Expanding Health Insurance with Mandate and Subsidy: Theory and Evidence from Massachusetts

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Abstract

What is the desirable scope of social insurance, and what motivates governments to mandate and subsidize health insurance? This paper explores adverse selection and the societal burden of charity care as motivations for expanding health insurance. I show that expansions replacing charity care with tax-financed subsidies on premiums generally improve welfare under adverse selection and progressive taxation, and I quantify the motivating benefits relative to the expansion costs exploiting the penalty and subsidy incentives in Massachusetts. Expansions generate large benefits on both premiums and charity costs, and the joint benefit offsets the fiscal cost of expansion. Further expansions of subsidized insurance increase welfare with redistribution, but increases in the mandate penalty are less desirable.

Keywords: health insurance, subsidy, penalty, adverse selection, charity care

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1 Introduction

Governments worldwide invest great amounts of resources in the health, education, and the well-being of citizens. In the United States, federal spending on health insurance subsidies totals 8.9 billion, or 4.0% of GDP in 2020, and is projected to reach 4.4% of GDP by 2030.[1] Compared to costs, the motivations of public spending on health insurance and the effectiveness of expansion policies such as mandates and subsidies are less understood.

The canonical motivation for government intervention in the insurance market is adverse selection (Akerlof 1970). Absent a coverage mandate or subsidies, premiums are pushed up by high-cost enrollees, driving out low-cost individuals from the risk pool. In private insurance markets, welfare loss from adverse selection tends to be small, however, and does not fully justify subsidies on premiums (Einav *et al.*, 2010). Moreover, while information asymmetry can potentially explain the absence of private insurance markets for certain risks (Hendren, 2017), the sweeping nature of a coverage mandate also limits the empirical variation useful for understanding the role of adverse selection, if any, in these contexts.

A second motivation recognizes the fact that the uninsured do not bear the full financial risk of health expenditures; a non-trivial share of the medical bill is borne by third-party payers (Finkelstein *et al.*, 2015). When the government cannot pre-commit to not providing care to the uninsured, transfers from the charity care program decrease the WTP for health insurance. Expanding health insurance reduces the social cost of charity care which in turn lowers the net cost of expansion. When transfers through insurance premiums achieve more efficient and equitable distribution of healthcare costs, replacing charity care with health insurance improves the public finance of a coverage mandate.

This paper evaluates both motivations in determining the desirable scope of social insurance. In a conceptual framework, I first examine the case for a universal insurance mandate when the government either enrolls individuals in health insurance or provides

[1] source: Congressional Budget Office (CBO), https://www.cbo.gov/publication/56571.

charity care. Adverse selection alone presents weak justification for an insurance mandate unless full redistribution across risks in addition to income is desirable. Replacing charity care with tax-financed subsidies on premiums improves welfare, if progressive taxation on income reduces the excess burden on charity cost payers. When higher incomes have lower risks, fully replacing charity care with subsidized health insurance maximizes welfare.

Although both adverse selection and charity care potentially motivate an insurance mandate, I assess their empirical relevance for policy efforts leveraging tax and subsidy incentives to expand health insurance. Exploiting the premium subsidy and tax penalty adopted in the 2006-2007 reform in Massachusetts, I develop an empirical framework where the incentive effect on uptake, the change in risk pools, and the pricing implications for premiums and charity costs provide sufficient statistics to characterize and compare the motivating benefits. The net benefit relative to the fiscal cost indicates the desirability of incremental insurance expansions using policy incentives.

The welfare framework traces out the social externality of expansion across individuals. With adverse selection, expansion reduces the average cost in health insurance and in charity care. The cost composition change impacts premium and the surcharge fee on services according to regulations on premiums and charity care. The fiscal cost includes direct transfers to recipients and spending on marginal enrollees responding to policy. For subsidies, I further include employment responses and coverage from employer-sponsored insurance (ESI) as additional sources of fiscal externality.

Although behavioral responses to subsidies and taxes in health insurance are well examined in the literature, hence allowing for a pure calibration exercise for welfare, I estimate incentive effects specific to the Massachusetts reform focusing on non-elderly adults in the American Community Survey (ACS). The estimates serve two purposes. First, they show that incentive effects in Massachusetts fall within the range of existing evidence under similar contexts. Applying alternative estimates in the welfare calculation thus informs the potential impacts of expansion in Massachusetts. Second, they reveal

heterogeneous effects across sub-groups.

I exploit differences in subsidy generosity across income groups within rating communities where insurer price does not differ by individuals. Subsidy reduces the premium price by a greater percent for low-income individuals. To reduce biases from endogenous responses, I quantify subsidy generosity as a percent of premium using simulated generosity from a pre-reform sample of individuals unaffected by the incentive (Currie and Gruber 1996a; Currie and Gruber 1996b). Given premium, simulated generosity isolates subsidy differences across demographic groups predicted by pre-existing differences in incomes. I use the simulated measure to estimate the policy impacts and to instrument for subsidy rates observed in Massachusetts. The variation across groups driven by the rating regulation on premiums and subsidies has been widely adopted to estimate insurance demand in the individual market (Tebaldi, 2017) and the incentive effect on uptake (Frean *et al.*, 2017).

The simulated measure suggests that increasing subsidy generosity by 10 percentage points (above the 70% baseline) increases uptake by 1.3 percentage points in 2008-2011, and by 1.8 percentage points in 2011. The largest increase occurs for younger individuals (below age 30) who are less likely to obtain insurance from employers. Employment responses are indistinguishable from zero, but increase significantly with subsidy in the near-elderly (55-64), where coverage from ESI decreases with subsidy. In contrast, estimates based on endogenous subsidy rates are wrong-signed for insurance uptake and indicate substantially larger disincentive on employment than the existing literature.

Based on the cost composition change induced by marginal enrollees, I calculate the pricing benefits of an additional dollar of subsidy applied to premiums. I approach the calculation first from a pure efficiency standpoint: expansion alleviates the adverse selection in premiums and the social cost of charity care, but does not serve redistribution purposes through the subsidy transfers or premiums. In this case, the pricing benefits net of the fiscal externality indicate the cost-effectiveness of subsidized expansion. For a

range of behavioral responses to subsidy, the net benefit is evaluated to be close to zero. Put differently, above the 95% insurance rate in Massachusetts, the pricing benefits of subsidized expansion do not recover the fiscal cost of expansion.

Between the pricing benefits, the reduction in premium increases welfare by $0.10 for an additional dollar of subsidy, and charity costs internalized by individuals increase welfare by another $0.06. Expansion thus generates significant benefits for the large share of population enrolled in health insurance in addition to payers of charity care. Omitting either benefit would drastically under-state the cost-effectiveness of subsidized expansion. As a means of redistribution, subsidy further improves welfare through the transfer value to the low-income. With even small degrees of redistribution preferences, benefits exceed costs and further expansion of subsidized insurance is desirable.

By contrast, redistribution reduces welfare for expansions through the tax penalty. Because uninsured individuals subject to the penalty are more likely to be young and have low incomes, raising revenues from the penalty is more costly than the taxation of workers. For reducing premiums and charity costs, the pricing benefits roughly offset the fiscal externality of marginal enrollees, implying that the current penalty is close to the optimal from the efficiency standpoint. However, further expansions through the penalty are not desirable due to the utility costs imposed on the uninsured.

Previous studies have separately identified the role of charity care for insurance demand in the subsidized market (Finkelstein *et al.*, 2019) and the impacts of selection on premiums in the individual market (Hackmann *et al.*, 2015). This paper shows that the mechanisms are fundamentally linked and jointly present motivations for policy efforts expanding health insurance. Drawing on incremental expansions in Massachusetts, I quantify the pricing benefits to interpret the desirability of expansion and the relative importance of efficiency versus equity arguments. I use the trade-off against costs to inform the design of effective policies implementing the expansion.

This paper more broadly relates to a recent literature exploring the rationales of

universal insurance mandated by the government. Cabral *et al.* (2019) finds that standard market failures including adverse selection present only weak justifications for mandating workers' compensation insurance in Texas. For unemployment insurance, moral hazard limits the desirability of universal supplemental coverage above a minimum mandate (Landais *et al.*, 2021). For health insurance, this paper shows that universal coverage may ultimately involve redistribution preferences, but externality on prices still indicates very high insurance rates absent a mandate. Moreover, policy incentives are important for balancing efficiency and redistribution in voluntary, choice-based insurance.

2 Massachusetts health insurance reform

Massachusetts enacted its comprehensive health reform law, Chapter 58 of the Acts of 2006, in April, 2006. The law aims to improve healthcare access in the state by implementing mandates (in the form of tax penalties) on individuals and firms, subsidies to the low-income, and regulations of premiums and risk pools. Together, the structure of the reform resembles a "three-legged stool." I introduce each component of the law below.

2.1 Mandate

The individual mandate is the most innovative and controversial component of the law. The mandate requires that individuals above age eighteen must purchase health insurance or pay a tax penalty. The penalty was first implemented in 2007, and tax-filers without proof of insurance by December, 2007 were denied their personal income tax exemption. From 2008 onward, the tax penalty is linked to the premium in the cheapest plan available to individuals, adjusted by the number of uninsured months.

The employer mandate imposes penalties on firms that fail to sponsor health insurance for employees. The penalty amount is adjusted based on the expected cost of uninsured workers on the state's charity care program. Larger penalty amounts apply when uninsured

workers generate particularly high costs of charity care (more than $50,000 annually). The purpose of the employer mandate is to maintain coverage from employer sponsored insurance (ESI) so that expansions cover individuals not eligible for private insurance. Due to the administrative burden on firms, the state repealed the employer mandate in July, 2013.

2.2 Subsidized Insurance

The second component of the law alleviates the financial burden of premiums in the low-income population. Previously, the state's Medicaid program, MassHealth, covers individuals with income below 133% federal poverty level (FPL).[2] No premium is charged for the Medicaid insurance. To increase affordability for more individuals with low and middle incomes, the state sponsored an insurance market, called the Commonwealth Care (CommCare), where individuals below 300% FPL can purchase insurance at subsidized premium rates. Those with Medicaid eligibility or ESI are not eligible for subsidies.

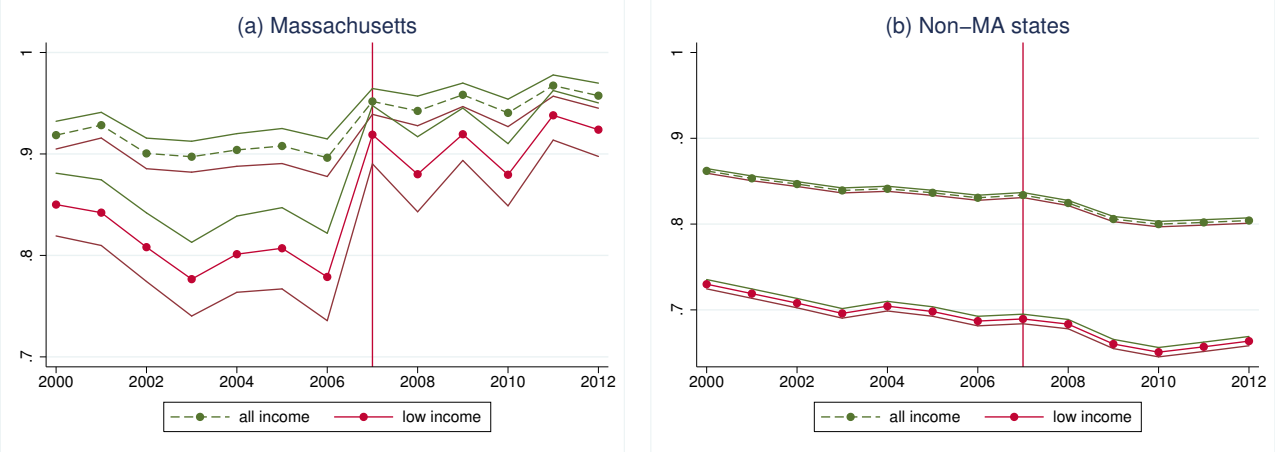
Enrollees in Commonwealth Care contribute an "affordable" amount towards the monthly premium cost of insurance. Premiums above the affordability limit are paid for by the state. For individuals with income less than 150% FPL, affordability is zero, so that premiums are fully subsidized in this range. Above 150% FPL, in 2011, affordability is $39 per month in the 150-200% bracket, $77 per month in the 200-250% bracket, and $116 in the 250-300% bracket. Above 300% FPL, a separate program called the Commonwealth Choice offers unsubsidized insurance to high-income individuals.

The difference between enrollee cost (affordability) and the premium price charged by insurers is the subsidy. Relative to the lowest premium price ($405 in 2011), subsidy is roughly 90% of premium in the 150-200% bracket, 80% in the 200-250% bracket, and 70% in the 250-300% bracket. Figure 1 illustrates the coverage gain in the low-income population in MA. Insurance rate was substantially lower below 300% FPL, but the gap

[2]Coverage is further restricted to individuals who are parents or caretakers of dependent children.

from the state average nearly closed after 2007 in MA and stayed constant over time in the rest of US.

Figure 1: Insurance coverage trends



Notes. Figure compares insurance coverage rates in Massachusetts (panel a) with the rest of US states (panel b), for the full population and the low-income group below 300% FPL. Insurance rates are derived for the 27-64 age group from the CPS March supplement, adjusted by the sampling weights for insurance. 95% confidence intervals are plotted around annual estimates.

2.3 Rating Regulation

The final piece of the law involves regulation on premiums. Before Chapter 58, community rating in MA requires that premiums can only differ based on enrollees' age and residential location, and not by other factors such as health or demographics. Chapter 58 further requires that the maximum premium difference across age groups does not exceed a ratio of 2, further limiting the discrimination in premiums. Moreover, Chapter 58 merged the risk pools of small-group insurance and the individual market in July 2007. After the merger, premiums of both insurance are subject to regulations based on the combined risk pool.[3] In particular, regulations on the medical loss ratio require that insurers spend no

[3]Because previously the individual market was much smaller, the merger significantly reduced premiums of individual insurance without meaningfully increasing premiums of small-group insurance (Graves and Gruber, 2012).

less than 80% of premiums on the claim costs of enrollees.

Table 1 summarizes enrollment by the source of insurance in Massachusetts. Consistent with Figure 1, Commonwealth Care is the largest contributor to the coverage gains from Chapter 58: of the 442,000 new enrollees by July 2008, around 40% received premium assistance from the program. Including the fully subsidized MassHealth program, more than half (68%) of new enrollees received some premium assistance from the state.

Table 1: Enrollment counts by source of insurance

	6/30/2006	12/31/2006	6/30/2007	12/31/2007	6/30/2008	diff. from 6/30/06
Private Group	4,274,000	4,338,000	4,378,000	4,406,000	4,421,000	147,000
Individual Purchase	40,000	39,000	36,000	65,000	80,000	40,000
MassHealth	705,000	741,000	732,000	765,000	785,000	80,000
Commonwealth Care	0	18,000	80,000	158,000	176,000	176,000
Total	5,020,000	5,136,000	5,226,000	5,394,000	5,462,000	442,000

Notes: Table summarizes administrative enrollment counts published in *Health Care in Massachusetts: Key Indicators, November 2008*. The report is accessible at http://archives.lib.state.ma.us/bitstream/handle/2452/36763/ocn232606916-2008-11.pdf?sequence=1&isAllowed=y. Only enrollment in the primary source of insurance included in the statistics.

2.4 Charity Care

Outside the main frame of Chapter 58, the state's Uncompensated Care Pool (UCP) is a safety net program that reimburses hospitals for treating uninsured individuals. UCP is important in the passage of Chapter 58 because a key motivation of the law is to reduce charity care through subsidized expansion, hence solving a "free-rider problem." The problem originates from the 1986 Emergency Medical Treatment and Active Labor Act (EMTALA), which mandated hospital emergency services to all individuals regardless of the ability to pay. In Massachusetts, UCP provides more generous assistance to the uninsured and reimburses hospitals through taxation on private sector revenues. In 2005, UCP was billed $701.8 million for hospital charity care and paid out $498.6 million from the program fund.[4]

Chapter 58 reformed the financing of charity care and renamed the UCP program

[4]Source: Health Safety Net (Uncompensated Care Pool) annual reports, available at https://archives.lib.state.ma.us/handle/2452/47833

the Health Safety Net (HSN). In 2005, Chapter 58 received permission from the federal government to redirect the funding for charity care to subsidies on premiums in Commonwealth Care, expecting the subsidized program to drastically reduce charity costs in the state. Five years into the reform, charity costs decreased to $496 million in 2011, or by $243 million compared to the $739 million in 2005.

The remaining costs are financed through a mix of assessments, surcharges, and general revenues under the HSN. Surcharges are service fees on the medical bills of enrollees, and assessments are taxation on hospital revenues. Surcharge fees and assessments are revised each year to match the expected charity cost, and assessments are further adjusted across hospitals to reduce the burden on safety net hospitals. In 2011, surcharge fees and assessments each contribute $160 million to the program budget, with an additional $100 million appropriated from the general revenue.[5]

3 Conceptual Framework

Although reforms expanding health insurance are subjects of constant debate, most insurance programs are universal by design. Contribution to the program is mandatory and individuals access benefits once eligible. One typical example is unemployment insurance (UI), which mandates firms and employees to contribute to the program trust fund and pays out benefits in the event of separation. In contrast, absent a coverage mandate, health insurance in the US is voluntary and far from universal. To date, there remains substantial debate regarding the desirability of universal health insurance and the design of tax and transfers that finance universal insurance.

To understand the desirability of an insurance mandate, I develop a conceptual framework where the government can either enroll individuals in health insurance or cover their medical expenses through charity care. Adverse selection and the social burden of charity

[5]Source: the Health Safety Net program report, available at https://www.mass.gov/files/documents/2016/07/tp/hsn11-ar.pdf

care present motivations for insurance expansions that re-direct charity care transfers to subsidies on premiums. I formulate the benefits on premiums and transfers and discuss welfare implications below.

