WEDGES, LABOR MARKET BEHAVIOR, AND HEALTH INSURANCE COVERAGE UNDER THE AFFORDABLE CARE ACT

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The Affordable Care Act's taxes, subsidies, and regulations significantly alter terms of trade in both goods and factor markets. We use an extended version of the classic Harberger model to predict and quantify consequences of the Affordable Care Act for the incidence of health insurance coverage and patterns of labor usage. If and when the new exchange plans are competitive with employer-sponsored insurance (ESI), our model predicts that more than 22 million people will leave ESI as a consequence of the law. Behavioral changes are expected to add two million participants to the new exchange plans: beyond those that would participate solely as the result of employer decisions to stop offering coverage and beyond those who would have been uninsured. We find large differences in coverage-pattern impacts based on the benefit (including tax incentives) of joining exchange plans and degree to which statutory penalties on individuals and firms are implemented: If exchange plans were not valued while the individual mandate were fully enforced, ESI could potentially even expand.

I. INTRODUCTION

Making healthcare affordable should profoundly affect the labor market, because the poor and unemployed can least afford health expenses and because employers have traditionally financed much of the economy's health spending. A fully implemented Affordable Care Act (hereafter, ACA) has the potential of altering the composition of employers, the demographic composition of the workforce, the size of the workforce, the number of unemployed, and the structure of wages. The purpose of this paper is to measure the tax wedges that the ACA creates in the labor market and to use

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market-equilibrium analysis to help predict how health insurance coverage will change. In doing so, it emphasizes four types of provisions in the ACA: the employment- and means-tested subsidies/tax credits for health insurance premiums and out-of-pocket expenses for persons who are not offered affordable health insurance by an employer (hereafter, "exchange subsidies," which went into effect in January 2014), the monetary penalties on employers who do not offer health insurance to their full-time employees (which went into full effect in January 2016), the monetary penalties on uninsured persons, and the major medical reinsurance assessment.[1] We also consider the interactions of these provisions with pre-existing payroll, personal income, and business income tax rules, and the so-called "family glitch" with the exchange subsidies.[2] We model the possibility that various ACA provisions may not be fully implemented, enforced, or valued by households; these factors prove to be important determinants of the equilibrium amounts and types of coverage.

At the core of our model is that the ACA's new taxes and subsidies on the employer-employee pair fall differently depending on the skill composition of a firm's employees and whether firms offer employer-sponsored insurance (ESI), employees obtain non-group insurance (NGI), such as through the exchanges, or employees obtain no private insurance (which we denote as "uninsured"). If exchange plans are valued highly and firms have a low-skilled workforce, then subsidies to low-skilled workers obtaining NGI outweigh the penalty owed by their employer (and reflected in their cash wages), and the firm drops its ESI and hires more low-skilled workers. With highly valued exchange plans, subsidies net of penalties on uncovered workers are positive for the low-skilled and negative for the high-skilled, causing the high-skilled to migrate from firms and industries dropping coverage to ones that offer ESI. However, if exchange plans are not valued highly even as penalties are strongly enforced, then employers with low administrative costs grow and ESI may increase, rather than decrease. If employers and industries are able to reorganize to offer ESI to high-skilled employees while allowing low-skilled employees to be eligible for NGI subsidies, then the ACA's effects on ESI are dramatically muted, even as the change in total coverage remains similar.

Our model features health insurance decisions that depend on taxes, subsidies, and administrative costs. Aside from possible tax benefits, a producer may offer health insurance to her employees because employees demand a cash wage premium to work for an employer that does not offer insurance as part of compensation.[3] In our model, producers are heterogeneous in terms of the skill-intensity of their production technology and their costs of administering health insurance.

Household labor supply and factor prices are also endogenous in our model. Altogether, tax and subsidy rules affect factor prices and the number of people covered by

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[1] The ACA creates subsidized health insurance "marketplaces" or "exchanges" where individuals can purchase health insurance.

[2] See also Mulligan (2013) on interactions between ACA provisions, unemployment insurance, and uncompensated health care.

[3] See, for instance, Gruber (1994), Jensen and Morrisey (2001), and Miller (2004).

ESI through four types of behavioral responses: whether to offer ESI, factor market comparative advantage, consumer substitution, and labor supply.

