV = 0$ means the newborn's ex-ante expected lifetime utility is equalized between the baseline model pre-ACA and the model post-ACA.

In Table 19, the first column shows the welfare effects of the ACA and those of each component of the ACA. Relevant for welfare, the second column shows the uninsured rate, the third column shows total hours worked, the fourth column shows the general income tax rate, and the fifth column shows the unemployment insurance tax rate.

Let us make six remarks about the welfare numbers. First and most important, the model states that the ACA implies a welfare gain equivalent to 0.52 percent of flow consumption. Since we do not incorporate features such as health insurance coverage improving health, and health improving productivity, the number can be thought of as a conservative estimate. Still we obtain a positive welfare effect of introducing the ACA. Moreover, there is a welfare gain even though the general income tax rate is raised to finance the additional expenses under the ACA, and labor inputs (and outputs) decline. This suggests that the welfare gains are due to redistribution of lower-income workers through Medicaid and health insurance subsidies, and the fact that the ACA relaxes the link between FT employment and access to health insurance. We verify our conjecture with a series of experiments in the second and third panels of Table 19.

Second, according to the second panel, in which only one of the components of the ACA is implemented in each experiment, most of the welfare gains of the ACA are coming from the Medicaid expansion and health insurance subsidies, especially when the coverage gap is closed. This result is consistent with our conjecture and consistent with the findings of Pashchenko and Porapakkarm (2013). They find a welfare gain of a similar size (0.64 percent in the CEV) by implementing the ACA.[35] Moreover, they find that workers with lower education benefit significantly more (+1.43 percent) than those with higher education (+0.51 percent) because of the redistribution effects of the ACA.

Third, although the welfare gain of the ACA is realized through expanded coverage of subsidized health insurance, a lower uninsured rate does not necessarily mean a positive welfare effect. Interestingly, if only the individual mandate is implemented, the uninsured rate drops to 2.1 percent and the welfare effect is negative (-0.1 percent). Forcing workers to obtain health insurance without subsidies does not improve welfare, even if it achieves near-universal coverage.

Fourth, according to the last panel, in which one of the components of the ACA is excluded, the ACA generates a higher welfare gain if the employer mandate is not implemented. This is because the employer mandate has distortionary effects on firms' decision on hiring, as in Restuccia and Rogerson (2008) and Guner et al. (2008). Removing the individual mandate, which is another controversial component of the ACA, implies a lower welfare gain from the ACA. As shown in Table 13, without the individual mandate, many relatively healthy workers stay away from the health insurance exchange, which weakens the role of the exchange to subsidize lower-income less-

[35] They take into account the transition between the initial steady state pre-ACA to the one post-ACA. However, there is no decision on the firms' side.

healthy workers.

Fifth, obviously, if taxes do not need to be raised to finance the extra fiscal burden of the ACA, the welfare effect of the ACA is larger, at 1.1 percent of flow consumption. Since lower-income workers disproportionately suffer from a higher tax, this result implies that, if a more progressive tax is used, the welfare gain of introducing the ACA might be even larger.

Finally, leaving the coverage gap while declining to implement the Medicaid expansion has serious welfare consequences. This result is important because many states are actually choosing this option. When the Medicaid expansion is removed but the coverage gap is closed, the welfare gain is 0.26 percent, which is lower than the full ACA, but still sizably positive. However, if the coverage gap is left open with no Medicaid expansion, the welfare gain from implementing the ACA vanishes. It delivers no welfare gain. Although the assumption here is that the Medicaid expansion is removed nationally, and thus the result cannot be extrapolated to the states which opted out of the Medicaid expansion. Still, this experiment suggest a significant welfare cost of opting out, and especially leaving the coverage gap open.

8 Result: Health Care Reform in Massachusetts

As we discuss below, there are a lot of similarities between the ACA, which is the main focus of this paper, and the Massachusetts Health Care Reform. Indeed, the latter is often cited as the blueprint for the former. In this section, we implement a stylized version of the Massachusetts Health Care Reform within our model and study the health insurance and labor market consequences. One advantage of the Massachusetts Reform is that the reform was implemented starting in 2007, and thus we have data and know more about the consequences of the Massachusetts Reform than we do about the ACA.

In Section 8.1, we provide details about the Massachusetts Health Care Reform. In Section 8.2, we compare the data in Massachusetts on the labor market and health insurance decisions before and after the Massachusetts Health Care Reform. Finally, in Section 8.3, we implement the stylized version of the Massachusetts Reform and investigate the reform's implications by comparing the model's implications with the data since the reform was implemented in 2007. We also compare the key statistics among the calibrated baseline model, the model with the ACA, and the model with the Massachusetts Health Care Reform.