3.1 Environment

I consider a unit mass of individuals with heterogeneous health type μ and labor productivity ν. The distribution of types follows the density $f(\nu, \mu)$.[6] $\mu \in [0,1]$ is the probability of staying healthy. With probability $1-\mu$, the individual experiences a health event and incurs medical cost M to restore health. The expected cost of type μ is $(1-\mu)M$.

Let $hi(\nu, \mu) \in \{0, 1\}$ indicate the insurance coverage of type (ν, μ). The insurance requires premium $p(\nu, \mu)$ and fully covers the medical cost in the health event. Uninsured individuals are eligible for charity care transfer $\Delta t(\nu, \mu)$ in the health event. Before the realization of health states, ex-ante transfers such as income taxation and subsidies on premiums are captured in $t(\nu, \mu)$.

Let $e(\mu, \nu) \in [0, 1]$ indicate the employment status of type (μ, ν), and $w(\nu)$ is labor income. The opportunity cost of working is captured in $g(\frac{1}{\nu})$ and differs by productivity $\nu \in [0,1]$. With $g'(\cdot) > 0$ and $g''(\cdot) > 0$, the opportunity cost of working decreases (and decreases faster) with productivity. I further assume that $g(1) = 0$ and $g(+\infty) = +\infty$, so that the highest productivity types always work and the lowest productivity types do not.

Absent insurance coverage, the expected utility of type (ν, μ) is

$$U(\nu, \mu | hi = 0) = \mu\, u(c_H(\nu, \mu)) + (1-\mu)\, u(c_S(\nu, \mu)) - e(\nu, \mu)\, g(\frac{1}{\nu}),$$

where consumption equals $c_H(\nu, \mu) = e(\nu, \mu) \cdot w(\nu) + t(\nu, \mu)$ in the healthy state and equals $c_S(\nu, \mu) = e(\nu, \mu) \cdot w(\nu) + t(\nu, \mu) + \Delta t(\nu, \mu) - M$ in the unhealthy state. Assuming that consumption is bounded away from zero with transfers, expected income $e(\nu, \mu) \cdot w +$

[6] The density $f(\nu, \mu)$ is a smooth function over the unit square $[0,1]^2$. The marginal distribution for each type is denoted $f(\nu, \cdot)$ and $f(\cdot, \mu)$, respectively. The correlation between types is unrestricted.

$t(\nu, \mu) + (1-\mu)\Delta t(\nu, \mu)$ exceeds the cost of insurance $(1-\mu)M$. For risk-averse individuals, the government can subsidize health insurance by re-directing charity care $\Delta t(\nu, \mu)$ to ex-ante transfer $\bar{t}(\nu, \mu) = t(\nu, \mu) + (1-\mu)\Delta t(\nu, \mu)$, which increases individual utility without raising the transfer cost to the government. Thus, replacing charity care with subsidized insurance generally improves welfare with type-specific transfers. Under information asymmetry, insurance premiums suffer from adverse selection and subsidies linked to premiums are less able to target individuals directly. I examine insurance expansion under these constraints next.

3.2 Charity Care and Subsidies on Premiums

Consider a government-sponsored insurance market where price discrimination based on health is prohibited. Premium p equals expected cost $\mathbf{E}[1-\mu|hi(\nu, \mu) = 1]M$. For simplicity, I assume that charity care does not require additional out-of-pocket costs in the health event for non-employed individuals, so that healthcare is fully subsidized for the low-income. Employees can access charity care after paying the premium price p, and those without proof of purchase pay the tax penalty equal to a fixed percent k of premium.

Let $e = Pr\{e(\nu, \mu) = 1\}$ indicate the employment share, $\lambda_{e,0}$ the uninsurance rate in workers, and $h^0_{e,0}$ the share accessing charity care in uninsured workers. With similar notations for the non-employed $1-e$, the cost of charity care equals

$$UC = e\,\lambda_{e,0}\,h^0_{e,0}\,(M-p) + (1-e)\,\lambda_{1-e,0}\,h^0_{1-e,0}\,M\,.$$

Charity care is financed by surcharge fees collected from private sector enrollees. Assume that share t of the cost is financed by fees on services utilized by patients, so that the medical bill increases by $\frac{t\,UC}{e\lambda_{e,1}h^0_{e,1}}$ in the health event. When the budget share t exceeds the patient share $h^0_{e,1}$ in health insurance, charity care places excess burden on patients. The remainder cost imposes a surcharge fee $\frac{(1-t)\,UC}{e\lambda_{e,1}h^1_{e,1}}$ on enrollees absent the health event.

Subsidies on premiums are financed by a tax on payroll and the penalty on the uninsured. The contribution of payroll is $(1-e)\,\lambda_{1-e,1}\,p - e\,k\,\lambda_{e,0}\,h^1_{e,0}\,p$ net of the penalty, and the implied tax rate per productivity unit is $\tau = \frac{(1-e)\,\lambda_{1-e,1} - e\,k\,\lambda_{e,0}\,h^1_{e,0}}{e\cdot\mathbf{E}[\nu\,|\,e(\nu,\mu)=1]}\,p$.

Given income $y(\nu,\mu)$, insurance purchase and taxation result in consumption $c^1_{e,1} = y(\nu,\mu) - p - \tau\,\nu - \frac{(1-t)\,UC}{e\lambda_{e,1}h^1_{e,1}}$ for insured workers absent the health event, and $c^0_{e,1} = y(\nu,\mu) - p - \tau\,\nu - \frac{t\,UC}{e\lambda_{e,1}h^0_{e,1}}$ for patients. If uninsured, the worker consumes $c^1_{e,0} = y(\nu,\mu) - \tau\,\nu - k\,p$ after paying the penalty, and consumes $c^0_{e,0} = y(\nu,\mu) - \tau\,\nu - p$ after paying the premium price in the health event.

3.3 Expanding Subsidized Insurance

I first examine expansion of subsidized insurance to the non-employed assuming that workers receive mandatory insurance from employers. Let n_{1-e} indicate the marginal health type in subsidized insurance when types with $\mu < n_{1-e}$ already enroll. Expanding insurance to healthier individuals above n_{1-e} impacts welfare according to

$$\frac{\mathrm{d}W}{\mathrm{d}n_{1-e}} = e\sum_{l=0,1} h^l_{e,1}\,\mathbb{E}[u'(c_{e,1})]\cdot\mathbb{E}\left[\frac{dc_{e,1}}{dn_{1-e}}\,\middle|\,e=1,h=l\right] + e\sum_{l=0,1} h^l_{e,1}\,Cov\left[u',\frac{dc_{e,1}}{dn_{1-e}}\,\middle|\,e=1,h=l\right].$$

The first term summarizes the cost of expansion on workers. Because expansion does not increase the transfer to the non-employed, absent marginal utility differences, the term vanishes due to zero resource cost of expansion. However, the service surcharge implies higher marginal utility for patients in health insurance. Let $\Delta u'_h$ indicate the utility difference. Expansion thus impacts welfare through patient utility $\Delta u'_h\,\mathbf{E}\left[\frac{\mathrm{d}c_{e,1}}{\mathrm{d}n_{1-e}}\,\middle|\,e=1,h=0\right]$ and the tax incidence of subsidy $Cov\left[u',\frac{\mathrm{d}c_{e,1}}{\mathrm{d}n_{1-e}}\,\middle|\,e=1,h\right]$.

Expansion affects consumption through changes in the subsidy burden ΔS net of the marginal cost MC covered in charity care.[7] Applying the changes in $\frac{\mathrm{d}c_{e,1}}{\mathrm{d}n_{1-e}}$, welfare depends

[7] ΔS includes the direct cost of marginal enrollees and the reduction in infra-marginal costs through premiums. Appendix A provides detailed derivation of welfare.

on

$$\underbrace{h^0_{e,1}\Delta u'_h\left[\left(1-\frac{\mathbf{E}[\nu\,|\,e=1,h=0]}{\mathbf{E}[\nu\,|\,e=1]}\right)\Delta S+\left(\frac{t}{h^0_{e,1}}-1\right)MC\right]}_{\text{patient burden}}\underbrace{-\sum_{l=0,1}\frac{Cov[u',\nu\,|\,e=1,h=l]\cdot h^l_{e,1}}{\mathbf{E}[\nu\,|\,e=1]}\Delta S}_{\text{tax incidence of subsidy}},$$

with $\left(1-\frac{\mathbf{E}[\nu\,|\,e=1,h=0]}{\mathbf{E}[\nu\,|\,e=1]}\right)\Delta S$ the subsidy burden relative to an average worker. When subsidy imposes smaller burden on patients ($\frac{\mathbf{E}[\nu\,|\,e=1,h=0]}{\mathbf{E}[\nu\,|\,e=1]}<1$) in addition to reducing charity costs, expansion increases welfare for patients. Moreover, with progressive taxation, expansion places smaller tax burdens on individuals with higher marginal utility, thus improving welfare also through the incidence of subsidy. The overall welfare impact satisfies the following proposition

Proposition 1. *Assume that workers receive mandatory insurance from employers. Under the condition that*

(1) worker productivity increases with health: $Cov[\nu,\mu\,|\,e=1]>0$,

(2) tax burden decreases with marginal utility: $Cov[u',\nu\,|\,e=1,h]<0$,

enrolling uninsured individuals in subsidized insurance always improves welfare, and subsidized universal insurance maximizes welfare.

The first condition implies that subsidy cost is smaller on patients. The second condition ensures that subsidy is financed by progressive taxation. Together, the conditions ensure that replacing charity care with tax-financed subsidies increases welfare, and subsidized universal insurance maximizes welfare.

3.4 Universal Health Insurance with Penalty

I then examine the case for universal insurance when employees without insurance are subject to a tax penalty. Unlike subsidized expansion, expansion for workers could decrease

utility for marginal enrollees paying unsubsidized premiums but increase infra-marginal utility through premiums and transfers. For universal insurance, utility necessarily decreases on the ultra-health margin where $\mu = 1$. To highlight the trade-offs, I consider expansion covering the ultra-health margin and summarize welfare in the following proposition.

Proposition 2. *Expanding insurance to the ultra-health margin impacts welfare through*

(1) marginal utility loss: $MP = \mathbb{E}[u(c^1_{e,1}) - u(c^1_{e,0})|e = 1, \mu = 1]$,
where $c^1_{e,0} - c^1_{e,1} = (1-k)\,p$ *is the net cost of insurance for* $\mu = 1$

(2) benefits to enrollees: $IB = \mathbb{E}[u'|e = 1](1-k)\,p$,

(3) tax incidence of subsidy: $TS = -\frac{Cov[u',\nu|e=1]}{\mathbb{E}[\nu|e=1]}\left(k + \frac{e}{e_{\mu=1}} - 1\right)p$,
with $e_{\mu=1}$ *the employment share on the ultra-health margin*

Universal insurance thus trades-off marginal utility with infra-marginal benefits with the welfare impact

$$\left.\frac{dW}{dn}\right|_{n=1} \propto MP + IB + TS$$

The proposition states that universal insurance involves transfers from the ultra-health margin to infra-marginal enrollees. The net benefit is ambiguous when marginal utility differs. Furthermore, expansion increases subsidy transfers when the cost of new enrollees exceeds the infra-marginal reduction through premiums. This is the case when the share eligible for subsidy is higher on the ultra-margin, so that $\frac{e}{e_{\mu=1}} > 1$. Adding the lost revenue from penalty, the tax incidence adjusts according to the term TS. Overall welfare thus trades-off marginal utility against infra-marginal benefits through premiums and the redistribution through the tax incidence across workers.

Taken together, the argument for an insurance mandate strengthens if subsidized insurance replaces charity care and re-direct the costs more broadly and equitably over the tax base. In the unsubsidized population, an insurance mandate results in marginal utility

losses as well as infra-marginal gains, and the desirability of expansion depends on the relative strengths of the trade-off. For the 2006-2007 insurance reform in Massachusetts, I evaluate the trade-off using an empirical framework of policy-induced expansion. I turn to the empirical framework next.

4 Incremental Expansion in Massachusetts

Guided by the theoretical analysis, I develop an empirical framework to evaluate the welfare impacts of insurance expansion in Massachusetts. Exploiting responses to policy incentives as "sufficient statistics" (Chetty 2006, Chetty and Finkelstein 2013), I formulate and evaluate the pricing benefits on premiums and charity costs relative to the fiscal cost to the government. I present key elements of the framework below.

4.1 Setting

Consider the life-cycle problem of individuals with different health μ and productivity ν. In the beginning of period t, individuals choose employment $e_t \in \{0, 1\}$ and health insurance $hi_t \in \{0, 1, 2\}$, where $hi_t = 0$ indicates uninsurance, $hi_t = 1$ employer sponsored insurance (ESI), and $hi_t = 2$ individual insurance from the government or insurers. Individuals are then subject to a health shock and $h_t = 0$ indicates a health event. The period utility is

$$U(c_{i,j,t}) = \mu\, u(c^1_{i,j,t}) + (1-\mu)\, u(c^0_{i,j,t}) - 1_{\{e_t=1\}}\, g\left(\frac{1}{\nu}\right), \tag{1}$$

where $c^l_{i,j,t}$ is consumption in health state $h_t = l$, and $g\left(\frac{1}{\nu}\right)$ is the disutility from foregone leisure.

In a stationary dynamic setting, a new cohort of (ν, μ) individuals is born each period. The life-cycle utility for the cohort born in period 0 is $\mathcal{U} = \int_0^\infty U(c_{i,j,t}) S(t)\, dt$, where $S(t) = \exp\{-\int_0^t \Lambda(h_\tau)\, d\tau\}$ is the survival probability and Λ is the mortality hazard from

previous health shocks.[8] Individuals maximize life-cycle utility subject to the budget constraint

$$\begin{aligned}\dot{A}_{i,j,t}(h_t) = {} & y_t(A_t, e_t) - 1_{\{e_t=1\}}\tau_{pb} - 1_{\{e_t=1,\, hi_t=1\}}\tau_{pr} - 1_{\{hi_t=2\}}(1-\lambda_p)p \\ & - 1_{\{hi_t=0\}}kp - 1_{\{hi_t=0,\, h_t=0\}}(1-gn)M \\ & - 1_{\{hi_t>0,\, h_t=0\}}[(1-n)M + uc_p] - c_{i,j,t}(h_t), \end{aligned} \tag{2}$$

where income y_t generated by asset A_t and employment e_t is subject to insurance transfers τ_{pb} and τ_{pr}, subsidy or penalty based on insurance choice, and out-of-pocket costs in the health event. Individuals then choose saving $\dot{A}_{i,j,t}$ to determine consumption $c_{i,j,t}$ in period t and health state h_t.

In the cross section, the equilibrium insurance rate and premium price determine the charity costs and insurance transfers financed by the government. Let e indicate the size of workers and λ_j the size choosing insurance j each period. Given premium p, public transfer τ_{pb} satisfies the balanced budget

$$\lambda_1\tau_{ESI}p + \lambda_2\lambda_p p = \lambda_0 kp + e\tau_{pb}, \tag{3}$$

where the government subsidizes ESI at rate τ_{ESI} through tax deductions and subsidize individual insurance at rate λ_p. The subsidies are financed from the tax revenue $e\tau_{pb}$ and penalty $\lambda_0 kp$. Firms finance ESI through the private transfer τ_{pr} from employees as follows

$$\lambda_1(1-\tau_{ESI})p = \tau_{pr}e\lambda_{e,1}, \tag{4}$$

where $\lambda_{e,1}$ is the share of workers with ESI.

I assume that insurance covers n percent of the medical cost M in the health event, so

[8] From stationarity, the size of age-t individuals born in period 0, $\int_{(\nu,\mu)}\int_0^\infty S(t)\,dt\,dF(\nu,\mu)$, equals the size of age-t individuals in the cross section. Government thus implements life-cycle transfers through cross-sectional distribution each period.

that expected cost is $(1-\mu)\,n\,M$ for health type μ. $r(\lambda_0) = h^0_{>0}\,n\,M$ is the average enrollee cost when λ_0 do not enroll, and $h^0_{>0}$ is the patient share in health insurance. Insurers charge an administrative load β above costs, so that premium equals

$$p = (1+\beta)\,r(\lambda_0), \tag{5}$$

with β capped at 25% in Massachusetts. The charity care program covers cost $g\,n\,M$, where g allows for different spending levels in charity care compared to health insurance.[9] In the health event, uninsured individuals are charged $(1-g\,n)\,M$, and enrollees are charged $(1-n)\,M$ plus a service surcharge uc_p. The service surcharge finances fraction α of the charity cost

$$\alpha\,\lambda^0_0\,g\,n\,M = \lambda^0_{>0}\,uc_p, \tag{6}$$

where λ^0_0 ($\lambda^0_{>0}$) is the size of uninsured (insured) patients. The remaining cost, $(1-\alpha)\,\lambda^0_0\,g\,n\,M$, is borne by hospitals as profit loss.

4.2 Welfare

The government provides policy incentives $\mathbf{K} = (\lambda_p, k)$ to increase insurance uptake. With the expansion, the government seeks to reduce the social burden of charity care and to increase individual utility. I thus consider the following social welfare function

$$W = \zeta\,V - (1-\alpha)\,\lambda^0_0\,g\,n\,M, \tag{7}$$

where $V = \int_{(\nu,\mu)} \mathcal{U}\,dF(\nu,\mu)$ is the sum of individual utility and $(1-\alpha)\,\lambda^0_0\,g\,n\,M$ the uncompensated costs borne by hospitals. ζ normalizes utility to private sector revenues using the marginal utility of workers.