Our model also features NGI in the sense that employers can choose to forgo the subsidy implicit in the exclusion of ESI costs from the personal income and payroll tax bases, and let their employees obtain health insurance in a non-group market in which the real administrative costs participating in NGI are the same as what they would be if employees had obtained insurance through their employer. Absent the ACA, our model offers little reason for workers to obtain NGI because of the implicit tax subsidy for ESI. In contrast, the ACA offers subsidies that vary by worker skill and thereby attract a specific part of the population into the non-group market. Under both regimes, a segment of the population prefers not to be privately insured because they face administrative costs and insurance loadings that are too large to justify the purchase of either ESI or non-group coverage. Our model therefore has quantitative predictions as to the number of people covered by private health insurance and the composition of that coverage.

Sectors are heterogeneous, and some can be interpreted as "entrepreneurial" or intensive in small establishments. However, we do not model the ACA's significant employer-size provisions in any detail.[4] Our paper does not specifically model health outcomes.[5] We look at the entire labor market, but doing so prevents us from explicitly modeling any one industry's organization and performance. These simplifications allow us to tractably derive quantitative results for various important labor market behaviors that previous authors have held constant, and to help the reader readily understand the origins of our results.

Presumably the ACA was intended to reshape the market for healthcare, but not the market for labor. Perhaps those intentions explain why, so far, forecasts of various coverage effects of the ACA have come from health insurance "microsimulation" models that hold constant most, if not all, labor market outcomes. For example, the Congressional Budget Office's Health Insurance Simulation Model (Congressional Budget Office, 2007) and RAND's Comprehensive Assessment of Reform Efforts (Eibner and Price, 2012) forecast policy effects on health insurance coverage, but hold constant employee compensation, the size of the workforce, and its composition.[6] By assumption, a person's income, employment, and coverage are unaffected unless the policy directly contacts him or his employer. Each employer continues to hire the

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[4] See Gallen's (2013) model, which also distinguishes part-time from full-time work. Mulligan (2017) has results from two different surveys showing a significant employer-size distortion.

[5] Although the ACA expands health insurance coverage, even the direction of its effects on health is still debated. Cole, Kim, and Krueger (2012) note that uninsured people potentially have better incentives to make personal investments in their health — exercise, diet, adherence to physician instructions, etc. — because they bear more of the financial consequences of poor health than insured people do. Others are concerned that, by encouraging high deductibles, the ACA discourages insured people from using health services (for instance, Pear (2015)). Price ceilings have the potential of reducing quantities and the ACA creates or lowers a number of them such as the prices of preventative services, physician services, and insurance plans.

[6] See also the studies surveyed by Buchmueller, Carey, and Levy (2013).

same number and types of employees, even though employers are heterogeneous and therefore experiencing the policy change differently. The distribution of workers across firms is taken as a constant: the employers in the microsimulation models update their insurance offering without regard for what their competitors are doing. In particular, "decision-making by employers regarding insurance provision is assumed to depend on the characteristics and preferences of its [fixed set of] workers" (Abraham, 2012, p. 4). Furthermore, each employer "*balance*[s] the preferences of workers who have a strong demand for insurance *against* those of workers who are less willing to trade wages for benefits" (emphasis added).[7]

The microsimulation-model results are potentially inaccurate to the extent that health insurance policy affects where, when, or how people work. In our model, the market, rather than individual employers, "balances the preferences" of workers who value employer coverage against those who prefer all cash compensation (and the subsidy eligibility that goes with it). Each employer's decision to offer coverage, and each worker's total compensation, depend on market prices, and thereby depend indirectly on the preferences of *all* of the workers in the economy rather than merely those who happened to work together at the same firm when the policy change was implemented. People who value employer coverage get more cash compensation when they take or retain a job from an employer not offering coverage, and this compensating difference is an equilibrium outcome (i.e., it depends on public policy, and not just the employer's cost of providing coverage). Our model has employers hiring more when they gain a comparative advantage in the labor market (a "partial equilibrium" effect) or when there is more demand from their customers (a "general equilibrium" effect).

Microsimulation models assume that there is a stable "demand" for ESI, revealed by historical policy changes, and that health insurance policy just moves market participants along the same curve (Remler, Zivin, and Glied, 2004). But ESI demand in our model is a function of alternatives, and the intention of the ACA is to introduce private-sector alternatives that are close substitutes for ESI. For the purposes of estimating the impact of the ACA on ESI, the willingness and incentives of market participants to change types of private coverage may prove to be more important than their willingness to go without any private coverage.