8.1 Massachusetts Health Care Reform: Details

In 2006, a comprehensive health-care reform legislation was passed in Massachusetts. The law overhauled much of the existing health-care system in the state. The Massachusetts Health Care Reform's key components were (1) an individual mandate, (2) a state health insurance exchange (3) subsidizes at the exchange, (4) a Medicaid expansion, and (5) an employer mandate. Below we discuss details of each component:

The individual mandate required all residents of the state to obtain some form of health insurance or pay a penalty of up to 50 percent of the lowest cost premium they would have qualified for on the state's health insurance exchange, called the Connector. Individuals with no access to employer-provided health insurance (EHI) could obtain coverage through the Connector. Individuals with incomes up to 150 percent of the FPL received no penalty, while penalties for those with incomes above 150 percent of the FPL were indexed to their income. Health insurance was filed on tax returns.

Launched in may 2007, the Connector allowed individuals to shop online for health insurance that met the minimum requirements dictated by the Health Reform Act. The Connector offered both subsidized and nonsubsidized plans for those who did not have access to health insurance through their families or employers.[36] Subsidized insurance options were offered through the Commonwealth Care Health Insurance Program (Care), while nonsubsidized insurance was offered through the Commonwealth Choice Health Insurance Program (Choice). Care was a subsidized insurance program available to adults earning up to 300 percent of the FPL ($10,210 for an individual in 2007) who did not have access to EHI or other subsidized insurance and who met additional eligibility guidelines. Fully subsidized health insurance was provided to individuals with incomes up to 150 percent of the FPL. Care provided subsidized private health coverage on a sliding scale: individuals with incomes below 150 percent of the FPL were eligible for fully subsidized coverage. For those with incomes between 150-300 percent of the FPL, individual monthly premiums ranged between $39-$116.

Massachusetts also expanded Medicaid and other public health insurance programs, mostly for children and their parents. Medicaid was expanded for children with family incomes up to 300 percent of the FPL, for parents with incomes up to 133 percent of the FPL, for pregnant women with incomes up to 200 percent of the FPL, and for the long-term unemployed with incomes up to 100 percent of the FPL.

The last component of the reform was an employer mandate, which required employers with more than 10 employees to provide health insurance for their employees. Employers could offer a standard group plan to their employees and contribute to the premium costs. Alternatively, they could pay an "employer fair share contribution," which was essentially a tax of up to $295 per employee. Employers were additionally required to let their employees pay their insurance premiums with pre-tax dollars. The employer mandate took effect on July 31, 2007, but was repealed in July 2013 to better facilitate the transition to the requirements in the national health-care reform.

While there are many similarities between the Massachusetts reform and the ACA, there are a few important differences. The penalties for firms that fail to comply are much larger under the ACA than under the Massachusetts reform, but fewer firms are likely to be affected under the ACA. In ACA, the employer mandate applies to firms with 50 or more FTE employees. In comparison, in Massachusetts employers with 11 or more employees were required to contribute towards employees' health insurance premiums. Firms that failed to comply were required to pay a penalty of $295 per employee in Massachusetts, while this penalty is much larger for firms under the ACA ($2,000 per FT employee after the first 30 FT employees). Similarly, penalties for individuals who do not obtain health insurance are larger under the ACA ($695 annually or 2.5 percent of the family income by 2016) compared with the Massachusetts reform (up to 50 percent of the lowest cost premium they would have qualified for under the Connector in 2008).

Another difference between the two reforms is the extent of expansion in public health insurance programs and subsidies. The reform in Massachusetts primarily expanded Medicaid for children

[36] The Massachusetts Health Connector Board, by the Authority of the Massachusetts Health Care Reform, determined which plans provided by various insurers were offered for purchase on the Connector. Insurance providers presented (or bid) to the board with relevant information about the cost and coverage of their plans. The board then decided which of these plans to offer on the Connector for Commonwealth Choice. The plans were designated as Gold, Silver, or Bronze based on their actuarial value, while a fourth level, Young Adult Plans, was created exclusively for young adults 19-26 years of age and offered a narrower benefits package. For more info see: http://www.commonwealthfund.org.