Assuming individual optimization, marginal enrollees responding to a small increase

[9] $g \leq 1$ indicates greater spending in health insurance potentially from additional benefits and moral hazard.

in policy are indifferent with the uptake. On the infra-margin, expansion improves welfare for enrollees and charity cost payers through the externality on premium and charity care. Including the fiscal externality on the government budget, the welfare impact of policy-induced expansion can be summarized as follows

Proposition 3. *An increase in policy spending $d\mathbf{K}p$ impacts welfare through*

1. *beneficiary utility* $\frac{\mathrm{d}W_B}{\mathrm{d}\mathbf{K}p} = \lambda_2\,\omega_{\cdot 2}\frac{\mathrm{d}\lambda_p}{\mathrm{d}\mathbf{K}} - \lambda_0\,\omega_{\cdot 0}\frac{\mathrm{d}k}{\mathrm{d}\mathbf{K}}$
2. *premium payment* $\frac{\mathrm{d}W_P}{\mathrm{d}\mathbf{K}p} = -\frac{\mathrm{d}\log p}{\mathrm{d}\mathbf{K}}\left[e\frac{\tau_{pb}}{p} + e\lambda_{e,1}\omega_{1,1}\frac{\tau_{pr}}{p} + \lambda_0\omega_{\cdot 0}k + \lambda_2\omega_{\cdot 2}(1-\lambda_p)\right]$
3. *charity care burden* $\frac{\mathrm{d}W_{UC}}{\mathrm{d}\mathbf{K}p} = -\lambda^0_{>0}\,\omega^0_{\cdot>0}\frac{\mathrm{d}uc_p}{\mathrm{d}\mathbf{K}p} - (1-\alpha)\frac{\mathrm{d}\lambda^0_0}{\mathrm{d}\mathbf{K}p}g\,nM$
4. *fiscal cost* $\frac{\mathrm{d}W_C}{\mathrm{d}\mathbf{K}p} = -e\frac{\mathrm{d}\tau_{pb}}{\mathrm{d}\mathbf{K}p} - e\lambda_{e,1}\,\omega_{11}\frac{\mathrm{d}\tau_{pr}}{\mathrm{d}\mathbf{K}p}$

where $\omega^l_{i,j} = U'(\overline{c^l_{i,j}})/U'(\overline{c_{1\cdot}})$ is the welfare weight of individuals with employment i, insurance j, and health state l. The overall welfare impact is

$$\frac{\mathrm{d}W}{\mathrm{d}\mathbf{K}p} = \frac{\mathrm{d}W_B}{\mathrm{d}\mathbf{K}p} + \frac{\mathrm{d}W_P}{\mathrm{d}\mathbf{K}p} + \frac{\mathrm{d}W_{UC}}{\mathrm{d}\mathbf{K}p} + \frac{\mathrm{d}W_C}{\mathrm{d}\mathbf{K}p}. \tag{8}$$

Proposition 3 formulates welfare in terms of the impacts on beneficiaries, premium, charity cost, and the fiscal cost. Additional policy spending increases beneficiary utility by $\frac{\mathrm{d}W_B}{\mathrm{d}\lambda_p p} = \lambda_2\omega_{\cdot 2}$ with the subsidy dollar, and reduces utility by $\frac{\mathrm{d}W_B}{\mathrm{d}k\,p} = -\lambda_0\omega_{\cdot 0}$ with penalty. The impact on premium is $\frac{\mathrm{d}\log p}{\mathrm{d}\mathbf{K}} = \frac{\varepsilon_{r,\lambda_0}}{\lambda_0}\frac{\mathrm{d}\lambda_0}{\mathrm{d}\mathbf{K}}$, where $\varepsilon_{r,\lambda_0}$ is the cost elasticity in health insurance to the expansion. With adverse selection, expansion reduces premium and insurance transfers, improving welfare by

$$\frac{\mathrm{d}W_P}{\mathrm{d}\mathbf{K}p} = -\frac{\mathrm{d}\log p}{\mathrm{d}\mathbf{K}}\Big[\underbrace{e\frac{\tau_{pb}}{p} + e\lambda_{e,1}\omega_{1,1}\frac{\tau_{pr}}{p}}_{\text{subsidy and ESI transfers}} + \underbrace{\lambda_0\omega_{\cdot 0}k}_{\text{penalty}} + \underbrace{\lambda_2\omega_{\cdot 2}(1-\lambda_p)}_{\text{enrollee cost}}\Big]. \tag{9}$$

Let $\varepsilon_{ri,\lambda_0}$ indicate the elasticity of uninsured cost ri to the expansion. Service surcharge responds according to $\frac{\mathrm{d}uc_p}{\mathrm{d}\mathbf{K}} = \alpha\,g\,\frac{nM}{\lambda_{>0}}\frac{ri}{r}\left(\frac{1}{\lambda_{>0}} + \varepsilon_{ri,\lambda_0} - \varepsilon_{r,\lambda_0}\right)\frac{\mathrm{d}\lambda_0}{\mathrm{d}\mathbf{K}}$, which increases in the cost

elasticity difference in risk pools. Further including hospital uncompensated costs, the benefit from reduced charity care is

$$\frac{\mathrm{d}W_{UC}}{\mathrm{d}\mathbf{K}\,p} = \underbrace{-\omega^{0}_{\cdot>0}\,\alpha\,g\,\frac{ri}{p}\left(\frac{1}{\lambda_{>0}} + \overbrace{\varepsilon_{ri,\lambda_0} - \varepsilon_{r,\lambda_0}}^{\text{cost difference}}\right)\frac{\mathrm{d}\lambda_0}{\mathrm{d}\mathbf{K}}}_{\text{service surcharge}} - \underbrace{(1-\alpha)\,g\,\frac{ri}{p}\left(1+\varepsilon_{ri,\lambda_0}\right)}_{\text{hospital assessment}}\frac{\mathrm{d}\lambda_0}{\mathrm{d}\mathbf{K}}. \tag{10}$$

Financing the subsidy dollar increases worker taxation and reduces welfare by $-e\frac{\mathrm{d}\tau_{pb}}{\mathrm{d}\lambda_p\,p} = -\lambda_2 + (\lambda_p + k)\frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p} + (\lambda_p - \tau_{ESI})\frac{\mathrm{d}\lambda_1}{\mathrm{d}\lambda_p} - \frac{\tau_{pb}}{p}\frac{\mathrm{d}e}{\mathrm{d}\lambda_p}$. This amount includes the mechanic cost of enrollees λ_2 and the fiscal externality from uptake $\frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p}$ and ESI crowd-out $\frac{\mathrm{d}e\lambda_{e,1}}{\mathrm{d}\lambda_p}$. $\frac{\tau_{pb}}{e}\frac{\mathrm{d}e}{\mathrm{d}\lambda_p}$ is the adjustment in the tax burden from employment $\frac{\mathrm{d}e}{\mathrm{d}\lambda_p}$. Including the response in ESI transfers, the fiscal impact of the subsidy dollar is thus

$$\begin{aligned}\frac{\mathrm{d}W_C}{\mathrm{d}\lambda_p\,p} = &-\lambda_2 + \overbrace{(\lambda_p + k)\frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p}}^{\text{new enrollees}} + \Bigg[\underbrace{\lambda_p - \tau_{ESI}}_{\text{crowd-out}} \overbrace{-\omega_{1,1}\,(1-\tau_{ESI})\Big]\frac{\mathrm{d}\lambda_1}{\mathrm{d}\lambda_p}}^{\text{response in ESI}} + \overbrace{\underbrace{(1-\tau_{ESI})}_{\text{reduced private transfer}}\underbrace{\frac{\lambda_1\omega_{1,1}}{e\lambda_{e,1}}\frac{\mathrm{d}e\lambda_{e,1}}{\mathrm{d}\lambda_p}}_{\text{transfer burden per worker}}}^{\text{response in ESI}} \\ &+ \frac{\tau_{pb}}{p}\frac{\mathrm{d}e}{\mathrm{d}\lambda_p}.\end{aligned} \tag{11}$$

I show detailed derivation in Appendix B. Overall welfare thus depends on the transfer values to enrollees, the externality on premiums and charity costs, and the fiscal cost to the government. The net benefit indicates the desirability of further expansion using policy. I discuss model assumptions and alternative mechanisms affecting welfare below.

4.3 Model Discussion

Charity Costs. I assume that government maintains a balanced budget for charity care and subsidies on premiums. This implies that expansion reducing charity care has immediate impact on the surcharge burden on patients. In Massachusetts, the surcharge decreased from 2.90% in 2005 to 1.87% in 2013, or by $46.68 per patient annually, implying large

benefits of expansion on patients. In addition, hospital uncompensated costs decrease in states expanding health insurance to the low-income (Dranove *et al.* 2016; Blavin 2016), consistent with large financial benefits directly to hospitals.

In Massachusetts, the service surcharge is designed to finance around one-third of the charity costs. With low program budget, hospitals may seek private payments from insurers to cover costs uncompensated by the government. To allow for cost-shifting, I deviate from the program budget and calculate welfare when different private payers bear the charity costs. As I show in Section 7.3, alternative incidences yield similar impacts on welfare as the main specification applying the program budget (equation 10).

Private Insurance. Expansions are more costly if spending on subsidized insurance replaces private insurance by firms. Because subsidizing enrollees previously in ESI does not improve the insurance risk pool or reduce charity costs, crowd-out does not generate pricing benefits but impacts costs through the substitution with private transfers in equation 11. In particular, the loss of workers in ESI is welfare-relevant because it affects the per worker cost of private insurance after the expansion.

Empirical evidence points to a non-trivial extent of crowd-out following public expansions (Gruber and Simon, 2008). Under an employer mandate, evidence of significant crowd-out is not strong (Sommers *et al.* 2014; Sommers *et al.* 2018; Frean *et al.* 2017). Nonetheless, subsidy may induce younger individuals to sort into jobs without ESI while increasing ESI coverage with age (Aizawa, 2019), thus allowing subsidy to impact the transfer burden of private insurance. In Massachusetts, I examine the joint response in employment and ESI to quantify the expansion cost through private insurance.

Individual Optimization. A key assumption of the empirical framework is that individuals optimally choose health insurance but do not internalize the pricing implications on premiums and charity care. Exploiting individual optimization, government can provide fiscal incentives to expand insurance and improve welfare. The policy environment lends

itself to the sufficient statistics approach that formulates the resulting welfare benefits from individual responses to policy.

Optimization also implies that marginal enrollees responding to policy are indifferent with the uptake. For welfare, this implies that private benefits of insurance given prices are fully internalized in choices. Due to the complexity of insurance contracts and insurance choice, realistic deviations from optimization may arise due to cognitive and behavioral biases of individuals (Handel and Kolstad 2015; Handel *et al.* 2019). In such cases, policies increasing uptake can further benefit marginal enrollees by improving their choice and utility. These benefits are not included in the empirical framework.

5 Estimation

The key statistics in the empirical framework are the incentive effects of policy on insurance and employment choice. These responses determine the pricing externality in equation 9 to 11. I turn to the estimation of these empirical quantities next.

5.1 Subsidy Rate

Subsidy in Massachusetts ensures that premiums paid by enrollees do not exceed an affordability limit. Regulations on premiums prohibit price discrimination within rating communities defined by enrollee age and county. Given the market price charged by insurers, subsidy rate as a percent of premium equals

$$subs = 1 - \frac{affordability}{market\_rate}, \tag{12}$$

which is the discount provided by policy. I detail the construction of $subs$ next.

Numerator: affordability. Affordability starts from zero for individuals with income below 150% FPL and increases discretely with income at 200%, 250%, and 300% FPL.

The income cut-offs are displayed in the Schedule HC Worksheets and Tables prepared by the state government to help tax filers determine the affordability, subsidy, and penalty amounts applicable to their income and insurance status. Figure 2 shows the affordability schedule and market premium rates printed in the 2011 Worksheets and Tables. The cut-off at 150% FPL corresponds to an annual income of $16,344 for single individuals and a family income of $22,068 for married couples. Above 300% FPL, insurance is affordable and subsidy no longer applies.

Denominator: market rate. The right panel of Figure 2 shows the cheapest premium price across counties and enrollee age in 2011. Across ages, premium is nearly twice as high for the oldest group (55+) compared to young adults (age 27-29).[10] Across locations, premiums are higher in the Berkshire-Franklin-Hampshire counties, where the monthly premium for single adults in age 40-44 is $316. These prices further differ over years. For instance, premiums in the Berkshire-Franklin-Hampshire counties are the lowest across regions in 2010 and rank middle in 2009.[11]

Subsidy Rate in ACS. I construct subsidy rate for 132,360 Massachusetts individuals of age 27-64 in the 2008-2011 American Community Survey (ACS). Because adult children living with parents are not claimed as dependents, I construct family units for each generation in co-residing households (Ruggles *et al.*, 2018) and assign affordability to family members based on incomes. I assign market premium rates based on individual age and location across public use micro-data areas (PUMAs). In Massachusetts, 52 PUMAs divide up 14 counties, with 7 intersecting multiple counties. For these PUMAs, I follow Frean *et al.* (2017) and assign the average premium weighted by population shares to individuals.[12]

[10] Younger individuals below age 26 are eligible for dependent coverage from parents' insurance. I exclude this group from the analysis.

[11] The 2009 Worksheets and Tables is available at https://www.mass.gov/doc/hc-instrpdf/download, and the 2010 document is available at https://www.mass.gov/doc/sched-hc-worksheetspdf.

[12] The split of PUMA population across counties is detailed in http://usa.ipums.org/usa/volii/2000pumas.shtml. The weighting affects premiums in 7 PUMAs or 14% of the state population. As I show in the robustness analysis, results are not sensitive to dropping the border PUMAs or subsuming them into counties with the largest population share.

Figure 2: 2011 Schedule HC Worksheets and Tables, Affordability and Premiums

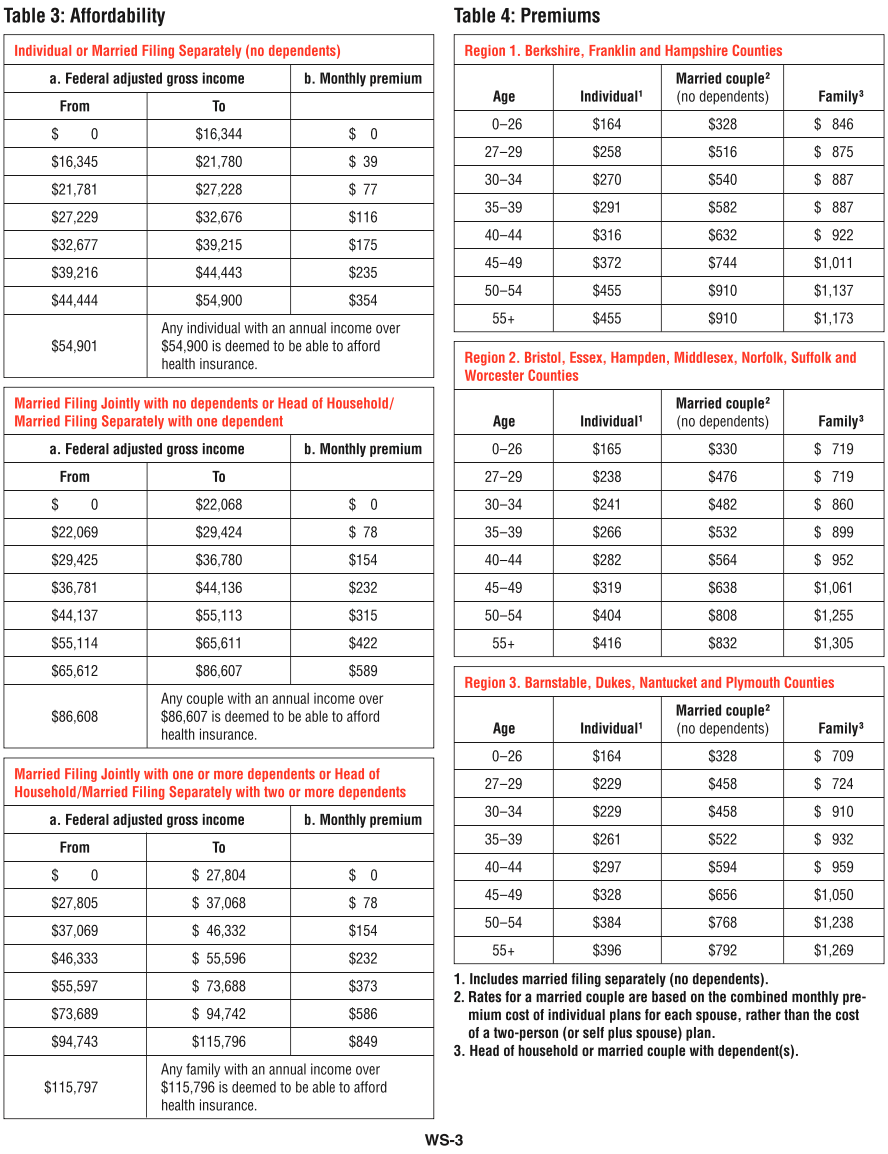


Table 3: Affordability

Individual or Married Filing Separately (no dependents)

a. Federal adjusted gross income		b. Monthly premium
From	To	
$ 0	$16,344	$ 0
$16,345	$21,780	$ 39
$21,781	$27,228	$ 77
$27,229	$32,676	$116
$32,677	$39,215	$175
$39,216	$44,443	$235
$44,444	$54,900	$354
$54,901	Any individual with an annual income over $54,900 is deemed to be able to afford health insurance.	

Married Filing Jointly with no dependents or Head of Household/ Married Filing Separately with one dependent

a. Federal adjusted gross income		b. Monthly premium
From	To	
$ 0	$22,068	$ 0
$22,069	$29,424	$ 78
$29,425	$36,780	$154
$36,781	$44,136	$232
$44,137	$55,113	$315
$55,114	$65,611	$422
$65,612	$86,607	$589
$86,608	Any couple with an annual income over $86,607 is deemed to be able to afford health insurance.	

Married Filing Jointly with one or more dependents or Head of Household/Married Filing Separately with two or more dependents

a. Federal adjusted gross income		b. Monthly premium
From	To	
$ 0	$ 27,804	$ 0
$27,805	$ 37,068	$ 78
$37,069	$ 46,332	$154
$46,333	$ 55,596	$232
$55,597	$ 73,688	$373
$73,689	$ 94,742	$586
$94,743	$115,796	$849
$115,797	Any family with an annual income over $115,796 is deemed to be able to afford health insurance.	