The evidence shows that employers offer fringe benefits on the basis of their under-standing of their competition, and not just characteristics of their current payroll. A recent survey of small businesses (Mercatus Center at George Mason University, 2017) finds that a majority of small employers are knowledgeable about the health plans offered by competitors, about the health plans that current employees had on their previous job, and about the current health plans of former employees. When asked to

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7 Buchmueller, Carey, and Levy (2013, p. 1523). On one occasion, the Congressional Budget Office (2012) considered that firms may "restructure" in response to the ACA, but that is limited to legal changes or shifting from full-time schedules to part-time. It does not include changes in the skill mix of the workers used to produce, changes in reaction to what competing employers offer, or changes in customer demand.

cite a single reason for offering health insurance, 37 percent of employers say "staying competitive" [in the labor market]. Results like these suggest looking at competition in the labor market, with an equilibrium that is affected by policy, as we do in this paper. In addition, thinking through equilibrium labor market effects points us to important features of the data, including the proportion of firms at the margin of switching between private, NGI and ESI, the degree to which ESI firms can find loopholes and gain NGI subsidies for low-skilled workers, the sectoral disparities in taxation, and the degree to which penalties and subsidies are implemented in the long run.

Our model is not designed to represent the short run. For now, the future of the ACA is highly uncertain, political discussion of major modifications and implementation are ongoing, and insurance markets are still adapting, with changing market structure and premiums (Mathews and Armour, 2016; Pear, 2016). Optimization frictions for workers and firms may cause short-run responses to differ from long-run responses (Chetty, 2012). We consider our model, especially its examination of implementation rates, as providing a menu to policymakers about the long-run equilibria arising from different policies. We examine coverage and labor decisions, and consequently do not make any welfare calculations, although our tax-wedge estimates would be a helpful starting point for such work.

Section II of the paper sets up the model with an algebraic representation of tastes, technologies, public policies, and market equilibrium. Section III characterizes an equilibrium's qualitative properties. Section IV calibrates the model, with special emphasis on measuring the startling size of the new tax wedges between sectors and skill groups. Section V presents quantitative predictions for the impact of the ACA on the amount and incidence of insurance coverage. A companion paper (Mulligan and Gallen, 2013) presents our model's quantitative predictions for the impact of the ACA on wages and aggregate output. Section VI concludes by indicating how the results of the paper help reconcile seemingly disparate approaches to estimating the coverage effects of the ACA.

II. MODEL SETUP

A. Tastes and Technologies

Producers differ according to their costs of administering health insurance. Broadly interpreted, this administrative cost can reflect employee turnover, economies of scale, abilities to self-insure, abilities to minimize adverse selection, insurance loadings, etc. For each unit of insured labor rented by a firm in sector i, $1 - e^{-\delta(i)} << 1$ units must be devoted to private health insurance administration (including, under the ACA, NGI), and the remaining $e^{-\delta(i)} < 1$ devoted to producing for the firm's customers.

We assume that uncompensated care and Medicaid have some undesirable characteristics and that, if health insurance administrative costs were zero, workers would prefer private insurance to both of these options. We let $\chi > 0$ quantify the undesirable characteristics, such as the amounts that uninsured individuals are required to pay

for their health care, the (imperfect) quality and accessibility of uncompensated care and Medicaid, and the extra financial risks associated with being uninsured. For each unit of uninsured labor rented by a firm, $e^{-\chi} < 1$ units are devoted to producing for the firm's customers, with the remaining $1 - e^{-\chi} << 1$ units representing foregone employee healthcare product attributes. If firms and employees were not taxed on the basis of health insurance offerings, a firm i with employees whose only reasonable source of insurance is through the employer would maximize their joint interests by offering ESI if and only if $\chi > \delta(i)$.

The differences among producers in the costs of administering health insurance appear to be large, because significant increases in the implicit subsidy (associated with exclusion from income and payroll tax bases) failed to make ESI universal among employers — especially small employers, and significant subsidy cuts fail to eliminate ESI — especially among large employers (Congressional Budget Office, 2007). Small firms may enjoy other advantages that help offset advantages of administration enjoyed by their larger competitors. We capture both of these effects by having (a) multiple sectors in our model whose outputs are imperfect substitutes in consumer utility and (b) allowing consumer preferences for the output to vary across sectors.