Table 20: Pre-Reform vs. Post-Reform: Labor Market Outcomes[1]

	All	Young	Prime Age	Old
Pre-reform (2000-2005)				
Full-time (FT) employed	76.12	49.10	83.26	11.44
Part-time (PT) employed	17.73	33.54	13.34	16.87
Unemployed	6.14	17.36	3.40	3.28
Post-reform (2007-2012)				
Full-time (FT) employed	73.00	43.50	81.54	75.41
Part-time (PT) employed	18.10	36.46	13.09	15.22
Unemployed	8.89	20.03	5.37	9.37

[1] Source: Current Population Survey (CPS) Annual Social and Economic Supplement (ASEC).

and their parents and offered fully subsidized coverage for those with incomes below 150 percent of the FPL. Individuals with incomes between 150 percent and 300 percent of the FPL were eligible to receive subsidies. In comparison, the ACA offered states federal funding to expand Medicaid to all individuals with incomes below 133 percent of the FPL and extended subsidized coverage for individuals with incomes up to 400 percent of the FPL. While the national reform gives subsidies to more families, the subsidies in Massachusetts were more generous.

8.2 Massachusetts Health Care Reform: Changes After the Reform

Table 20 compares the distribution of FT employed, PT employed, and unemployed, for the overall labor force as well as the three age groups. The top panel presents the pre-reform (2000-2005) averages from the CPS (ASEC), while the bottom panel shows post-reform (2007-2012) averages. With these time periods, we aim to present a longer-run view of the changes in Massachusetts. Using a longer time series helps us overcome the issue that arises from the relatively small number of individuals observed in CPS (ASEC), because we consider only the individuals in Massachusetts.

The first column shows the numbers from the entire labor force (ages 16-64). Before the reform, 76.1 percent of the labor force worked FT, while 17.8 percent worked PT. The remaining 6.1 percent were unemployed during 2000-2005. In the six years following the reform, there have been small shifts in the composition of employment in the state. The share of PT employment rose to 18.1 percent, while the share of FT employment declined modestly to 73.0 percent. Meanwhile, the average unemployment rate was 8.9 percent in the post-reform period, which likely reflects the effects of the Great Recession. Certain patterns remain unchanged after the reform, such as, (i) the proportion of FT employment increases with age, (ii) the proportion of PT work is the highest among young workers. However, (iii) the unemployment rate is the smallest among prime-age workers in the post-reform period compared with older workers in the pre-reform period.

Table 21 compares the choices regarding health insurance in Massachusetts in the pre-reform (top panel) and post-reform periods (bottom panel). There are five major changes to discuss: (i) The uninsured rate drops 16.5 percent in 2000-2005 to 10.1 percent in 2007-2012.[37], (ii) insurance enrollment increases for all age groups, but mostly for young and old workers, (iii) the share of workers

[37] The average uninsured rate for 2007-2008 was 10.7 percent, showing that the drop in the uninsured rate happened right after the implementation of the reform.

Table 21: Pre-reform vs. Post-reform: Health Insurance Choice[1]

	All	Young	Prime Age	Old
Pre-reform (2000-2005)				
Employer-provided health insurance (EHI)	59.88	29.23	67.29	68.24
Private health insurance (PHI)	16.70	30.41	12.61	17.66
Medicaid	6.89	11.60	5.97	4.38
Uninsured	16.52	28.76	14.13	9.73
Post-reform (2007-2012)				
Employer-provided health insurance (EHI)	58.55	28.50	66.29	65.40
Private health insurance (PHI)	18.59	37.05	13.09	17.79
Medicaid	12.75	18.09	11.42	11.33
Uninsured	10.11	16.36	9.20	5.48

[1] Source: Current Population Survey (CPS) Annual Social and Economic Supplement (ASEC). As for the adjustments to make data consistent with the model, see Section 5.1.

obtaining Medicaid almost doubles from 6.9 percent pre-reform to 12.8 percent post-reform. Enrollment increases for all age groups. For prime-age and old workers, enrollment in Medicaid more than doubles after the reform, and this corresponds to a shift from uninsurance. (iv) The proportion of workers with private health insurance (PHI) increases slightly from 16.7 percent in 2000-2005 to 18.6 percent in 2007-2012. The change is almost entirely due to increased enrollment of young workers in PHI. (v) Interestingly, the proportion of workers with EHI declines modestly from 59.9 percent in 2000-2005 to 58.6 percent in 2007-2012. The share of workers with EHI drops for all age groups, but mostly among old workers.

8.3 Massachusetts Health Care Reform: Model Experiment

In the model, we introduce the stylized version of the Massachusetts Health Care Reform, which consists of the following six components:

1. **Individual Mandate:** Workers have to obtain health insurance or pay penalty of $0.5q_1$.
2. **Health Insurance Exchange:** Workers can purchase health insurance from the exchange (the Connector). The premium is based on the entire pool of health insurance purchasers and does not depend on individual characteristics.
3. **Health Insurance Subsidies:** Workers with income between 150 percent and 300 percent of the FPL receive subsidies when they purchase health insurance from the exchange. The health insurance premium is up to 2.7 percent of their income.
4. **Medicaid Expansion:** Workers with incomes below 150 percent of the FPL receive free health insurance.
5. **Employer Mandate:** Firms with 11 or more FTE employees have to offer health insurance to FT workers or pay a penalty of $295 per employee.
6. **Financing:** τ_w and τ_u are adjusted to satisfy the respective government budget constraint.