Table 4: Premiums

Region 1. Berkshire, Franklin and Hampshire Counties

Age	Individual[1]	Married couple[2] (no dependents)	Family[3]
0–26	$164	$328	$ 846
27–29	$258	$516	$ 875
30–34	$270	$540	$ 887
35–39	$291	$582	$ 887
40–44	$316	$632	$ 922
45–49	$372	$744	$1,011
50–54	$455	$910	$1,137
55+	$455	$910	$1,173

Region 2. Bristol, Essex, Hampden, Middlesex, Norfolk, Suffolk and Worcester Counties

Age	Individual[1]	Married couple[2] (no dependents)	Family[3]
0–26	$165	$330	$ 719
27–29	$238	$476	$ 719
30–34	$241	$482	$ 860
35–39	$266	$532	$ 899
40–44	$282	$564	$ 952
45–49	$319	$638	$1,061
50–54	$404	$808	$1,255
55+	$416	$832	$1,305

Region 3. Barnstable, Dukes, Nantucket and Plymouth Counties

Age	Individual[1]	Married couple[2] (no dependents)	Family[3]
0–26	$164	$328	$ 709
27–29	$229	$458	$ 724
30–34	$229	$458	$ 910
35–39	$261	$522	$ 932
40–44	$297	$594	$ 959
45–49	$328	$656	$1,050
50–54	$384	$768	$1,238
55+	$396	$792	$1,269

1. Includes married filing separately (no dependents).
2. Rates for a married couple are based on the combined monthly premium cost of individual plans for each spouse, rather than the cost of a two-person (or self plus spouse) plan.
3. Head of household or married couple with dependent(s).

WS-3

Notes. Figure shows a screenshot of the 2011 Schedule HC Worksheets and Tables in Massachusetts. Table on the left panel shows the affordability amount across incomes. Table on the right panel shows the market premium rates across counties. Affordability is zero below 150% FPL, or $16,344 in annual income for single adults and $22,068 in family income for married couples. Subsidy is not applicable above 300% FPL. The full Worksheets and Tables for 2011 is available at https://www.mass.gov/lists/dor-health-care-forms.

Appendix Table C1 summarizes the subsidy rate in Massachusetts. About one quarter of the state population does not have ESI and hence qualifies for subsidized insurance. The eligible individuals are more likely to be young adults with lower education and income. The average subsidy rate is 68% (69% excluding the uninsured), implying an expected premium cost that is one-third of the market rate with subsidy.

5.2 Empirical Strategy

I estimate the incentive effects of subsidy exploiting variations in affordability and the premium differences across rating communities. Building on the subsidy measure $subs$, I compare choices across individuals exposed to the same market price in the denominator but eligible for different affordability amounts due to differences in incomes. The strategy comparing subsidy differences given premiums has been successfully implemented in Frean *et al.* (2017), Jaffe and Shepard (2018), and Tebaldi (2017) to study the subsidized individual market.

There are several challenges to applying the strategy. First, the means-tested subsidy schedule may induce individuals to reduce incomes to qualify for higher subsidy. The endogenous choice of subsidy rates can bias estimates through reverse causality.

In addition, unobserved factors affecting choices could be correlated with income and the subsidy rate of enrollees. For instance, differences in education and labor market conditions affect both insurance coverage and income, and failing to account for theses differences would lead to omitted variable biases in the estimates. Moreover, measurement errors in subsidy introduce attenuation bias to the estimates.

To overcome the challenges, I simulate subsidy rates assuming that individuals in the 2005-2006 ACS were subject to the premiums and subsidy schedules in Massachusetts in 2008-2011. Using a pre-reform national sample ensures that simulated rates do not capture behavioral responses to incentives. I detail the simulation next.

5.3 Simulated Instrument

I simulate two generosity measures and use them as instruments for the subsidy rate $subs$. I construct the first instrument, $subiv$, as follows

$$subiv_{dapt} = 1 - \frac{1}{|\mathbb{N}_{da}|} \sum_{i \in \mathbb{N}_{da}} \frac{affordability_{it}}{market\_rate_{apt}},$$

where individual rates are first calculated for premiums in PUMA p and year t given the age a and income of individual i. I then average the individual rates by demographics d and age a to generate $subiv_{dapt}$. The instrument thus quantifies subsidy generosity predicted by pre-existing differences in incomes across groups. Different from the subsidy rate measured in Massachusetts, the simulated instrument parametrizes policy incentives without also measuring the behavioral responses to policies.

I include 144 demographic groups in d to capture the substantial variations in subsidy across gender, race, ethnicity, education, marital and parenthood status (Appendix Table C2).[13] For instance, subsidy is 98% for African American single mothers in age 30-34 without high school diploma, and less than 10% for college-educated White males in the same age who are married without children.

Despite the variations, causal interpretation requires the assumption that outcomes would have trended similarly across demographics absent the subsidy. If confounding changes correlated with policy have differential impacts on demographics, the instrument is invalid. To address concerns of omitted variable bias, I construct a second instrument

$$sublean_{apt} = 1 - \frac{1}{|\mathbb{N}_{a}|} \sum_{i \in \mathbb{N}_{a}} \frac{affordability_{it}}{market\_rate_{apt}},$$

where individual rates are averaged simply by age a. Compared to $sublean$, the additional

[13] I use gender, race (White, Black, other), Hispanic origin, education (high school drop-out, high school, some college), marital and parenthood status to generate demographic groups in d. Some groups have few observations in ACS due to small number of Hispanics in the group. Dropping the Hispanic differences yields very similar results.

demographic variation in the main instrument $subiv$ allows for over-identification and specification tests based on the variation. I focus on estimates from $subiv$ and include both instruments for model specification tests.

5.4 Econometric Model

I assign simulated instruments to Massachusetts individuals across rating community apt and demographics d. The outcome of interest is insurance and employment choice y_{iapt}, which depends on subsidy generosity $subiv_{dapt}$ in the reduced form as follows

$$\begin{aligned} y_{iapt} = \beta \cdot subiv_{d(i)apt} + \chi_1 \cdot incb_{d(i)} + \rho_a + \phi_p + \tau_t + \rho_{b(a)} \cdot \phi_{r(p)} \cdot \tau_t + \rho_{b(a)} \cdot \phi_{r(p)} \cdot incb_{d(i)} \\ + \phi_{r(p)} \cdot \tau_t \cdot incb_{d(i)} + \rho_{b(a)} \cdot \tau_t \cdot incb_{d(i)} + \phi_{r(p)} \cdot \tau_t \cdot X_{d(i)} + \gamma \cdot UE_{d(i)apt} + \epsilon_{iapt}, \end{aligned} \tag{13}$$

where I control for the main effects of age ρ_a, PUMA ϕ_p, year t, and the income $incb_{d(i)}$ of demographic d derived from the simulation sample. I include community fixed effects $\rho_{b(a)} \cdot \phi_{r(p)} \cdot \tau_t$ to control for premiums and include additional interactions to flexibly control for income differences across demographics, location, and over time.[14]

I further control for unemployment rates at the same level of the instrument in $\gamma \cdot UE_{d(i)apt}$. To do so, I include age-specific unemployment rate $UE_{b(a)t}$ as well as interactions with demographic characteristics $X_{d(i)}$ across region-year $\phi_{r(p)} \cdot \tau_t$. These controls allow macroeconomic shocks to differentially impact demographics across insurance markets, which importantly account for the impacts of the recession in 2008-2009. Less aggressive controls of unemployment rates yield similar estimates.

Table 2 shows the first-stage prediction. In a basic specification with main effects and demographic controls, the simple instrument $sublean$ is a good predictor of the subsidy rate, but including $subiv$ significantly improves statistical power when additional controls and unemployment rates are added. With full controls (column 4), $subiv$ strongly

[14] I control for differences across age bands $b(a)$ and ten rating regions $r(p)$ in the interactions. The main effects control for integer ages in ρ_a and PUMAs in ϕ_p.

predicts subsidy rate with an F-statistic above 600. I turn to the reduced-form results and two-stage-least-square (TSLS) estimates next.

Table 2: First-stage prediction by simulated instruments

	(I)	(II)	(III)	(IV)
subiv		0.92***	0.88***	0.89***
		(0.034)	(0.037)	(0.037)
sublean	0.90**	0.22	-1.76	
	(0.42)	(0.42)	(1.46)	
region-year FE	Y	Y	Y	
region-year-age FE				Y
UE			Y	Y
F-statistic	4.63	379.71	289.48	580.22
R^2	0.27	0.29	0.29	0.29
N	132,360	132,360	132,360	132,360

*** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

Notes: Table summarizes the first-stage prediction of subsidy rate *subs* from simulated instruments *subiv* and *sublean*. All specifications include main effects of PUMA, year, age, and income, as well as region-year effects and demographic controls. Column 3 and 4 includes controls of unemployment rates (UE) at the same level of the instrument *subiv*. Column 4 further includes three-way interaction terms as in equation 13, and the rating community fixed effects by region-year-age fully absorb the simple instrument *sublean*. Robust standard errors clustered at the level of PUMA in the parenthesis.

5.5 Results

Table 3 estimates equation 13 for insurance and employment outcomes. In Panel A, estimates based on the endogenous subsidy measure indicate lower insurance rates for more subsidized individuals. In contrast, simulated generosity capturing policy variations has positive and significant impacts on uptake. In Panel B, increasing the subsidy by ten percentage points increases uptake by 1.3 percentage points, with slightly larger increases estimated by TSLS in Panel C. Across age groups, young adults are the most responsive to subsidy, increasing uptake by 1.9 percentage points (Appendix Table C3).

The employment effects of subsidy are not distinguishable from zero in Table 3. In-

creasing subsidy generosity by ten percentage points, for instance, reduces participation by less than 1 percentage point, with similar null effects across years in 2008-2011. Across age groups, subsidy reduces participation in the near-elderly and increases employment in prime age (Appendix Table C3), but the overall impact on employment is not significant.

Column 4-5 examines ESI coverage jointly with employment. Across ages, crowd-out is larger for younger individuals less likely to obtain ESI and for the early-elderly existing the labor market (Appendix Table C3). These patterns are consistent with the "retirement-lock" of ESI (Wood 2019; Duggan *et al.* 2021) and increased sorting of young workers to subsidized insurance (Aizawa, 2019). Overall, increasing subsidy by ten percentage points decreases ESI and employment jointly by 1.7 percentage points, and decreases ESI and non-employment jointly by 3.5 percentage points (Table 3).

5.6 Robustness

I report p-values from over-identification tests in Panel C of Table 3. For all outcomes, simulated instruments are uncorrelated with unobserved factors in the error term, lending support to the specification in equation 13. In Appendix Table C4, I examine alternative specifications without unemployment controls. I find larger reductions in ESI (column 4) compared to Table 3, but the instruments are potentially correlated with economic shocks directly impacting ESI and employment. Thus, controlling for the recession could be important for estimating the ESI crowd-out in response to subsidy.

I examine alternative subsidy measures in the border PUMAs in Appendix Table C5. Instead of using premiums weighted across regions (Panel A), calculating subsidy based on premiums in the largest share region gives very similar estimates (Panel B). Dropping the border PUMAs, which affects 14% of the state population, has very little impact on the estimates (Panel C). Overall, the effects of subsidy are not sensitive to premiums in the border PUMAs.

To assess the significance of policy impacts, I conduct randomization tests using the

Table 3: Effects of subsidy generosity on insurance and employment

	(I) Any Insurance	(II) Employed	(III) In Labor Force	(IV) ESI + Employed	(V) ESI + Not Employed
			Panel A: OLS		
$subs$	-0.071***	-0.41***	-0.31***	-0.55***	0.046***
	(0.003)	(0.007)	(0.007)	(0.007)	(0.004)
R^2	0.082	0.21	0.19	0.29	0.054
			Panel B: Reduced Form		
$subiv$	0.13***	0.010	-0.003	-0.17***	-0.35***
	(0.024)	(0.053)	(0.045)	(0.056)	(0.024)
R^2	0.070	0.090	0.10	0.13	0.054
2008	0.051	-0.008	0.014	-0.17*	-0.39***
	(0.049)	(0.087)	(0.084)	(0.093)	(0.042)
2009	0.11***	0.056	-0.008	-0.14*	-0.39***
	(0.040)	(0.080)	(0.062)	(0.081)	(0.042)
2010	0.15***	-0.001	-0.003	-0.19***	-0.32***
	(0.036)	(0.064)	(0.057)	(0.066)	(0.035)
2011	0.18***	-0.003	-0.011	-0.16*	-0.32***
	(0.045)	(0.081)	(0.072)	(0.083)	(0.034)
			Panel C: Over-Identified TSLS		
$\widehat{subs}$	0.14***	0.012	-0.003	-0.19***	-0.39***
	(0.028)	(0.059)	(0.050)	(0.058)	(0.030)
F-statistic	289.48	289.48	289.48	289.48	289.48
p-value	0.32	0.43	0.54	0.81	0.44
y mean	0.95	0.77	0.83	0.81	0.10
N	132,360	132,360	132,360	132,360	132,360

*** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

Notes: Table estimates the effects of subsidy generosity on insurance and employment outcomes. Panel A shows OLS estimates using endogenous subsidy rate $subs$. Panel B shows reduced-form estimates using simulated generosity $subiv$ and separate estimates across years. Both panels apply the full specification in equation 13. Panel C estimates over-identified two-stage-least-square (TSLS) estimates using instruments $sublean$ and $subiv$. The specification controls for region-year fixed effects instead of rating community fixed effects by region-year-age. First-stage F-statistic and p-values from over-identification tests are reported. Robust standard errors clustered at the level of PUMA in the parenthesis.

50 non-MA states as placebos. In these states, I generate premiums across random rating communities by age, year, and PUMA, and generate affordability differences over income assigning simulated generosity randomly to demographics. Appendix Figure D1 shows estimates of equation 13 in placebo states and in Massachusetts. Effects on insurance uptake and ESI are highly significant at 95% level in Massachusetts, whereas employment responses are not distinguishable from placebo effects occurring by chance.

6 Calculation

Based on the incentive effects, I calculate the benefits on premiums and charity costs of a marginal increase in policy. I quantify the welfare weights associated with the benefits using consumption data. I detail the calculation of fiscal costs incorporating ESI and employment responses in Section 7.3.

Subsidy. I calculate the cost composition change in the subsidized market based on the cost curve derived in Finkelstein *et al.* (2019). Adjusted to the 150% FPL income, the average cost of enrollees is \$334 and marginal cost decreases from \$203 to \$148 between the 20th and the 6th percentile of WTP in 2011,[15] and decreases to \$141.4 at the lowest WTP observed in sample. Expanding subsidized insurance by 0.1% of the state population thus reduces average cost by $\frac{\$334 \cdot 95\% + \$148 \cdot 0.1\%}{95\% + 0.1\%} - \$334 = -\$0.20$, where 95% is the state insurance rate. In terms of elasticity, the expansion reduces average cost by $\varepsilon_{r,\lambda_0} = \frac{\mathrm{d}r}{\mathrm{d}\lambda_0} \cdot \frac{\lambda_0}{r} = \frac{\$0.20}{0.1\%} \frac{5\%}{\$334} = 0.03$ for one percent reduction of uninsurance.

Given the cost elasticity, expansion through subsidy λ_p impacts premium according to

$$\frac{\mathrm{d}p}{\mathrm{d}\lambda_p} = \varepsilon_{r,\lambda_0} \frac{r}{\lambda_0} (1+\beta) \frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p} = 0.03 \cdot \frac{\$334}{5\%} \cdot (1+25\%) \cdot (-0.18) = -\$45.1$$

[15] The corresponding enrollment share is 80% to 94% of eligible individuals (Appendix Table 7, Finkelstein *et al.* 2019). Under linear extrapolation, the slope of the cost curve is -\$392.9 above 80% enrollment in subsidized insurance, and the lowest WTP type has marginal cost \$124.4.

under the maximum administrative load $\beta = 25\%$.[16] Linked to the benchmark premium ($417.5), an additional dollar of subsidy reduces premium by $\frac{\mathrm{d}p}{\mathrm{d}\lambda_p p} = \frac{\$45.1}{\$417.5} = -0.11$.

To derive the average cost of uninsured individuals in the state, I linearly extrapolate the cost curve assuming common slopes for costs in the subsidized and unsubsidized market.[17] In specifics, marginal cost in the unsubsidized market is $137 at the lowest WTP in sample. From linear extrapolation, the average cost of uninsured individuals is $130.7 in the unsubsidized market and $136.2 in the subsidized market. With 73% eligible for subsidy, the average cost of uninsured individuals (5% of the state population) is $ri = 73\% \cdot \$136.2 + 27\% \cdot \$130.7 = \$134.7$, which is greater than the average cost to the charity care program ($117.1).[18] This implies a spending difference $g = \frac{\$117.1}{\$134.7} = 0.9$ attributable to program benefits and moral hazard.

Enrolling 0.1% of the state population in subsidized insurance thus reduces the uninsured average cost by $\frac{\$134.7 \cdot 5\% - \$148 \cdot 0.1\%}{5\% - 0.1\%} - \$134.7 = -\$0.27$, or by $\varepsilon_{ri,\lambda_0} = \frac{\$0.27}{0.1\%} \frac{5\%}{\$134.7} = 0.10$ per one percent reduction of uninsurance. Given the cost elasticity, expansion through subsidy λ_p reduces the surcharge fee on patients according to

$$\begin{aligned}\frac{\mathrm{d}uc_p}{\mathrm{d}\lambda_p} &= \frac{\alpha g}{1-\lambda_0} \frac{ri(\lambda_0)}{h^0_{>0}} \left[\frac{1}{1-\lambda_0} + \varepsilon_{ri,\lambda_0} - \varepsilon_{r,\lambda_0}\right] \frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p} \\ &= \frac{36\% \cdot 0.9}{95\%} \frac{\$134.7}{12.6\%} \left[\frac{1}{95\%} + 0.10 - 0.03\right] (-0.18) = -\$73.7,\end{aligned}$$

where $\alpha = 36\%$ is the budget share of service surcharge and $h^0_{>0} = 12.6\%$ is the hospital utilization rate.[19] Increasing the subsidy by one dollar thus reduces the surcharge fee by

[16] Compared to the average premium price ($422 in 2011), administrative load is 26% above the average enrollee cost. In the calculation, I use premium $p = (1 + 25\%) \cdot \$334 = \$417.5$ as the benchmark premium linked to policy.