Sectors also differ according to the skill-intensity of their technologies. Sector i's technology is[8]:

$$(1) \quad y(i) = z(i)e^{-\delta(i)INS(i)-[1-INS(i)]\chi} [(1-\alpha(i)) K(i)^{(\sigma-1)/\sigma} + \alpha(i)A(i)L(i)^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)},$$

where $K(i)$ is the amount of high-skill labor employed in sector i, $L(i)$ is the amount of low-skill labor employed in sector i, $y(i)$ is sectoral output, the constants $z(i)$ are sector i's overall productivity, σ is the elasticity of substitution in production, $A(i)$ is a sector i low-skill labor biased technology term, and the α_i's are labor share parameters in the production function.[9] $INS(i)$ is an indicator variable for whether firms in sector i offer ESI or, under the ACA, have employees who obtain affordable private non-group coverage through the "exchanges."[10]

Let $i \in [0,1]$ denote quantiles of the administrative cost distribution. Given that we observe firms that do not offer health insurance have relatively low-skill employees, we suspect that α and δ are positively correlated. For simplicity, we assume a one-to-one monotonic relationship between α and δ, so that i also denotes quantiles of the α distribution.

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[8] An important difference in our model compared to other models of the ACA, such as Aizawa and Fang (2013), Nakajima and Tüzemen (2015), or Brügemann and Manovskii (2010) is this focus on worker heterogeneity in productivity and the consequences of differential taxation rates by type by sector.

[9] Our model has constant returns to the two types of labor, and no explicit reference to physical capital inputs. We interpret equation (1) as a long-run value function or reduced form that implicitly accounts for physical capital accumulation in proportion to the amount of labor, assuming the capital-labor ratio does not change.

[10] Medicaid and uncompensated care are included in the $INS = 0$ category.

B. Public Policy Parameters

Low- and high-skill labor rental rates (inclusive of the costs of employee fringe benefits, if any) are denoted w and r, respectively. Inclusive of taxes and subsidies, firms in sector i pay factor rental rates for low-skill labor and high-skill labor that are, respectively:

$$(2) \quad (1 + \tau_{iL})w, \; (1 + \tau_{iK})r,$$

where $\{\tau_{iL}, \tau_{iK}\}$ are sector-specific factor tax rates (subsidy rates, if negative). We assume that τ_{iL} and τ_{iK} are common to all producers making the same *INS* decision (more later on the *INS* decision). The five primary examples of these tax rates are employer payroll taxes, the per-employee penalties for failing to offer affordable health insurance, subsidies for purchasing NGI, the individual penalties for failing to purchase insurance, and the subsidy implicit in the exclusion of ESI costs from the personal income and payroll tax bases.

The ultimate incidence of the taxes and subsidies does not depend on whether employers or employees pay them, so we assume that τ_{iL} and τ_{iK} are paid by employers and adjust empirical estimates of factor prices appropriately to conform to our normalization. We assume that the taxes and subsidies are close enough to zero that each sector's equilibrium marginal product of high-skill labor exceeds its marginal product of low-skill labor (equilibrium is formally defined later).

The wedges τ_{iL} and τ_{iK} do not include taxes or subsidies related to the labor supply decision, like unemployment insurance, the taxes paid on personal income not spent on health insurance, and employee payroll taxes.[11] s_L and s_K denote the combined marginal tax rates from the taxes related to the labor supply decision. The marginal rewards to working are therefore $(1 - s_L)w$ and $(1 - s_K)r$ for low- and high-skill persons, respectively.

Table 1 displays empirical concepts of employee compensation and employer costs, and relates them to our model's notation. Only low-skill notation is shown; high-skill notation would merely replace "*L*" with "*K*." The top row is total employer cost, inclusive of penalties and fringes, with the notation indicated in equation (2). Table 1's second row shows employee compensation excluding employer penalties and employer payroll taxes.

The employee compensation shown in the second row still differs across sectors because employees may receive a personal income and payroll tax advantage by receiving some of their compensation as ESI or receive tax credits for buying health insurance on the exchanges. The third row subtracts these items, measured relative to the tax credits received by NGI employees, from the second row. The fourth row shows employee compensation net of all payroll and personal income taxes.