Table 22: The ACA vs. the Massachusetts Health Care Reform[1]

	Baseline	The ACA	MA Reform
Health Insurance Choices			
Employer health insurance (EHI)	56.30	54.89	47.94
Private health insurance (PHI)	14.45	14.37	18.66
Medicaid	6.61	25.18	29.55
Uninsured	22.64	5.56	3.85
Labor Market Outcomes			
FT employed	79.25	78.23	78.28
PT employed	15.11	16.42	16.35
Unemployed	5.64	5.35	5.36
Total hours worked	20.19	20.12	20.12
Output	7.154	7.126	7.124
τ_w (%)	0.80	1.63	2.17
τ_u (%)	0.83	0.80	0.79
Welfare in CEV (%)	–	+0.54	+0.60

[1] FTE = Full-time equivalent. One PT worker is counted as 0.54 FTE.

Table 22 compares the key statistics among the calibrated baseline model (first column), the model with the ACA (second column), and the model with the Massachusetts Health Care Reform (third column). First of all, the Massachusetts reform achieves a lower uninsured rate (3.9 percent) than the ACA (5.6 percent), and the welfare gain is larger with the Massachusetts reform (+0.60 percent) than with the ACA (+0.54 percent). Since the health insurance subsidies are more generous and Medicaid is available for workers with even higher income than under the ACA, the proportion of workers obtaining Medicaid and subsidized PHI is higher under the Massachusetts reform. On the other hand, since the employer mandate penalty is lower, less firms offer health insurance and thus less workers obtain health insurance from their employers. Although the more generous nature of the Massachusetts reform requires a higher tax to finance the reform (2.2 percent in the Massachusetts reform versus 1.6 percent under the ACA), a more extensive redistribution through more generous health insurance subsidies leads to a higher welfare gain under the Massachusetts reform.

In terms of the labor market outcomes, the composition among FT employment, PT employment, and unemployment is similar under the two reforms. In both cases, workers are less attached to FT employment with health insurance. As a result, PT employment increases to 16.4 percent under both reforms, compared with 15.1 percent in the model without a reform.

How well does our model capture changes in Massachusetts in the post-reform period? In Section 8.2 we compared labor market outcomes and insurance enrollment in Massachusetts in the pre- and post-reform periods. Table 22 shows that our model successfully captures the main features of the experience in Massachusetts: (i) The uninsured rate drops significantly after the implementation of the reform; (ii) this is mostly due to increased enrollment in Medicaid; (iii) the proportion of workers with PHI increases slightly; (iv) the proportion of workers with EHI declines slightly. The model also predicts a shift in employment from FT to PT, which is consistent with the observed changes pre- and post-reform in Massachusetts, as we show in Section 8.2. However, the observed shift in the data might be due to the effect of the Great Recession; some workers might have unwillingly accepted PT jobs while FT jobs were relatively scarce.

Table 23: The ACA vs. Universal Health Care

	Baseline	The ACA	Universal Health Care	
			Tax Based	Compulsory
Health Insurance Choices				
Employer health insurance (EHI)	56.30	54.89	–	–
Private health insurance (PHI)	14.45	14.37	–	90.51
Medicaid	6.61	25.18	100.00	9.49
Uninsured	22.64	5.56	–	–
Labor Market Outcomes				
FT employed	79.25	78.23	78.98	78.26
PT employed	15.11	16.42	15.58	15.57
Unemployed	5.64	5.35	5.44	6.17
Average Consumption (dollars)				
Overall	28,497	28,283	28,098	28,132
Young	12,377	12,732	12,490	11,223
Prime Age	32,761	32,399	32,227	32,602
Old	33,773	33,366	33,206	33,687
Total hours worked	20.19	20.12	20.19	20.02
Output	7.154	7.126	7.143	7.148
τ_w (%)	0.80	1.63	6.74	0.66
τ_u (%)	0.83	0.80	0.77	0.82
Welfare in CEV (%)	–	+0.54	−0.50	−2.04

9 Universal Health Care

While the U.S. health-care market is primarily based on employer-provided health insurance (EHI), many developed economies adopt universal health-care systems in which all individuals are covered by health insurance. In this section, we compare two versions of a universal health-care system with the U.S. health care pre- and post-ACA as shown in Table 23.