[17] The common slope assumption is invoked to analyze the combined individual market in Hackmann *et al.* (2015). Here, I assume that the lowest WTP types have the same cost in both markets ($124.4), and impose common slope in the last segment of cost curves describing uninsured individuals in both markets. I thus use the assumption specifically for linear extrapolation out of sample.

[18] From the Health Safety Net program report (https://www.mass.gov/files/documents/2016/07/tp/hsn11-ar.pdf), hospital charity care totals $440 million in 2011, with 63% spent on uninsured individuals (without primary or bridge insurance) and 90% on non-elderly adults in age 19-64. Average monthly spending is $117.1, or $\$440m \cdot 63\% \cdot 90\%$ spending divided by $12 \cdot 177,535$ uninsured months.

[19] In 2011, surcharge payments provide $160 million to the HSN budget, covering 36% of the

$\frac{\mathrm{d}uc_p}{\mathrm{d}\lambda_p p} = \frac{-\$73.7}{\$417.5} = -0.18$. Moreover, hospital profit loss decreases by $(1-\alpha)g\frac{ri}{p}(1+\varepsilon_{ri,\lambda_0})\frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p} = 64\% \cdot 0.9 \cdot \frac{\$134.7}{\$417.5} \cdot (1+0.10) \cdot (-0.18) = -0.04$.

Penalty. I quantify the incentive effect of penalty using the regression discontinuity (RD) evidence from Lurie *et al.* (2021). Above the income cut-off of penalty (138% FPL) under the Affordable Care Act (ACA), uninsured months decrease by 0.08 for a \$21 increase in penalty.[20] On an annual basis, the increase in uptake is $\frac{0.08/12}{\$21/\$417.5} = 0.13$ per penalty percent linked to premium. In Massachusetts, purely based on the increase in unsubsidized insurance (2.3%) after the reform, the incentive on uptake is around $\frac{2.3\%}{\$101/\$417.5} = 0.10$ per penalty percent for a \$101 penalty.[21] I focus on the RD estimate in the calculation.

With 73% of the uninsured eligible for subsidy, the cost of marginal enrollees responding to penalty is $73\% \cdot \$148 + 27\% \cdot \$137 = \$145.0$, Expanding insurance by 0.1% of the population reduces the average cost in health insurance by $\frac{\$334 \cdot 95\% + \$145.0 \cdot 0.1\%}{95\% + 0.1\%} - \$334 = -\$0.20$, or by $\varepsilon^k_{r,\lambda_0} = \frac{\$0.20}{0.1\%} \cdot \frac{5\%}{334} = 0.03$ per one percent reduction of uninsurance. The expansion reduces uninsured costs by $\frac{\$134.7 \cdot 5\% - \$145.0 \cdot 0.1\%}{5\% - 0.1\%} - \$134.7 = -\$0.21$, implying elasticity $\varepsilon^k_{ri,\lambda_0} = \frac{\$0.21}{0.1\%} \cdot \frac{5\%}{\$134.7} = 0.08$ per one percent reduction of uninsurance.

The benefit of increased penalty on premium is

$$\frac{\mathrm{d}p}{\mathrm{d}k} = \varepsilon^k_{r,\lambda_0}\frac{r}{\lambda_0}(1+\beta)\frac{\mathrm{d}\lambda_0}{\mathrm{d}k} = 0.03 \cdot \frac{\$334}{5\%} \cdot (1+25\%) \cdot (-0.13) = -\$32.6,$$

with an additional penalty dollar reducing premium by $\frac{\mathrm{d}p}{\mathrm{d}kp} = \frac{-\$32.6}{\$417.5} = -0.08$. The benefit

hospital charity cost (\$440 million). From state reports on health cost trends, hospital discharge rate is 126 per 1000 resident in Massachusetts in 2011 (source https://www.mass.gov/doc/2019-cost-trends-report-chartpack).

[20] The 0.08 reduction is reported in Table 3 of Lurie *et al.* (2021) based on verified enrollment data in the tax return.

[21] According to the Key Indicator (http://archives.lib.state.ma.us/bitstream/handle/2452/112747/ocn232606916-2011-05.pdf), enrollment in unsubsidized insurance increased by 77,330 between 2006 and 2010, or by 2.3% of the age 19-64 population in Massachusetts.

on the service surcharge is

$$\begin{aligned}\frac{\mathrm{d}uc_p}{\mathrm{d}k} &= \frac{\alpha\, g}{1-\lambda_0}\frac{ri(\lambda_0)}{h^0_{>0}}\left[\frac{1}{1-\lambda_0}+\varepsilon^k_{ri,\lambda_0}-\varepsilon^k_{r,\lambda_0}\right]\frac{\mathrm{d}\lambda_0}{\mathrm{d}k}\\ &= \frac{36\%\cdot 0.9}{95\%}\frac{\$134.7}{12.6\%}\left[\frac{1}{95\%}+0.08-0.03\right](-0.13) = -\$52.3,\end{aligned}$$

with the additional penalty dollar reducing the surcharge by $\frac{-\$52.3}{\$417.5} = -0.13$. The penalty reduces the profit loss of hospitals by $(1-\alpha)\, g\, \frac{ri}{p}\,(1+\varepsilon^k_{ri,\lambda_0})\,\frac{\mathrm{d}\lambda_0}{\mathrm{d}k} = -0.03$.

Consumption. – I assume that state utility exhibits constant relative risk aversion (CRRA) over consumption, so that marginal utility equals $u'(c^k_{ij}) = \left(c^k_{ij}\right)^{-\gamma}$ for employment i, insurance j, and health state k. I normalize welfare by the marginal value of labor earnings, so that welfare weights across groups are functions of consumption ratios given γ.[22]

I measure consumption in Massachusetts using the 2011 panel of the Consumer Expenditure Survey (CEX). I determine insurance choice from expenditures on premiums and classify health state based on expenses on hospital services. Appendix Table C6 summarizes non-medical consumption across groups. The consumption ratios imply welfare weight $1.03^{-\gamma}$ on ESI sponsors, $0.64^{-\gamma}$ on subsidized enrollees, $0.58^{-\gamma}$ on the uninsured, and $0.77^{-\gamma}$ on insured patients subject to the surcharge.

7 Welfare

7.1 Subsidy

I apply the empirical results to quantify the welfare impacts of subsidy summarized in Proposition 3. As a benchmark, I consider the special case where $\gamma = 0$, so that marginal utility is constant across individuals and the social value of transfers is zero. In this case,

[22] Welfare weights are $\zeta^k_{ij} = \left(\overline{c^k_{ij}}/\overline{c_{1\cdot}}\right)^{-\gamma}$ with $\overline{c^k_{ij}}$ the average consumption in group i-j-k.

welfare calculates the cost-effectiveness of subsidy at reducing the societal burden of charity care. Further expansions are desirable if individual WTP for subsidies exceeds the fiscal cost.

Table 4: Welfare impacts of subsidies on premiums

	$\frac{dW_B}{d\lambda_p p}$	$\frac{dW_P}{d\lambda_p p}$	$\frac{dW_{UC}}{d\lambda_p p}$	$\frac{dW_C}{d\lambda_p p}$				$\frac{dW}{d\lambda_p p}$
				transfer	marginals	ESI+work	total	
$\gamma = 0$	0.24	0.10	0.06	-0.24	-0.15	-0.02	-0.42	-0.02
$\gamma = 1$	0.38	0.10	0.06	-0.24	-0.15	-0.03	-0.42	0.12
$\gamma = 2$	0.59	0.11	0.07	-0.24	-0.15	-0.04	-0.43	0.34
$\gamma = 3$	0.92	0.12	0.08	-0.24	-0.15	-0.04	-0.44	0.68

Notes: Table calculates the welfare impacts of a dollar increase in subsidy based on Proposition 3. Subsidy percent is 76% of the benchmark premium for eligible individuals ($\lambda_p = 0.76$). Increasing the subsidy by one dollar affects welfare through the transfer to recipients $\frac{dW_B}{d\lambda_p p}$, benefits on premium $\frac{dW_P}{d\lambda_p p}$ and charity cost $\frac{dW_{UC}}{d\lambda_p p}$, and the fiscal cost $\frac{dW_C}{d\lambda_p p}$. γ incorporates redistribution values adjusting the welfare weights of individuals.

Table 4 summarizes the welfare effects. The fiscal cost of an additional subsidy dollar is \$0.40, of which \$0.24 is transfer to current recipients and \$0.17 is the subsidy to new enrollees. ESI crowd-out and employment responses have very small impact on costs. The subsidy dollar reduces premium by $\frac{dp}{d\lambda_p p} = \$0.11$, improving welfare by $\$0.11 \cdot 95\% = \$0.10$ for the 95% enrolled in health insurance. Charity costs internalized by individuals improve welfare by \$0.06, and the surcharge burden on patients accounts for roughly $36\% \cdot \$0.06 = \$0.02$ of the benefit. The pricing benefits nearly offset the fiscal externality, implying that current subsidies are close to the optimal for effectively reducing charity costs in the state.

In addition to improving pricing efficiency, subsidies also serve redistribution purposes when directed towards low-income individuals. I consider different transfer values of subsidy through the parameter γ. Higher transfer values substantially increase the benefits to subsidized enrollees, offsetting the fiscal externality for low values of γ around 1. The benefit on charity costs further increases as redistribution reduces the surcharge burden on

patients. Overall, benefits exceed costs with even small degrees of redistribution captured in $\gamma > 0$.

7.2 Mandate penalty

Table 5 summarizes the welfare impacts of mandate penalty. In Massachusetts, penalty owed by the 5% uninsured is around 10% of the benchmark premium. Increasing the penalty by one dollar raises revenue by \$0.05 and raises the subsidy cost to new enrollees by \$0.11, on net increasing spending by \$0.06. The spending on new enrollees is offset by the pricing benefits on premiums and charity costs, which are smaller than those of subsidy due to smaller effects on uptake. Overall, larger penalty has nearly zero impact on welfare, suggesting that the current amount optimally balances the benefits of expansion with costs.

Including redistribution concerns, because the uninsured are more likely to be young and have low incomes (Appendix Table C1), increasing the penalty significantly reduces welfare compared to raising the revenue through taxation on workers, whereas the benefits on prices increase less with redistribution. The large costs of penalty thus trade-off the pricing benefits and push for lower penalties to reduce the burden on the uninsured.

7.3 Robustness

For robustness checks, I calculate fiscal costs applying alternative estimates of employment and ESI responses from the literature. I also consider different incidences of charity care for the pricing benefits. These calculations yield very similar results on welfare.

Employment Effects. In Table 4, employment responses to subsidy have very small impacts on fiscal costs. Of the \$0.42 fiscal cost implied by an additional subsidy dollar, less then \$0.01 is driven by employment reduction. In the ACA, expansions of Medicaid insurance also have limited impacts on employment (Duggan *et al.* 2019; Leung and Mas

Table 5: Welfare impacts of mandate penalty

	$\frac{dW_B}{dkp}$	$\frac{dW_P}{dkp}$	$\frac{dW_{UC}}{dkp}$	$\frac{dW_C}{dkp}$			$\frac{dW}{dkp}$
				revenue	marginals	total	
$\gamma = 0$	-0.05	0.07	0.04	0.05	-0.11	-0.06	0
$\gamma = 1$	-0.09	0.08	0.05	0.05	-0.11	-0.06	-0.03
$\gamma = 2$	-0.15	0.08	0.05	0.05	-0.11	-0.06	-0.08
$\gamma = 3$	-0.26	0.08	0.06	0.05	-0.11	-0.06	-0.17

Notes: Table calculates the welfare impacts of a dollar increase in penalty based on Proposition 3. Penalty percent is 10% of the benchmark premium for uninsured individuals ($k = 10\%$). Increasing the penalty by one dollar affects welfare through the payment by the uninsured $\frac{dW_B}{dkp}$, benefits on premium $\frac{dW_P}{d\lambda_p p}$ and charity cost $\frac{dW_{UC}}{d\lambda_p p}$, and the fiscal cost $\frac{dW_C}{d\lambda_p p}$. γ incorporates redistribution values adjusting the welfare weights of individuals.

2016). These estimates alleviate concerns that subsidized expansion could meaningfully reduce workforce and worsen the fiscal condition of government (CBO, 2014).

Nonetheless, significant employment responses have been detected in some states despite very small effects on average. These larger estimates suggest that gaining Medicaid eligibility could lead to a 4.6 to 5.3 percentage point reduction in employment (Garthwaite *et al.* 2014; Dague *et al.* 2017). Allowing for these effects, I set $\frac{de}{d\lambda_p} = -0.050$ and re-calculate welfare in Appendix Table C7. The employment reduction increases fiscal costs by $0.02, or by less than 15% of the spending on new enrollees responding to subsidy. The welfare impact of employment is not substantial compared to the impacts of insurance uptake. Alternatively, applying the reduction in labor supply ($\frac{de}{d\lambda_p} = -0.011$ from Table 3) gives similarly small costs of employment. Taken together, the employment effect of subsidy is not a significant factor in the welfare trade-offs of expansions.

ESI Crowd-Out. Switching from ESI to subsidized insurance increases the fiscal cost if subsidy is more generous than the tax exemption of ESI. In Massachusetts, purchasing

ESI on the pre-tax basis reduces premium by 25% for enrollees.[23] Compared to the subsidy (76% of benchmark premium), ESI crowd-out increases the subsidy cost by $(\lambda_p - \tau_{ESI})\frac{d\lambda_1}{d\lambda_p} = (0.76 - 0.25) \cdot (-0.48) = -\$0.24$ and reduces the private transfer from ESI sponsors by \$0.22. The net increase in spending is a modest \$0.02 from the crowd-out.

The crowd-out in Massachusetts is lower than the average estimate suggesting $\frac{d\lambda_1}{d\lambda_p} = -0.60$ from previous Medicaid expansions (Gruber and Simon, 2008). Applying the average estimate increases the expansion cost by \$0.01, whereas assuming a zero crowd-out reduces the expansion cost by \$0.02 (Appendix Table C8), in which case subsidy is optimal at the current level. Based on the results, ESI crowd-out slightly reduces the efficiency of subsidized expansion, but overall welfare still favors further expansions with even small degrees of redistribution to the low-income.

Charity Costs. To allow for hospital cost shifts when reimbursement from the charity care program is low, I consider different incidences of charity costs on private payers. For charity costs fully financed by patients, subsidized expansion reduces the surcharge burden and improves welfare by an additional \$0.02-\$0.05 depending on redistribution (Appendix Table C9). Alternatively, charity costs financed through a tax on premiums result in similar benefits on welfare as the statutory finance.

Cost shifts have similarly small impacts in expansions through the mandate penalty (Appendix Table C10). Increasing the cost share on patients increases welfare by \$0.02-\$0.03, and charity costs fully financed by premiums yield nearly identical estimates on welfare. Different incidences on private payers would thus imply similar benefits of expansions on charity costs.

The benefit also depends on differences in the spending level between health insurance and charity care. In Massachusetts, $g = 0.9$ is consistent with an 11% increase in spending with health insurance. Much larger increases (43% with $g = 0.7$) still result in a \$0.05

[23] The average income of workers enrolled in ESI is \$70,117 (median \$53,000) in Massachusetts. Purchasing ESI on a pre-tax basis exempts premium from the 25% federal income tax applicable in this range.

reduction in charity costs with subsidy and a $0.02 reduction with penalty (Appendix Table C11 and C12). Despite the wide range of spending differences, overall welfare is comparable to the main results with $g = 0.9$.

7.4 Discussion

The welfare calculations reveal that adverse selection and charity costs both present important motivations for expansion. Over 60% of the pricing benefits accrue to payers of health insurance as lower premiums, with the rest accruing to patients and hospitals as lower charity costs. While the reform was primarily motivated by the state's charity costs, expansion ultimately benefited the majority of the state population enrolled in health insurance as well as individuals financing the charity costs. In particular, expansions through subsidies on premiums result in greater benefits on prices due to larger effects on uptake.

The fiscal cost of expansion reflects the cost of covering marginal enrollees in subsidized insurance. Perhaps not very surprisingly, starting from a 95% insurance rate, further expansions require fiscal costs that roughly offset the benefits on premiums and charity care, resulting in a net benefit that is close to zero across a range of estimates. This suggests that further expansions through either subsidy or penalty are unlikely to be cost-effective in terms of balancing the pricing benefits against costs.

However, further expansions are desirable when subsidy provides a means of redistribution to the low-income. Incorporating redistributive preferences, subsidy increases welfare primarily through the transfer benefit to recipients. The pricing benefits to enrollees and patients increase less with redistribution. In contrast, redistribution worsens the penalty cost on the uninsured and reduces welfare for expansions of penalty. Taken together, implementing universal insurance with subsidy may be desirable when redistribution provides a sufficiently strong motivation that offsets the fiscal costs.

8 Conclusion

The insurance expansion under Chapter 58 in Massachusetts is a landmark legislature with far-reaching implications for health insurance in the US. The key elements of the reform, namely the coverage mandate, subsidies on premiums, and rating regulations, provide the blueprint for the national reform under the Affordable Care Act, which expanded Medicaid in 39 states and enrolls over 11 million individuals in the subsidized Health Insurance Exchange in 2020. Building on the ACA, in March 2021, the American Rescue Plan Act (ARPA) introduced further incentives for states to expand Medicaid and increased the subsidies to Exchange enrollees and previously ineligible individuals.