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[11] For ease of measurement, we do include employer payroll taxes in the employer tax rates τ_{iL} and τ_{iK}.

Table 1
Components of Compensation and Employer Costs

Low-Skill Employees

Empirical Measure	Model Notation by Sector			Notes
	ESI	NGI	Uninsured	
Employer cost = value marginal product of labor – employer penalty and employer payroll taxes	$(1+\tau\_cL)w$	$(1+\tau\_nL)w$	$(1+\tau\_uL)w$	Varies by sector
= employee compensation (including fringes) – foregone HI subsidy	$(1+\tau\_cL-0.0765)w$	w	$(1+\tau\_uL-\tau\_nL)w$	Varies by sector
= employee comp. net of sector-specific health terms – personal taxes and forgone household subsidies	w	w	w	Employees are indifferent
= reward to work	$(1-s\_L)w$	$(1-s\_L)w$	$(1-s\_L)w$	between sectors

Notes

(1) ESI = Employer-sponsored health insurance, NGI = Non-group health insurance
(2) underscore indicates subscript
(3) 0.0765 is the employer payroll tax rate
(4) $(\tau\_cL-0.0765)w$ is the value of the exchange subsidy net of the value of the ESI tax exclusion
(5) $(\tau\_nL-0.0765)w$ is the employer penalty
(6) $(\tau\_uL-0.0765)w$ is the value of the exchange subsidy plus the employer penalty

At the core of Table 1 is our Harberger (1962) concept of compensating differentials between sectors. Pre-tax sectoral wages move to make households indifferent in utility terms between sectors. This is visible in the third and fourth rows because the employee amounts are the same in each column.

C. Household Preferences

Given an allocation of labor and production across sectors, the representative household's utility would be:

$$(3) \quad \ln\left[\int_0^1 e^{\rho(i)} y(i)^{(\lambda-1)/\lambda} \, di\right]^{\lambda/(\lambda-1)} - \gamma_L \frac{\eta}{\eta+1}\left[\int_0^1 L(i)\,di\right]^{(\eta+1)/\eta} - \gamma_K \frac{\eta}{\eta+1}\left[\int_0^1 K(i)\,di\right]^{(\eta+1)/\eta}.$$

The $\rho(i)$'s, η, λ, γ_L, and γ_K are preference parameters. The $\rho(i)$'s reflect consumer preferences for the various sectors. λ is the elasticity of sectoral-output substitution in utility. η is the Frisch wage elasticity of labor supply. γ_L and γ_K parameterize the disutility of work, holding constant the prevalence of insurance among workers and non-workers.

An efficient allocation of labor and INS would maximize equation (3) subject to the production functions in equation (1), and taking the taste and technology parameters as given. The efficient allocation of INS would be to the sectors $i \leq i^*$, with $\delta(i^*) \equiv \chi$.[12] However, the purpose of this paper is to consider equilibrium allocations in the presence of taxes and subsidies, which generally are not efficient.

The representative household uses its factor income and a lump sum transfer b to purchase the output of each industry according to the budget constraint:

$$(4) \quad \int_0^1 p(i) y(i)\,di = (1-s_L) w \int_0^1 L(i)\,di + (1-s_K) r \int_0^1 K(i)\,di + b,$$

where $p(\cdot)$ is the industry pattern of output prices, taken as given by the household. $(1-s_L)w$ and $(1-s_K)r$ are the household's rewards to working its two types of labor net of payroll taxes, personal income taxes, and means-tested subsidies.[13]

D. Equilibrium Defined

The insurance choice is one of three options: ESI, NGI, and those who choose neither, the "uninsured" in our model. Associated with these three options are three statutory employer tax rates for the covered (ESI), uncovered, and NGI sector for each skill level: τ_{cL}, τ_{cK}, τ_{nL}, τ_{nK}, τ_{uL}, and τ_{uK}, respectively. In this way, insurance choice affects production costs.

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[12] For simplicity, we assume that $\delta(i)$ is continuous and decreasing in i and crosses χ on the interval $i \in [0,1]$.

[13] In our calibration, new revenues are less than new spending, and the lump sum transfer rises. We do not study the new potential wedges introduced if distortionary taxes are raised.