The first two columns show the U.S. health-care system pre- and post-ACA. The third and the fourth columns show the properties of the models with universal health care. In the third column (labeled as "tax based"), all workers are covered by public health insurance, and this insurance is financed through a proportional income tax rate. This is similar to what is implemented in Canada or the U.K. Within our framework, it basically works like Medicaid and covers all individuals in the economy. That is why the first panel of the table shows that all everybody is covered by Medicaid in this variant of universal health care. Although, by assumption, the uninsured rate is zero under this universal health care, the welfare effect of moving from the baseline model pre-ACA to the tax-based universal health-care system is negative, at -0.5 percent in CEV, in contrast with 0.5 percent welfare gain from the ACA. Why? Since health insurance is completely financed through a proportional tax, the tax rate goes up from 0.8 percent in the baseline model to 6.7 percent in the model with universal health care. Although the average consumption among the young is slightly higher with universal health care ($\$12,490$) than in the baseline ($\$12,377$), the young with a lower income suffer a higher tax payment, while the young with a low income enjoy Medicare with a significantly lower tax rate in the baseline model. The effect on the labor market outcome is limited

though. In the model with tax-funded universal health care, 79.0 percent of the workers work FT, while 15.6 percent work PT, and 5.4 percent are unemployed. These numbers are very close to their counterparts in the baseline model.

In another experiment, we implement a compulsory health-care system. Under this system, individuals either purchase private health insurance (PHI) that offer the same premium for everyone regardless of their risks, or they obtain publicly funded Medicaid if they are eligible. The eligibility criteria for Medicaid is set at the same level as in the baseline (63 percent of the FPL). According to our model experiment, 9.5 percent of workers receive Medicaid, while the rest of the population purchase PHI at a fixed premium. Most important, the welfare effect of implementing such a universal health-care system is a large negative, at -2.04 percent. The reason is simple. This system is basically funding universal health care using a lump-sum tax, except for those who qualify for Medicaid. Therefore, the tax burden (or the health insurance premium) is too expensive for young workers. The average consumption among young workers is 9.3 percent lower than in the baseline. This version of the universal health care causes a slight shift towards unemployment (6.2 percent) and PT employment (15.6 percent), while 78.3 percent work FT. These two experiments indicate that, financing of a publicly funded health-care system is crucial for welfare implications.

10 Conclusion

In this paper, we analyzed the macroeconomic and welfare implications of the ACA, with a focus on the interaction between the health insurance market and the labor market. We constructed an equilibrium islands model with firm and worker heterogeneity. The model is rich enough to capture all the key features of the ACA, and it was used as a laboratory to implement various counterfactual experiments associated with the ACA. Our experiments indicate that the ACA achieves its goal of near-universal coverage and generates a welfare gain equivalent to 0.5 percent of flow consumption. The uninsured rate drops from 22.6 percent to 5.6 percent after the implementation of the reform, which is similar to the CBO's recent estimate of a drop to 7 percent among the nonelderly population (by 2018). The ACA impacts the allocation between PT and FT employment; the model predicts that 2.1 million (1.3 percent of the labor force) more PT jobs will be created as a result of the ACA, at the expense of 1.6 million FT jobs. However, the effect of the ACA on total hours is only modest (0.36 percent decline), compared with Mulligan (2014), who predicts a 3.0-percent decline in total hours, and the Congressional Budget Office (2014), which predicts a 1.5-2.0 percent decline. All things taken into account, our model implies a positive welfare effect equivalent to 0.5 percent of the flow consumption growth, even though our model does not have features such as better health insurance coverage improving health or better health leading to higher productivity, both of which are supported by various studies. We also compare the model's predictions for the consequences of the 2006 Massachusetts Health Care Reform with the data after the reform, and find that model's predictions are generally consistent with the data. This can be taken as a validation of our model.

Let us conclude by mentioning three promising areas of future research. First, the model developed in our paper can be used to investigate the optimal design of health insurance system. Some of our counterfactual experiments indicate ways to further improve the ACA, but a systematic analysis of these aspects would be useful. Second, as we show in Section 3, many individuals obtain health insurance as dependents, but our analysis abstracts from this dimension. Extending our model to include the distinction between policyholders and dependents is an important extension. New research by Fang and Shephard (2015) is taking a step in this direction. Finally, publicly provided health insurance naturally interacts with other government programs, such as disability insurance

and welfare programs. It is important to investigate such interaction for the optimal design of a health-care system in a global sense.

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