This paper analyzes adverse selection and the societal burden of charity care as motivations for expanding health insurance. I show that reducing the adverse selection in premium alone does not motivate an insurance mandate, but expansions replacing charity care with tax-financed subsidies on premiums generally improve welfare under adverse selection and progressive taxation. The desirability of expanding health insurance with policies such as taxes and subsidies thus depends on the strength and incidence of the motivating benefits relative to the expansion costs.

I quantify the welfare impacts of expansion exploiting the insurance subsidy and penalty in Massachusetts. Increasing either policy incentives generates substantial benefits on enrollees in health insurance as well as individuals financing the charity care, and the joint benefit offsets the fiscal externality of expansion. Importantly, omitting either benefit would drastically under-state the overall welfare of expansion. Moreover, redistribution could motivate further expansions of subsidized insurance, whereas increasing the tax penalty would reduce welfare through the excess burden on the uninsured.

While these results have direct implications for states imposing mandate penalty on the uninsured and the ongoing expansion of subsidized insurance, they also inform the desirable scope of social insurance under the presence of implicit or informal safety net programs available to the uninsured. The nature of selection between programs and the

implications for prices and spending are important considerations in the global design of social insurance.

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Appendix

A Appendix Proofs

A.1 Basic Trade-Offs

I first consider the argument for universal health insurance when charity care is not available to the uninsured. The government subsidizes health insurance premium at rate λ_p for the non-employed, and finances the subsidies from a linear tax on payroll. In simple settings where insurance is fully subsidized for the non-employed, the implied tax burden on worker ν is $\tau = \frac{(1-e)\cdot\lambda_{1-e,1}}{e\,\mathbb{E}[\nu\,|\,e(\nu,\mu)=1]}p$. Given income $y(\nu,\mu)$, consumption equals $c_{e,1} = y(\nu,\mu) - p - \tau\,\nu$ with insurance. Absent insurance, consumption is $c^1_{e,0} = c_{e,1} + p$ in the healthy state and $c^0_{e,1} = c_{e,1} + p - M$ in the health event. Insurance covering health types $\mu \leq n$ implies welfare

$$\begin{aligned} W \;=\; & \int_0^n \int_{\chi(\mu)}^1 u(c_{e,1})\,\mathrm{d}F(\nu,\mu) + \int_n^1 \int_{\chi(\mu)}^1 \mu\,u(c_{e,1}+p)\mathrm{d}F(\nu,\mu) \\ & + \int_n^1 \int_{\chi(\mu)}^1 (1-\mu)\,u(c_{e,1}+p-M)\mathrm{d}F(\nu,\mu) + \int_0^n \int_0^{\chi(\mu)} \mathrm{d}F(\nu,\mu)\cdot u(A) \\ & + \int_n^1 \int_0^{\chi(\mu)} \mu\,\mathrm{d}F(\nu,\mu)\cdot u(A) + \int_n^1 \int_0^{\chi(\mu)} (1-\mu)\,\mathrm{d}F(\nu,\mu)\cdot u(A-M) \\ & - \int_0^1 \int_{\chi(\mu)}^1 g\left(\frac{1}{\nu}\right)\mathrm{d}F(\nu,\mu) \end{aligned} \tag{A1}$$

where productivity types $\nu \geq \chi(\mu)$ are workers given health μ. Premium p equals the expected cost of enrollees Mr with $r = \mathbb{E}[1-\mu\,|\,hi(\nu,\mu)=1]$. An incremental expansion of insurance above health type n reduces premium by

$$\left.\frac{dp}{dn}\right|_n = -M\,\frac{r-(1-n)}{i}\int_0^1 f(\nu,n)d\nu\,, \tag{A2}$$

where $i = e\,\lambda_{e,1} + (1-e)\,\lambda_{1-e,1}$ is the population insurance rate. For universal insurance, expansion covering the ultra-health margin reduces premium by $\frac{dp}{dn}\Big|_{n=1} = -p\int_0^1 f(\nu,1)d\nu$. The implied premium reduction accruing to infra-marginal enrollees exactly offsets the premium cost on the ultra-health margin. Thus, universal insurance trades-off marginal utility loss with infra-marginal gains under risk pooling. Standard results apply that welfare depends on the utility differences between marginal and infra-marginal enrollees.[24]

In addition, insurance expansion creates externality on workers when subsidies are financed through a tax on payroll. On the ultra-health margin, expansion incurs additional subsidies to new enrollees but reduces subsidies to infra-marginal enrollees through premiums. The net cost increases when the share eligible for subsidy is higher on the ultra-health margin, so that $\frac{e}{e_{\mu=1}} > 1$. In this case, the tax incidence of subsidy differs across productivity types and impacts welfare through the correlation with marginal utility. The overall impact on welfare is

$$\frac{dW}{dn}\Big|_{n=1} \propto \underbrace{-\mathbb{E}[\Delta u\,|\,e=1,\mu=1] + p\cdot\mathbb{E}[u'\,|\,e=1]}_{\text{marginal vs. infra-marginal enrollees}} \underbrace{-\frac{Cov[u',\nu\,|\,e=1]}{\mathbb{E}[\nu\,|\,e=1]}\left(\frac{e}{e_{\mu=1}}-1\right)p}_{\text{tax incidence of subsidy}}, \tag{A3}$$

where $\Delta u = u(c_{e,1}+p) - u(c_{e,1})$ is the utility cost of premium for $\mu = 1$. $p\,\mathbb{E}[u'\,|\,e=1]$ is the infra-marginal benefit resulting from lower premiums. The third term gives the tax incidence of subsidy. With progressive taxation, the subsidy cost when $\frac{e}{e_{\mu=1}} > 1$ imposes smaller burdens on higher marginal utility, which further improves welfare through redistribution across workers.

Together, expansion achieving universal insurance is desirable if benefits to infra-marginal enrollees and the redistribution through taxes offset the marginal utility loss. In general, universal health insurance is not optimal due to the trade-off. When society already provides charity care to the uninsured, replacing charity care with subsidized

[24] For instance, differences in income, wealth, and risk attitudes affect the efficient risk sharing between individuals.

insurance can improve the public finance of the coverage mandate. I derive Proposition 1 regarding subsidized expansion under charity care next.

A.2 Expanding Subsidized Insurance

Following the setting in Section 3.2, I consider expansions of subsidized insurance when workers are enrolled in mandatory insurance from employers. Specifically, expanding insurance to cover health types above n_{1-e} impacts welfare according to

$$\frac{\mathrm{d}W}{\mathrm{d}n_{1-e}} = e \sum_{l=0,1} h^l_{e,1}\, \mathbb{E}[u'(c_{e,1})] \cdot \mathbb{E}\left[\frac{dc_{e,1}}{dn_{1-e}} \middle| e=1, h=l\right] + e \sum_{l=0,1} h^l_{e,1}\, Cov\left[u', \frac{dc_{e,1}}{dn_{1-e}} \middle| e=1, h=l\right].$$

Because subsidies replacing charity care do not increase the transfer to the non-employed, the resource cost of enrollment is zero

$$\sum_{l=0,1} h^l_{e,1}\, \mathbb{E}\left[\frac{dc_{e,1}}{dn_{1-e}} \middle| e=1, h=l\right] = 0.$$

Thus, when marginal utility does not differ across health states, expansion does not impact the utility of the average employee in health insurance. However, charity care implies higher marginal utility in the health event from the surcharge fees on services. Expansion reduces the service surcharge and increases welfare for patients according to $e\, h^0_{e,1}\, \Delta u'_h \cdot \mathbb{E}\left[\frac{dc_{e,1}}{dn_{1-e}} \middle| e=1, h=0\right]$, where $\Delta u'_h$ is the increase in marginal utility in the health event. The welfare impact can be written as

$$\frac{\mathrm{d}W}{\mathrm{d}n_{1-e}} = e\, h^0_{e,1}\, \Delta u'_h \cdot \mathbb{E}\left[\frac{dc_{e,1}}{dn_{1-e}} \middle| e=1, h=0\right] + e \sum_{l=0,1} h^l_{e,1}\, Cov\left[u', \frac{dc_{e,1}}{dn_{1-e}} \middle| e=1, h=l\right]. \quad \text{(A4)}$$

In the first term, the consumption implication for patients operates through the subsidy burden τ and charity cost UC. Let $s(n_{1-e}) = \int_0^{\chi(n_{1-e})} f(v, n_{1-e})\, dv$ indicate the size of subsidized enrollees on health margin n_{1-e}. Expansion incurs direct subsidy cost $p \cdot s(n_{1-e})$

to new enrollees, and reduces premiums and hence subsidies to infra-marginal enrollees by $(1-e)\lambda_{1-e,1}\frac{\mathrm{d}p}{\mathrm{d}n_{1-e}} = -(1-e)\lambda_{1-e,1}M\frac{r-(1-n_{1-e})}{i}\cdot s(n_{1-e})$. The net cost of subsidy is $\Delta S = p-(1-e)\lambda_{1-e,1}M\frac{r-(1-n_{1-e})}{i}$ multiplied by the size of expansion $s(n_{1-e})$. Let $MC = M(1-n_{1-e})$ indicate the marginal cost of new enrollees. With premium $p = Mr$, subsidy cost simplifies to $\Delta S = \frac{e}{i}p + (1-\frac{e}{i})MC$, an average of premium and marginal cost weighted by the worker share in health insurance. Furthermore, expansion reduces service surcharge by the marginal cost MC adjust by the budget share t. The consumption impact on patients is therefore

$$\mathbb{E}\left[\frac{dc_{e,1}}{dn_{1-e}}\middle| e=1,h=0\right] = \left[\left(1-\frac{\mathbb{E}[\nu\,|\,e=1,h=0]}{\mathbb{E}[\nu\,|\,e=1]}\right)\Delta S + \left(\frac{t}{h^0_{e,1}}-1\right)MC\right]\frac{s(n_{1-e})}{e}. \tag{A5}$$

Applying the consumption impact to equation A4 and factoring out expansion size $s(n_{1-e})$, welfare depends on

$$\underbrace{h^0_{e,1}\Delta u'_h\left[\left(1-\frac{\mathbf{E}[\nu\,|\,e=1,h=0]}{\mathbf{E}[\nu\,|\,e=1]}\right)\Delta S + \left(\frac{t}{h^0_{e,1}}-1\right)MC\right]}_{\text{patient burden}} \underbrace{-\sum_{l=0,1}\frac{Cov[u',\nu\,|\,e=1,h=l]\cdot h^l_{e,1}}{\mathbf{E}[\nu\,|\,e=1]}\Delta S}_{\text{tax incidence of subsidy}},$$

with $\left(1-\frac{\mathbf{E}[\nu\,|\,e=1,h=0]}{\mathbf{E}[\nu\,|\,e=1]}\right)\Delta S$ the subsidy burden relative to an average worker. When subsidy imposes smaller burden on patients ($\frac{\mathbf{E}[\nu\,|\,e=1,h=0]}{\mathbf{E}[\nu\,|\,e=1]}<1$) in addition to reducing charity costs, expansion increases welfare for patients. Moreover, with progressive taxation, expansion places smaller tax burdens on individuals with higher marginal utility, thus improving welfare also through the incidence of subsidy in the second term.

To derive Proposition 1, note that the condition $\frac{\mathbf{E}[\nu\,|\,e=1,h=0]}{\mathbf{E}[\nu\,|\,e=1]}<1$ is equivalent to a positive correlation $Cov[\nu,\mu|e=1]$ between productivity and health for workers. The condition $Cov[u',\nu\,|\,e=1,h]<0$ implies that subsidies are financed with progressive taxation decreasing in marginal utility. The conditions ensure that expansion improves welfare at each health margin, so that fully replacing charity care with universal subsidized

insurance maximizes welfare.

A.3 Universal Health Insurance with Penalty

To arrive at the welfare effects summarized in Proposition 2, note that expanding insurance to the ultra-health margin increases welfare by

$$\frac{dW}{dn}\Big|_{n=1} = \underbrace{\int_{\chi(1)}^{1} u(c_{e,1}) f(\nu,1)\, d\nu - \int_{\chi(1)}^{1} u(c_{e,0}) f(\nu,1)\, d\nu}_{\text{marginal utility}} + \underbrace{e \cdot \mathbb{E}\left[u'(c_{e,1}) \frac{dc_{e,1}}{dn} \,\middle|\, e=1\right]}_{\text{infra-marginal benefits}}, \quad \text{(A6)}$$

where the first two terms give the utility cost of insurance for the healthiest individuals. The consumption difference $c_{e,1} - c_{e,0} = -(1-k)p$ is the premium cost net of penalty. On the infra-margin, expansion reduces premium and improves utility according to the term $e \cdot \mathbb{E}\left[u'(c_{e,1}) \frac{dc_{e,1}}{dn} \,\middle|\, e=1\right]$, which is a sum of consumption benefit $e \cdot \mathbf{E}[u'(c_{e,1})]\mathbf{E}\left[\frac{\mathrm{d}c_{e,1}}{\mathrm{d}n} \,\middle|\, e=1\right]$ and incidence $e \cdot Cov\left[u'(c_{e,1}), \frac{\mathrm{d}c_{e,1}}{\mathrm{d}n} \,\middle|\, e=1\right]$.[25]

The consumption benefit equals

$$\frac{dc_{e,1}}{dn}\Big|_{n=1} = \int_0^1 f(\nu,1)\, d\nu \left[1 - \frac{\nu}{\mathbb{E}[\nu \,|\, e=1]}\left[1 - \frac{e_{\mu=1}}{e}(1-k)\right]\right] p, \quad \text{(A7)}$$

where the first term in the square bracket is the premium reduction from the expansion. The second term accounts for the increase in the subsidy burden on productivity type ν. The increase is smaller with larger employment share on the ultra-margin ($\frac{e_{\mu=1}}{e}$) and smaller revenue loss from foregone penalty. Total consumption increases for workers according to $e \cdot \mathbb{E}\left[\frac{dc_{e,1}}{dn} \,\middle|\, e=1\right] = p(1-k)\int_{\chi(1)}^{1} f(\nu,1)\, d\nu$, which is the resource transfer from the ultra-margin to the infra-margin.

Applying equation A7, the incidence term $e \cdot Cov\left[u'(c_{e,1}), \frac{\mathrm{d}c_{e,1}}{\mathrm{d}n} \,\middle|\, e=1\right]$ can be shown to equal $-\frac{Cov[u',\nu|e=1]}{\mathbb{E}[\nu|e=1]}\left(k + \frac{e}{e_{\mu=1}} - 1\right) p \cdot \int_{\chi(1)}^{1} f(\nu,1)\, d\nu$. The expression states that expansion

[25] Because consumption does not differ across health states when insurance is expanded to be universal, I omit the superscript for health state in the derivation.

increases subsidy transfers when the cost of marginal enrollees exceeds the infra-marginal reduction through premiums, and the net increase is proportional to $\frac{e}{e_{\mu=1}} - 1$. Including the lost revenue from penalty, the subsidy burden on workers adjusts and impacts welfare through the correlation with marginal utility $Cov[u', \nu | e = 1]$. The infra-marginal benefit in equation A6 thus equals

$$e \cdot \mathbb{E}\left[u'(c_{e,1}) \frac{dc_{e,1}}{dn} \middle| e = 1\right] = \left[p(1-k) - \frac{Cov[u', \nu | e = 1]}{\mathbb{E}[\nu | e = 1]} \left(k + \frac{e}{e_{\mu=1}} - 1\right) p\right] \int_{\chi(1)}^{1} f(\nu, 1)\, d\nu. \tag{A8}$$

From equation A6 and A8, normalized by the size of unsubsidized enrollees on the ultra-health margin $\int_{\chi(1)}^{1} f(\nu, 1)\, d\nu$, expansion impacts welfare according to

$$\begin{aligned} \frac{dW}{dn}\Big|_{n=1} \propto & \underbrace{\mathbb{E}[u(c^1_{e,1}) - u(c^1_{e,0}) | e = 1, \mu = 1]}_{\text{marginal utility loss } (MP)} + \underbrace{\mathbb{E}[u' | e = 1]\,(1-k)\,p}_{\text{benefits to enrollees } (IB)} \\ & \underbrace{- \frac{Cov[u', \nu | e = 1]}{\mathbb{E}[\nu | e = 1]} \left(k + \frac{e}{e_{\mu=1}} - 1\right) p}_{\text{tax incidence of subsidy } (TS)}, \end{aligned} \tag{A9}$$

which sums over marginal utility loss MP, enrollee benefit IB, and the tax incidence of subsidy TS as in Proposition 2. Universal insurance thus trades-off marginal utility losses against infra-marginal benefits through premiums and the redistribution across workers. When marginal utility differs, benefits on the infra-margin do not necessarily offset the utility losses, and universal insurance may not be desirable due to the trade-off.

B Insurance Expansion In An Empirical Framework

Let $\mathcal{U} = \int_0^\infty U(c_{i,j,t})\, S(t)\, dt$ indicate the life-cycle utility of type (ν, μ). From stationarity, $\mathcal{U}$ is the total utility of type (ν, μ) in each period, where $S(t)$ indicates the cross-sectional distribution of age t. Across types, $V = \int_{(\nu,\mu)} \mathcal{U}\, dF(\nu, \mu)$ is the sum of individual utility.