Given tax rates $\{\tau_{cL}, \tau_{cK}, \tau_{nL}, \tau_{nK}, \tau_{uL}, \tau_{uK}, s_L, s_K\}$, taste parameters $\{\eta, \lambda, \gamma_L, \gamma_H\}$, the parameter χ indicating the desirability of private insurance, the factor substitution elasticity σ, and industry patterns for $\alpha(\cdot)$, $\delta(\cdot)$, $\rho(\cdot)$, $A(\cdot)$, and $z(\cdot)$, an equilibrium is a pair of factor rental rates w and r and a list of industry patterns of low-skill employment $L(\cdot)$, high-skill employment $K(\cdot)$, output $y(\cdot)$, prices $p(\cdot)$, and employer coverage decisions such that: (a) the industry patterns of employment and consumption maximize household utility in equation (3) subject to the household budget constraint in equation (4) (taking as given coverage conditions as reflected in $INS(\cdot)$), (b) each industry's production equals household demand for their output, (c) the industry patterns of employment, output, and coverage decisions are consistent with the production function in equation (1), (d) each industry's coverage decision and composition of labor achieves the minimum production cost, and (e) each industry has zero profits. The government budget constraint and national income identity are:

$$(5) \quad b = \int_0^1 [(\tau_{iL} + s_L)wL(i) + (\tau_{iK} + s_K)rK(i)]\, di$$
$$Y = \int_0^1 [(1 + \tau_{iL})wL(i) + (1 + \tau_{iK})rK(i)]\, di.$$

For the purpose of calculating equilibria under various policies, we assume that all insurance is purchased through employers or former employers, but in mapping to the data we distinguish exchange purchases from ESI narrowly defined, and recognize that these two have different subsidy rates. In particular, under the ACA, employers have three choices: (a) to offer employees ESI, which qualifies for the tax subsidy but not the ACA subsidy, (b) to "offer" employees exchange subsidies, which creates penalties and makes the exchange subsidies available, or (c) not to offer any insurance, leaving employees to be uninsured or on Medicaid.

At first glance, it might seem unrealistic that employers in our model that do not offer ESI have a "choice" between non-group coverage and no insurance at all for their employees, and have to incur the same administrative costs for the non-group coverage as they do for ESI. We note that referring to administrative burdens as employer costs, rather than employee costs, is just a normalization because it is the burden for the joint employer-employee pair that determines equilibrium behavior, including employers' helping their workers navigate the complexities of the ACA's health insurance plans.[14] In any case, the important assumption is that the NGI offered on the exchanges do not meaningfully affect aggregate insurance administration and overhead costs.[15]

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[14] Walmart works "with a health coverage specialist to guide workers through the process of finding alternative coverage" (Tabuchi, 2014). Going forward, seasonal employers who perennially help their employees navigate the unemployment insurance system, may find it to their advantage to help employees navigate the ACA's exchanges too. For example, Georgia State Representative Mark Hamilton explained how school bus companies "pay a little bit less but supplement that by helping you [bus drivers] get your unemployment" (King, 2014).

[15] See also our companion paper (Mulligan and Gallen, 2013) for more discussion of the legal and practical incidence of insurance decisions. As shown later, we find potentially large shifts from ESI to NGI under the ACA, despite assuming that NGI does not reduce administrative costs.

III. QUALITATIVE EQUILIBRIUM CHARACTERISTICS

A. Employment and Coverage Patterns by Sector

Each of the three alternatives presents the employer with its own rental rates of skilled and unskilled labor, inclusive of the administrative costs, tax costs, and worker disutility of uncompensated care. Consequently, firms have marginal and average costs of production idiosyncratic to their sector. The log per-unit-output cost function for an employer facing a production function of the form in equation (1) is the minimum of the three possibilities:

$$
(6) \quad -\ln z + \min \left\{
\begin{array}{l}
\chi + \dfrac{1}{1-\sigma} \ln\left[(\alpha A)^{\sigma}[(1+\tau_{uL})w]^{1-\sigma} + (1-\alpha)^{\sigma}[(1+\tau_{uK})r]^{1-\sigma} \right] \\[2ex]
\delta + \dfrac{1}{1-\sigma} \ln\left[(\alpha A)^{\sigma}[(1+\tau_{nL})w]^{1-\sigma} + (1-\alpha)^{\sigma}[(1+\tau_{nK})r]^{1-\sigma} \right] \\[2ex]
\delta + \dfrac{1}{1-\sigma} \ln\left[(\alpha A)^{\sigma}[(1+\tau_{cL})w]^{1-\sigma} + (1-\alpha)^{\sigma}[(1+\tau_{cK})r]^{1-\sigma} \right]
\end{array}
\right\},
$$

which are no coverage, NGI, and ESI, respectively. Each of the coverage possibility terms in equation (6) reflects the fact that the tax rates associated with a coverage decision affect the optimal skill-intensity of the workforce.

For any particular coverage option, the square bracket term varies by sector only because the technology skill intensity parameter α varies. The only other source of cost variation is the administrative cost term δ, which also increases with the industry index i. Each of the three cost terms can therefore be graphed versus i, and any one of the schedules will cross any one of the others once, if at all. Thus, the equilibrium industry pattern of coverage decisions partitions the sectoral index scale $i \in [0,1]$ into at most three intervals.

Unless τ_{uL} were sufficiently large, the uninsured, if any, would be employed at the least skilled end of the scale because those industries have the greatest insurance administration costs. Absent the ACA, NGI receives no subsidy and is therefore dominated by ESI. The equilibrium coverage decisions in this case look like the gray dashed schedule in Figure 1 with ESI offered by the skill-intensive industries and no insurance offered by the remainder.[16]

Under the ACA, coverage is described by up to three intervals with ESI offered by the most skill-intensive industries because the ACA has $\tau_{cL} > \tau_{nL}$ and $\tau_{cK} < \tau_{nK}$. Employees purchasing NGI are employed in the middle interval. This situation is illustrated by the gray dashed and black dotted schedules in Figure 2.

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[16] Figures 1 and 2 are equilibrium simulation results using our benchmark parameter values and assuming full implementation of taxes and subsidies. For the moment, Figures 1 and 2 serve only to illustrate qualitative features of our model (our quantitative work is introduced later).

Figure 1

Equilibrium Allocations by Sector: no ACA
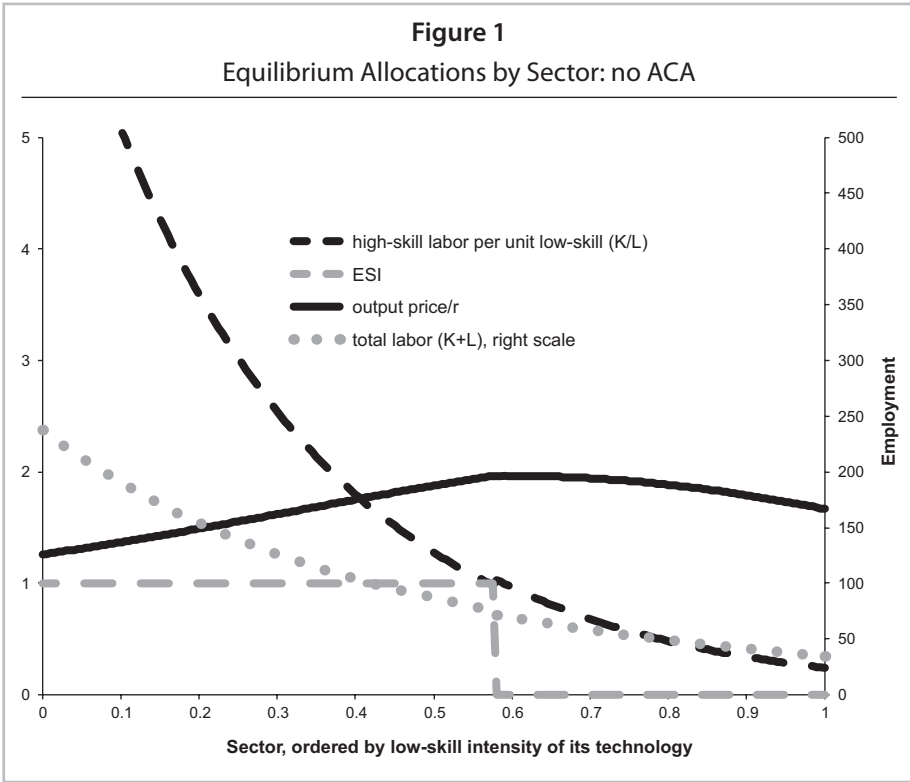
Equilibrium requires that every sector have the same tax-adjusted marginal rate of transformation (*MRT*) between low- and high-skill labor, which is equal to a common marginal rate of substitution in utility.