Increasing policy $\mathbf{K}$ affects utility V according to

$$\frac{dV}{d\mathbf{K}} = \int_{(\nu,\mu)} \int_0^\infty U' \frac{dc_{i,j,t}}{d\mathbf{K}} S(t)\, dt\, dF(\nu,\mu), \tag{B1}$$

where U is the period utility in equation 1. Assuming that individuals optimally choose employment i and insurance j, marginal enrollees following a policy increase $d\mathbf{K}$ are indifferent from optimization. On the infra-margin, expansion creates externality on prices and impacts consumption $c_{i,j,t}$ through the budget constraint in equation 2. Evaluated by the marginal utility of individuals bearing the externality, the welfare impact can be written as

$$\begin{aligned}\frac{dV}{d\mathbf{K}} \approx & -\frac{d\tau_{pb}}{d\mathbf{K}} \cdot e \cdot U'(\overline{c_{1\cdot}}) - \frac{d\tau_{pr}}{d\mathbf{K}} \cdot e\, \lambda_{e,1} \cdot U'(\overline{c_{11}}) \\ & - \frac{d\,(1-\lambda_p)p}{d\mathbf{K}} \cdot \lambda_2 \cdot U'(\overline{c_{\cdot 2}}) - \frac{d\,kp}{d\mathbf{K}} \cdot \lambda_0 \cdot U'(\overline{c_{\cdot 0}}) \\ & - \frac{d\,uc_p}{d\mathbf{K}} \cdot \lambda^0_{>0} \cdot U'(\overline{c^0_{\cdot>0}}),\end{aligned} \tag{B2}$$

where $\overline{c^l_{i,j}}$ is the average consumption given choice (i,j) and health state l.[26]

The pricing externality terms are derived from total differentiation of the program budget and premium (equation 3 to 6) with respect to a small policy increase $d\mathbf{K}$. In addition, expansion reduces the uncompensated costs borne by hospitals, captured in $-(1-\alpha)\frac{\mathrm{d}\lambda^0_0}{\mathrm{d}\mathbf{K}} g\, n M$.

[26] To illustrate the derivation, consider the externality on the public transfer which affects worker utility according to

$$-\frac{d\tau_{pb}}{d\mathbf{K}} \underbrace{\int_{(\nu,\mu)} \int_0^\infty 1_{\{e_t=1\}} U'\, S(t)\, dF(\nu,\mu)\, dt}_{\mathcal{V}_e},$$

where $\mathcal{V}_e$ evaluates the consumption change for workers. Normalizing by the population size $L = \int_{(\nu,\mu)} \int_0^\infty S(t)\, dt\, dF(\nu,\mu)$, the valuation $\mathcal{V}_e$ can be written as $L\,\mathbb{E}_{(t,\nu,\mu)}[1_{\{e=1\}} U']$, where $\mathbb{E}_{(t,\nu,\mu)}$ averages across population shares by type (ν,μ) and age t. Using e to indicate the size of workers, the welfare impact simplifies to $-\frac{d\tau_{pb}}{d\mathbf{K}} e\, \mathbb{E}_{(t,\nu,\mu)}[U' | e=1]$, which is approximately $-\frac{d\tau_{pb}}{d\mathbf{K}} e\, U'(\overline{c_{1\cdot}})$ ignoring third-order derivatives.

Welfare. The total impact of policy $\mathbf{K}$ on welfare $W = \zeta V - (1-\alpha)\lambda_0^0 g n M$ is given by

$$\frac{\mathrm{d}W}{\mathrm{d}\mathbf{K}} = \zeta \frac{\mathrm{d}V}{\mathrm{d}\mathbf{K}} - (1-\alpha)\frac{\mathrm{d}\lambda_0^0}{\mathrm{d}\mathbf{K}} g n M, \tag{B3}$$

where $\zeta = 1/U'(\overline{c_{1\cdot}})$ normalizes individual utility V to private sector revenues using the marginal utility of workers. Applying equation B2, welfare can be formulated as impacting beneficiary utility, premiums, charity costs, and the fiscal cost of expansion. I detail the derivation next.

B.1 Expanding Insurance with Subsidy

Proposition 3 states that increasing the policy spending $\mathbf{K}p$ impacts welfare according to

$$\frac{\mathrm{d}W}{\mathrm{d}\mathbf{K}p} = \frac{\mathrm{d}W_B}{\mathrm{d}\mathbf{K}p} + \frac{\mathrm{d}W_P}{\mathrm{d}\mathbf{K}p} + \frac{\mathrm{d}W_{UC}}{\mathrm{d}\mathbf{K}p} + \frac{\mathrm{d}W_C}{\mathrm{d}\mathbf{K}p}. \tag{B4}$$

Here I formulate each term for an increase in the subsidy on premium.

Beneficiaries. An additional subsidy dollar raises beneficiary utility by $-\lambda_2\omega_{\cdot 2}\frac{\mathrm{d}(1-\lambda_p)p}{\mathrm{d}\lambda_p p} = \lambda_2\omega_{\cdot 2} - \lambda_2\omega_{\cdot 2}(1-\lambda_p)\frac{\mathrm{d}\log p}{\mathrm{d}\lambda_p}$, where $\lambda_2\omega_{\cdot 2}$ is the transfer benefit to enrollees. $\frac{\mathrm{d}\log p}{\mathrm{d}p}$ is the response in premiums from the cost composition change in health insurance. I characterize the premium benefits separately. The benefit of subsidy to recipients is given by

$$\frac{\mathrm{d}W_B}{\mathrm{d}\lambda_p p} = \lambda_2\,\omega_{\cdot 2}. \tag{B5}$$

Premiums. The subsidy dollar expands insurance by $-\frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p p}$ and reduces premium by $\frac{\mathrm{d}\log p}{\mathrm{d}\lambda_p} = \frac{\varepsilon_{r,\lambda_0}}{\lambda_0}\frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p}$, where $\varepsilon_{r,\lambda_0}$ is the cost elasticity with respect to the expansion. The price change reduces payments for subsidized enrollees, sponsors of ESI premiums, taxpayers financing the subsidies, and the uninsured subject to mandate penalty. The total benefit

on premiums is given by

$$\frac{\mathrm{d}W_P}{\mathrm{d}\lambda_p p} = -\frac{\mathrm{d}\log p}{\mathrm{d}\lambda_p}\Big[e\frac{\tau_{pb}}{p} + e\lambda_{e,1}\omega_{1,1}\frac{\tau_{pr}}{p} + \lambda_0\omega_{\cdot 0}k + \lambda_2\omega_{\cdot 2}(1-\lambda_p)\Big]. \tag{B6}$$

Charity Care. The subsidy dollar reduces charity care costs on hospitals by $(1-\alpha)\frac{\mathrm{d}\lambda_0^0}{\mathrm{d}\lambda_p p} g\, nM$, and reduces the service surcharge uc_p on enrollees in the health event. From equation 6, the surcharge can be written as $uc_p = \alpha\, g\, \frac{\lambda_0}{\lambda_{>0}}\, \frac{ri(\lambda_0)}{r(\lambda_0)}\, nM$, where $ri(\lambda_0) = h_0^0\, nM$ is the counterfactual cost of the uninsured in health insurance. Expansion reduces uc_p by $\frac{\mathrm{d}uc_p}{\mathrm{d}\lambda_p p} = \alpha\, g\, \frac{nM}{\lambda_{>0}}\, \frac{ri}{r}\left(\frac{1}{\lambda_{>0}} + \varepsilon_{ri,\lambda_0} - \varepsilon_{r,\lambda_0}\right)\frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p p}$, where $\varepsilon_{ri,\lambda_0}$ is the cost elasticity in the uninsured. Total reduction in charity care $\frac{\mathrm{d}W_{UC}}{\mathrm{d}\lambda_p p} = -\lambda_{>0}^0\, \omega_{\cdot>0}^0\, \frac{\mathrm{d}uc_p}{\mathrm{d}\lambda_p p} - (1-\alpha)\frac{\mathrm{d}\lambda_0^0}{\mathrm{d}\lambda_p p} g\, nM$ can be written as

$$\frac{\mathrm{d}W_{UC}}{\mathrm{d}\lambda_p p} = -\omega_{\cdot>0}^0\, \alpha\, g\, \frac{ri}{p}\left(\frac{1}{\lambda_{>0}} + \varepsilon_{ri,\lambda_0} - \varepsilon_{r,\lambda_0}\right)\frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p} - (1-\alpha)\, g\, \frac{ri}{p}\left(1 + \varepsilon_{ri,\lambda_0}\right)\frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p}. \tag{B7}$$

Fiscal Cost. Financing the subsidy dollar increases work taxation and reduces welfare by $-e\frac{\mathrm{d}\tau_{pb}}{\mathrm{d}\lambda_p p} = -\lambda_2 + (\lambda_p + k)\frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p} + (\lambda_p - \tau_{ESI})\frac{\mathrm{d}\lambda_1}{\mathrm{d}\lambda_p} - \frac{\tau_{pb}}{p}\frac{\mathrm{d}e}{\mathrm{d}\lambda_p}$. This effect includes the mechanic cost λ_2 and the fiscal externality due to uptake $\frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p}$ and selection $\frac{\mathrm{d}\lambda_1}{\mathrm{d}\lambda_p}$. The last term $\frac{\tau_{pb}}{e}\frac{\mathrm{d}e}{\mathrm{d}\lambda_p}$ accounts for employment changes affecting the tax base. Including the changes in private transfer $\frac{\mathrm{d}\tau_{pr}}{\mathrm{d}\lambda_p p}$, the fiscal impact of a subsidy dollar is given by

$$\begin{aligned}\frac{\mathrm{d}W_C}{\mathrm{d}\lambda_p p} =& -\lambda_2 + (\lambda_p + k)\frac{\mathrm{d}\lambda_0}{\mathrm{d}\lambda_p} + \Big[\lambda_p - \tau_{ESI} - \omega_{1,1}(1-\tau_{ESI})\Big]\frac{\mathrm{d}\lambda_1}{\mathrm{d}\lambda_p} \\ &+ (1-\tau_{ESI})\frac{\lambda_1\omega_{1,1}}{e\lambda_{e,1}}\frac{\mathrm{d}e\lambda_{e,1}}{\mathrm{d}\lambda_p} + \frac{\tau_{pb}}{p}\frac{\mathrm{d}e}{\mathrm{d}\lambda_p}.\end{aligned} \tag{B8}$$

B.2 Expanding Insurance with Penalty

Similarly, the welfare impact of a dollar increase in penalty is given by

$$\frac{\mathrm{d}W}{\mathrm{d}k\,p} = \frac{\mathrm{d}W_B}{\mathrm{d}k\,p} + \frac{\mathrm{d}W_P}{\mathrm{d}k\,p} + \frac{\mathrm{d}W_{UC}}{\mathrm{d}k\,p} + \frac{\mathrm{d}W_C}{\mathrm{d}k\,p}. \tag{B9}$$

I characterize each component next.

Beneficiaries. A dollar increase in penalty reduces utility by $-\lambda_0\,\omega_{\cdot 0}$ for the uninsured. The welfare cost is

$$\frac{\mathrm{d}W_B}{\mathrm{d}k\,p} = -\lambda_0\,\omega_{\cdot 0}. \tag{B10}$$

Premiums. The increase in penalty expands insurance by $-\frac{\mathrm{d}\lambda_0}{\mathrm{d}k}$ and reduces premiums according to $\frac{\mathrm{d}\log p}{\mathrm{d}k} = \frac{\varepsilon^k_{r,\lambda_0}}{\lambda_0}\frac{\mathrm{d}\lambda_0}{\mathrm{d}k}$, where $\varepsilon^k_{r,\lambda_0}$ is the cost elasticity implied by an increase in mandate penalty. The price change affects payments by subsidized enrollees, ESI sponsors, taxpayers, and the uninsured. The total welfare impact on premiums is

$$\frac{\mathrm{d}W_P}{\mathrm{d}k\,p} = -\frac{\mathrm{d}\log p}{\mathrm{d}k}\left[e\frac{\tau_{pb}}{p} + e\lambda_{e,1}\omega_{1,1}\frac{\tau_{pr}}{p} + \lambda_0\omega_{\cdot 0}k + \lambda_2\omega_{\cdot 2}(1-\lambda_p)\right]. \tag{B11}$$

Charity Care. The penalty reduces charity costs on hospitals by $-(1-\alpha)\frac{\mathrm{d}\lambda^0_{>0}}{\mathrm{d}k\,p}\,g\,n\,M = -(1-\alpha)\,g\,\frac{ri}{p}\,(1+\varepsilon^k_{ri,\lambda_0})\,\frac{\mathrm{d}\lambda_0}{\mathrm{d}k}$, and reduces the surcharge fee by $\frac{\mathrm{d}uc_p}{\mathrm{d}k\,p} = \alpha\,g\,\frac{nM}{\lambda_{>0}}\,\frac{ri}{r}\left(\frac{1}{\lambda_{>0}} + \varepsilon^k_{ri,\lambda_0} - \varepsilon^k_{r,\lambda_0}\right)\frac{\mathrm{d}\lambda_0}{\mathrm{d}k\,p}$. The welfare benefit is

$$\frac{\mathrm{d}W_{UC}}{\mathrm{d}k\,p} = -\omega^0_{\cdot>0}\,\alpha\,g\,\frac{ri}{p}\left(\frac{1}{\lambda_{>0}} + \varepsilon^k_{ri,\lambda_0} - \varepsilon^k_{r,\lambda_0}\right)\frac{\mathrm{d}\lambda_0}{\mathrm{d}k} - (1-\alpha)\,g\,\frac{ri}{p}\left(1+\varepsilon^k_{ri,\lambda_0}\right)\frac{\mathrm{d}\lambda_0}{\mathrm{d}k}. \tag{B12}$$

Fiscal Cost. Increasing the penalty reduces taxation on workers by $-e\,\frac{\mathrm{d}\tau_{pb}}{\mathrm{d}k\,p} = \lambda_0 + (\lambda_p + k)\,\frac{\mathrm{d}\lambda_0}{\mathrm{d}k} + \frac{\tau_{pb}}{p}\,\frac{\mathrm{d}e}{\mathrm{d}k}$, where λ_0 is the revenue from penalty and $(\lambda_p + k)\,\frac{\mathrm{d}\lambda_0}{\mathrm{d}k}$ is the fiscal externality from uptake. I assume that the penalty does not affect employment or coverage from ESI.

The fiscal cost of penalty is

$$\frac{\mathrm{d}W_C}{\mathrm{d}k\,p} = \lambda_0 + (\lambda_p + k)\frac{\mathrm{d}\lambda_0}{\mathrm{d}k}. \tag{B13}$$

C Appendix Tables

Table C1: Summary statistics, estimation sample

	Full Sample N=132,360		No ESI N=30,389		No Insurance N=5,141	
	mean	s.e.	mean	s.e.	mean	s.e.
Demographics						
Age	45.39	0.034	44.81	0.074	41.87	0.17
Female	0.52	0.002	0.52	0.003	0.37	0.008
Race						
White	0.83	0.001	0.73	0.003	0.70	0.008
Black	0.061	0.001	0.095	0.002	0.10	0.005
other	0.11	0.001	0.18	0.003	0.20	0.007
Hispanic	0.080	0.001	0.16	0.003	0.19	0.007
Education						
less than high school	0.072	0.001	0.18	0.003	0.18	0.007
high school	0.30	0.002	0.41	0.003	0.45	0.008
some college	0.62	0.002	0.41	0.003	0.36	0.008
Married	0.60	0.002	0.39	0.003	0.33	0.008
Dependent Children	0.38	0.002	0.32	0.003	0.23	0.007
Insurance						
Any Insurance	0.95	0.001	0.80	0.003	0	–
ESI	0.74	0.002	0	–	0	–
Employment						
Employed	0.77	0.001	0.51	0.003	0.64	0.008
In Labor Force	0.83	0.001	0.64	0.003	0.83	0.006
Employed + ESI	0.64	0.002	0	–	0	–
Not Employed + ESI	0.10	0.001	0	–	0	–
Income (% FPL)	500.91	0.66	383.61	1.27	371.38	2.79
Subsidy Rate	0.29	0.001	0.68	0.003	0.62	0.007
Simulated Subsidy Rate	0.31	0.001	0.46	0.002	0.46	0.003

Notes: Table summarizes the demographics, insurance, employment, and subsidies for 132,360 Massachusetts individuals in age 27-64 sampled in the American Community Survey (ACS) in 2008-2011. ACS sampling weights applied. Subsidy rates are calculated based on policy rules and incomes (in % FPL) in tax-filing units. Simulated subsidy rates are calculated from a pre-reform national sample of individuals. See the main text for details of the subsidy rates.

Table C2: Differences in subsidy across demographics

	subsidy rate *subs*		simulated *subiv*	
	mean	s.e.	mean	s.e.
Age				
27-29	0.40	0.006	0.42	0.003
30-34	0.33	0.004	0.36	0.002
35-39	0.30	0.004	0.33	0.002
40-44	0.28	0.004	0.31	0.002
45-49	0.26	0.003	0.28	0.002
50-54	0.26	0.004	0.27	0.002
55-64	0.27	0.003	0.30	0.001
Male	0.27	0.002	0.29	0.001
Female	0.31	0.002	0.33	0.001
Race				
White	0.25	0.001	0.28	0.001
Black	0.50	0.007	0.49	0.003
Other	0.46	0.005	0.46	0.002
Hispanic	0.59	0.006	0.58	0.003
Non-Hispanic	0.26	0.001	0.29	0.001
Education				
Less than high school	0.69	0.006	0.72	0.002
High school	0.41	0.003	0.43	0.001
Some college	0.18	0.002	0.21	0.001
Married	0.18	0.001	0.21	0.001
Not Married	0.46	0.003	0.47	0.001
Dependent Children	0.28	0.002	0.31	0.001
No Dependent Children	0.30	0.002	0.32	0.001

Notes: Table summarizes the subsidy rate *subs* and the instrument *subiv* across demographic groups in the estimation sample. The simulated instrument *subiv* applies subsidy policies to a pre-reform national sample of individuals and quantifies generosity exploiting income differences by demographics. *subs* indicates subsidy rates based on observed incomes in Massachusetts. ACS sampling weights applied in the statistics.

Table C3: Effects of subsidy generosity across age groups

	(I) Any Insurance	(II) Employed	(III) In Labor Force	(IV) ESI + Employed	(V) ESI + Not Employed
27-29	0.19**	0	0.075	-0.37***	-0.33***
	(0.071)	(0.12)	(0.093)	(0.12)	(0.048)
30-24	0.12**	0.015	0.085	-0.19*	-0.38***
	(0.054)	(0.068)	(0.063)	(0.10)	(0.035)
35-39	0.10**	0.18**	0.20***	-0.072	-0.42***
	(0.040)	(0.082)	(0.073)	(0.087)	(0.041)
40-44	0.16***	0.14*	0.11	0.001	-0.41***
	(0.047)	(0.075)	(0.069)	(0.065)	(0.039)
45-49	0.12***	0.066	0.045	-0.18**	-0.27***
	(0.027)	(0.072)	(0.059)	(0.075)	(0.032)
50-54	0.13***	-0.071	-0.14***	-0.26***	-0.24***
	(0.028)	(0.061)	(0.051)	(0.059)	(0.039)
55-64	0.11***	-0.19***	-0.25***	-0.16**	-0.42***
	(0.026)	(0.069)	(0.055)	(0.064)	(0.036)
y mean	0.95	0.77	0.83	0.64	0.10
R^2	0.070	0.091	0.10	0.13	0.054
N	132,360	132,360	132,360	132,360	132,360

*** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

Notes: Table estimates the effect of subsidy generosity across age groups, interacting instrument *subiv* with age group indicators in the reduced-form specification in equation 13. Robust standard errors clustered at the level of PUMA in the parenthesis.

Table C4: Effects of subsidy generosity without controlling for unemployment rates

	(I) Any Insurance	(II) Employed	(III) In Labor Force	(IV) ESI + Employed	(V) ESI + Not Employed
			Panel A: OLS		
subs	-0.071***	-0.41***	-0.30***	-0.55***	0.045***
	(0.003)	(0.007)	(0.007)	(0.007)	(0.004)
R^2	0.065	0.20	0.18	0.29	0.052
			Panel B: TSLS estimates, instrument *sublean*		
$\widehat{subs}$	0.20	-0.69	-0.29	-1.30*	-0.30
	(0.34)	(0.49)	(0.42)	(0.68)	(0.41)
F-statistic	4.63	4.63	4.63	4.63	4.63
			Panel C: TSLS estimates, instrument *subiv*		
$\widehat{subs}$	0.11***	-0.081	-0.054	-0.33***	-0.31***
	(0.027)	(0.050)	(0.043)	(0.047)	(0.026)
F-statistic	722.78	722.78	722.78	722.78	722.78
			Panel D: Over-Identified TSLS		
$\widehat{subs}$	0.11***	-0.081	-0.054	-0.34***	-0.31***
	(0.027)	(0.050)	(0.043)	(0.047)	(0.026)
F-statistic	379.71	379.71	379.71	379.71	379.71
p-value	0.79	0.18	0.57	0.053	0.97
y mean	0.95	0.77	0.83	0.64	0.10

*** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

Notes: Table estimates the effect of subsidy using the endogenous rate *subs* in Panel A, instrument *sublean* in Panel B, instrument *subiv* in Panel C, and both instruments in Panel D. The specification controls for the main effects of PUMA, year, age and income, as well as demographic variables and region-year fixed effects. The specification does not include any controls of unemployment rates. In Panel D, p-values from over-identification tests are reported in addition to the first-stage F-statistics. Robust standard errors clustered at the level of PUMA in the parenthesis.

Table C5: Robustness analysis: border PUMAs

	(I) Any Insurance	(II) Employed	(III) In Labor Force	(IV) ESI + Employed	(V) ESI + Not Employed
			Panel A: main results		
subiv	0.13***	0.010	-0.003	-0.17***	-0.35***
	(0.024)	(0.053)	(0.045)	(0.056)	(0.024)
R^2	0.070	0.090	0.10	0.13	0.054
			Panel B: assign border PUMAs to the dominant region		
subiv	0.12***	0.005	-0.009	-0.18***	-0.35***
	(0.023)	(0.053)	(0.046)	(0.058)	(0.024)
R^2	0.061	0.088	0.10	0.13	0.053
			Panel C: dropping the border PUMAs		
subiv	0.12***	0.020	0.017	-0.17***	-0.35***
	(0.026)	(0.060)	(0.049)	(0.061)	(0.026)
R^2	0.062	0.088	0.10	0.13	0.053

*** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

Notes: Table show estimates applying different premiums to PUMAs intersecting multiple rating regions. Panel A assigns the average premium weighted by region population shares to the border PUMA. Panel B assigns border PUMAs to regions with the largest population share. Panel C drops the border PUMA (affecting 14% of the state population) from the analysis. Robust standard errors clustered at the level of PUMAs in the parenthesis.

Table C6: Non-medical consumption

	(I) $\overline{c_{1\cdot}}$	(II) $\overline{c_{11}}$	(III) $\overline{c_{\cdot 2}}$	(IV) $\overline{c_{\cdot>0}}$	(V) $\overline{c^{0}_{\cdot>0}}$	(VI) $\overline{c_{\cdot 0}}$	(VII) $\overline{c}$
mean	43.21	44.38	27.57	39.43	33.16	24.95	38.51
	(2.78)	(3.05)	(6.12)	(2.53)	(6.93)	(6.50)	(2.41)
ratio (vs. $\overline{c_{1\cdot}}$)	1	1.03	0.64	0.91	0.77	0.58	0.89
N	284	238	50	323	18	22	345

Notes: Table summarizes quarterly non-medical consumption expenditures (in thousands of dollars) for Massachusetts individuals in the 2011 Consumer Expenditure Survey. Standard error of mean estimates in the parenthesis.

Table C7: Welfare impacts of premium subsidy, alternative employment effects

	$\frac{dW_B}{d\lambda_p p}$	$\frac{dW_P}{d\lambda_p p}$	$\frac{dW_{UC}}{d\lambda_p p}$	$\frac{dW_C}{d\lambda_p p}$			$\frac{dW}{d\lambda_p p}$		
				$\frac{de}{d\lambda_p} = -0.003$	$= -0.011$	$= -0.050$	$\frac{de}{d\lambda_p} = -0.003$	$= -0.011$	$= -0.050$
$\gamma = 0$	0.24	0.10	0.06	-0.42	-0.42	-0.44	-0.02	-0.02	-0.04
$\gamma = 1$	0.38	0.10	0.06	-0.42	-0.42	-0.44	0.12	0.11	0.10
$\gamma = 2$	0.59	0.11	0.07	-0.43	-0.44	-0.46	0.34	0.33	0.31
$\gamma = 3$	0.92	0.12	0.08	-0.44	-0.44	-0.46	0.68	0.67	0.66

Notes: Table summarizes welfare for an additional dollar of subsidy assuming different employment responses $\frac{de}{d\lambda_p}$ in the calculation of fiscal costs. The main result uses a reduction of 0.003 estimated in Massachusetts. Here, I calculate welfare for alternative responses using the participation reduction in Massachusetts ($\frac{de}{d\lambda_p} = -0.011$) and larger estimates ($\frac{de}{d\lambda_p} = -0.050$) from the literature.

Table C8: Welfare impacts of premium subsidy, alternative ESI crowd-out

	$\frac{dW_B}{d\lambda_p p}$	$\frac{dW_P}{d\lambda_p p}$	$\frac{dW_{UC}}{d\lambda_p p}$	$\frac{dW_C}{d\lambda_p p}$			$\frac{dW}{d\lambda_p p}$		
				$\frac{d\lambda_1}{d\lambda_p} = -0.48$	$= -0.60$	$= 0$	$\frac{d\lambda_1}{d\lambda_p} = -0.48$	$= -0.60$	$= 0$
$\gamma = 0$	0.24	0.10	0.06	-0.42	-0.42	-0.40	-0.02	-0.02	0
$\gamma = 1$	0.38	0.10	0.06	-0.42	-0.43	-0.40	0.12	0.12	0.15
$\gamma = 2$	0.59	0.11	0.07	-0.43	-0.44	-0.40	0.34	0.33	0.37
$\gamma = 3$	0.92	0.12	0.08	-0.44	-0.45	-0.40	0.68	0.68	0.72

Notes: Table summarizes welfare for an additional dollar of subsidy assuming different ESI crowd-out in $\frac{d\lambda_1}{d\lambda_p}$. The main result applies a crowd-out of -0.48 (with one-third of the effect driven by workers) based on the estimate in Massachusetts. Alternatively, I calculate costs and welfare applying the average crowd-out (-0.60) in previous Medicaid expansions and a zero crowd-out in the table.

Table C9: Welfare impacts of subsidy, alternative incidence of charity cost

	$\frac{dW_B}{d\lambda_p p}$	$\frac{dW_P}{d\lambda_p p}$	$\frac{dW_{UC}}{d\lambda_p p}$			$\frac{dW_C}{d\lambda_p p}$	$\frac{dW}{d\lambda_p p}$		
			$\alpha = 36\%$	$= 100\%$	premium tax		$\alpha = 36\%$	$= 100\%$	premium tax
$\gamma = 0$	0.24	0.10	0.06	0.06	0.06	-0.42	-0.02	-0.02	-0.02
$\gamma = 1$	0.38	0.10	0.06	0.08	0.07	-0.42	0.12	0.13	0.12
$\gamma = 2$	0.59	0.11	0.07	0.10	0.07	-0.43	0.34	0.36	0.34
$\gamma = 3$	0.92	0.12	0.08	0.13	0.08	-0.44	0.68	0.72	0.68

Notes: Table summarizes welfare for an additional dollar of subsidy under alternative incidences of charity costs. $\alpha = 36\%$ is the share financed by the service surcharge according to the program budget. Alternatively, I consider complete cost shifts to private payers assuming that charity care is either fully financed by patients ($\alpha = 100\%$) or financed by enrollees through a premium tax $\tau_p = g\frac{\lambda_0 ri}{1-\lambda_0}$, in which case expansion improves welfare by $\frac{dW_{UC}}{d\lambda_p p} = \omega_{\cdot>0}\, g\, \frac{ri}{p}\left[\frac{1}{1-\lambda_0} + \varepsilon_{ri,\lambda_0}\right]\frac{d\lambda_0}{d\lambda_p}$.

Table C10: Welfare impacts of penalty, alternative incidence of charity cost

	$\frac{dW_B}{dkp}$	$\frac{dW_P}{dkp}$	$\frac{dW_{UC}}{dkp}$			$\frac{dW_C}{dkp}$	$\frac{dW}{dkp}$		
			$\alpha = 36\%$	$= 100\%$	premium tax		$\alpha = 36\%$	$= 100\%$	premium tax
$\gamma = 0$	-0.05	0.07	0.04	0.04	0.04	-0.06	0	0	0
$\gamma = 1$	-0.09	0.08	0.05	0.05	0.05	-0.06	-0.03	-0.02	-0.03
$\gamma = 2$	-0.15	0.08	0.05	0.07	0.05	-0.06	-0.08	-0.06	-0.08
$\gamma = 3$	-0.26	0.08	0.06	0.09	0.06	-0.06	-0.17	-0.14	-0.18

Notes: Table summarizes welfare for an additional dollar of penalty under alternative incidences of charity costs. $\alpha = 36\%$ is the share financed by the service surcharge according to the program budget. Alternatively, I consider complete cost shifts to private payers assuming that charity care is either fully financed by patients ($\alpha = 100\%$) or financed by enrollees through a premium tax $\tau_p = g\frac{\lambda_0 ri}{1-\lambda_0}$, in which case expansion improves welfare by $\frac{dW_{UC}}{dkp} = \omega_{\cdot>0}\, g\, \frac{ri}{p}\left[\frac{1}{1-\lambda_0} + \varepsilon_{ri,\lambda_0}\right]\frac{d\lambda_0}{dk}$.

Table C11: Welfare impacts of subsidy, differences in spending

	$\frac{dW_B}{d\lambda_p p}$	$\frac{dW_P}{d\lambda_p p}$	$\frac{dW_{UC}}{d\lambda_p p}$			$\frac{dW_C}{d\lambda_p p}$	$\frac{dW}{d\lambda_p p}$		
			$g = 0.9$	$= 0.7$	$= 1.1$		$g = 0.9$	$= 0.7$	$= 1.1$
$\gamma = 0$	0.24	0.10	0.06	0.05	0.07	-0.42	-0.02	-0.03	-0.01
$\gamma = 1$	0.38	0.10	0.06	0.05	0.08	-0.42	0.12	0.10	0.13
$\gamma = 2$	0.59	0.11	0.07	0.06	0.09	-0.43	0.34	0.32	0.35
$\gamma = 3$	0.92	0.12	0.08	0.06	0.10	-0.44	0.68	0.66	0.70

Notes: Table summarizes welfare for an additional dollar of subsidy assuming different spending levels in health insurance and charity care. $g = 0.9$ is calibrated for Massachusetts from a 11% spending increase with health insurance. $g = 0.7$ allows for much larger spending increase (43%), and $g = 1.1$ allows for lower spending in health insurance compared to charity care.

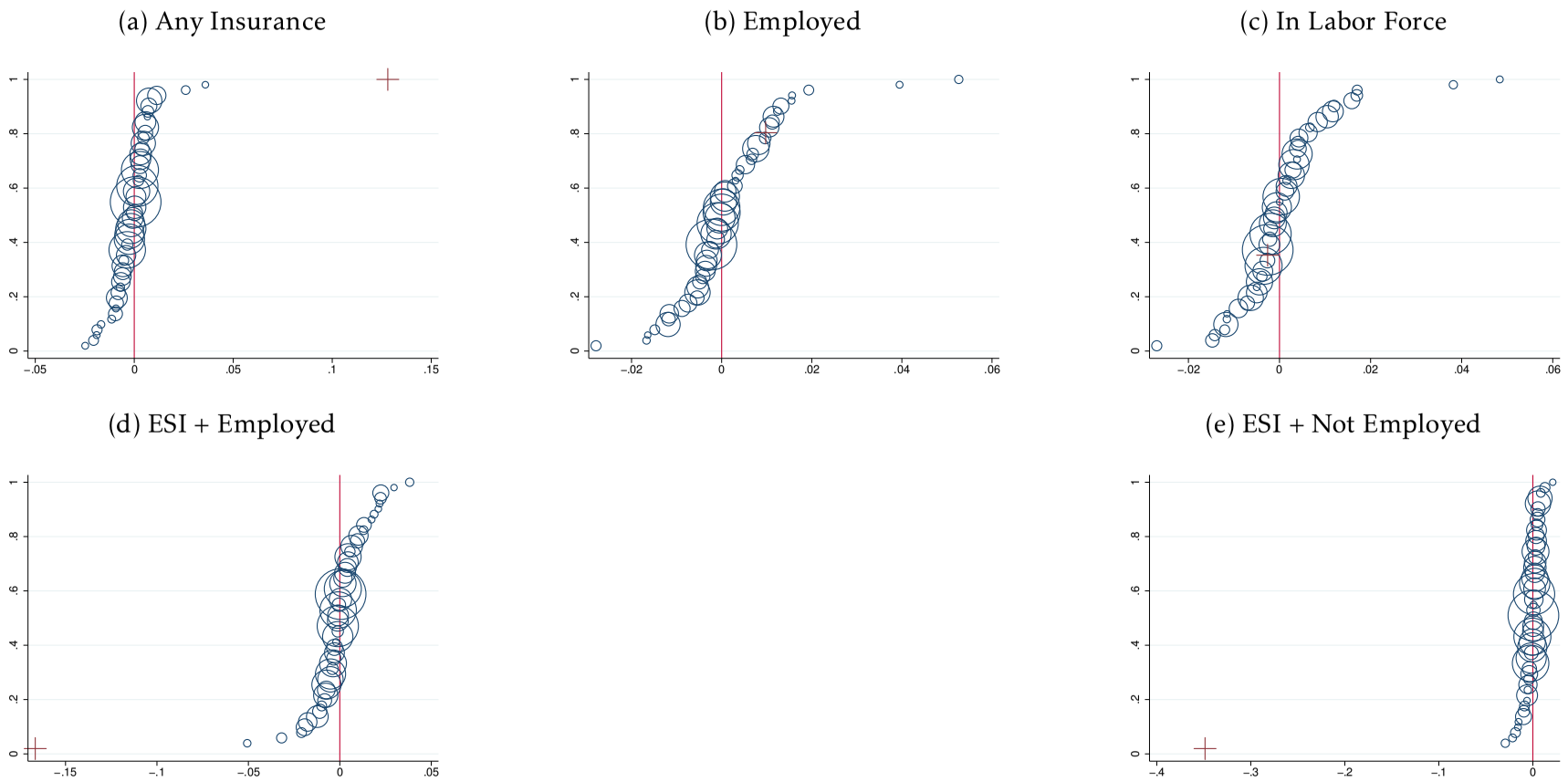
Table C12: Welfare impacts of penalty, differences in spending

	$\frac{dW_B}{dkp}$	$\frac{dW_P}{dkp}$	$\frac{dW_{UC}}{dkp}$			$\frac{dW_C}{dkp}$	$\frac{dW}{dkp}$		
			$g = 0.9$	$= 0.7$	$= 1.1$		$g = 0.9$	$= 0.7$	$= 1.1$
$\gamma = 0$	-0.05	0.07	0.04	0.03	0.05	-0.06	0	0	0.01
$\gamma = 1$	-0.09	0.08	0.05	0.04	0.06	-0.06	-0.03	-0.04	-0.02
$\gamma = 2$	-0.15	0.08	0.05	0.04	0.06	-0.06	-0.08	-0.09	-0.07
$\gamma = 3$	-0.26	0.08	0.06	0.05	0.07	-0.06	-0.17	-0.19	-0.16

Notes: Table summarizes welfare for an additional dollar of subsidy assuming different spending levels in health insurance and charity care. $g = 0.9$ is calibrated for Massachusetts from a 11% spending increase with health insurance. $g = 0.7$ allows for much larger spending increase (43%), and $g = 1.1$ allows for lower spending in health insurance compared to charity care.

D Appendix Figures

Figure D1: Randomization tests across states



Notes. Graphs plot the empirical cumulative distribution of estimates from non-MA states and Massachusetts (marked with a plus). I generate premiums in non-MA states across random rating communities by age, year, and PUMA, and generate affordability differences over income by assigning simulated generosity randomly to demographics. I then estimate equation 13 for the random policies in placebo states and compare the true policy in Massachusetts. The circle indicating the estimates increases with the sample size in each state.