$$(7) \quad \frac{\alpha(i)A(i)}{1-\alpha(i)}\left(\frac{K(i)}{L(i)}\right)^{1/\sigma} = \frac{1+\tau_{iL}}{1+\tau_{iK}}\frac{1-s_K}{1-s_L}\frac{\gamma_L}{\gamma_K}\left(\frac{L}{K}\right)^{1/\eta} = \frac{1+\tau_{iL}}{1+\tau_{iK}}\frac{w}{r}$$

$$L \equiv \int_0^1 L(i)di, \quad K \equiv \int_0^1 K(i)di,$$

where each employer's tax rates depend on his ESI or NGI decision. For an employer i^* at the margin between insurance choice j and insurance choice j' (e.g., moving from ESI to no ESI),

$$(8) \quad \frac{K_j(i^*)}{L_j(i^*)} = \left(\frac{1+\tau_{jL}}{1+\tau_{jK}}\frac{1+\tau_{j'K}}{1+\tau_{j'L}}\right)^{\sigma}\frac{K_{j'}(i^*)}{L_{j'}(i^*)} \equiv q_{jj'}^{\sigma}\frac{K_{j'}(i^*)}{L_{j'}(i^*)}.$$

With or without the ACA, employers on the margin between two insurance choices will face a different tax wedge from moving to a different insurance choice. Consequently,

Figure 2

Equilibrium Allocations by Sector: with ACA
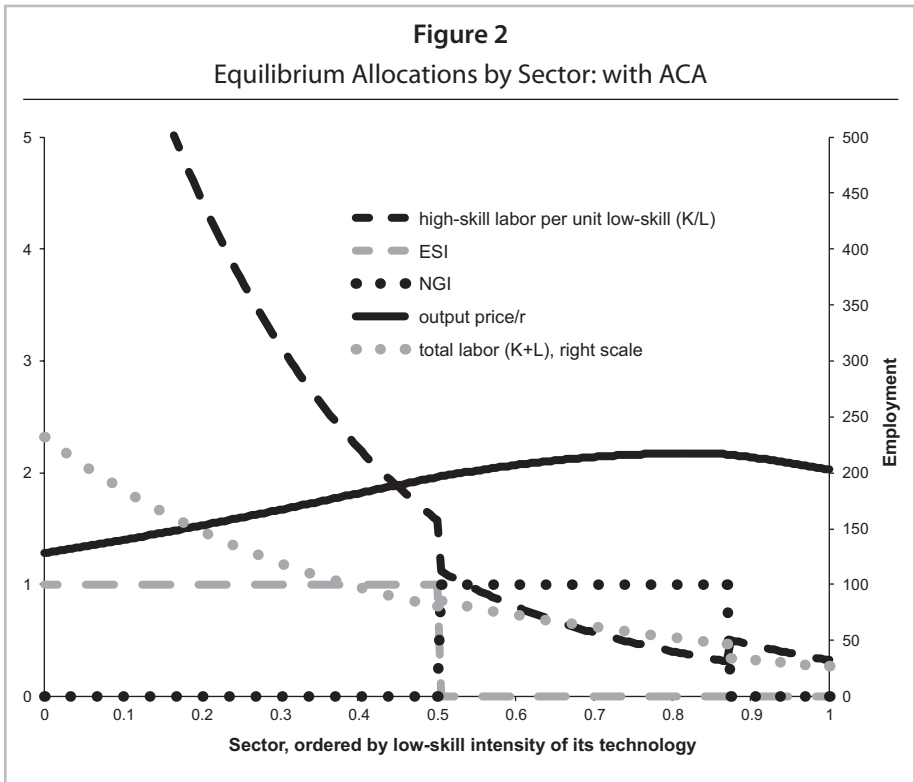
the coverage decision is not taken in isolation, but associated with a jump in the skill intensity. Absent the ACA, the ESI-uninsured tax wedge term in equation (8) is different from one and the skill intensity jumps up (moving from low i to high i) at the equilibrium i^*. Because cost does not jump at i^*, output does not jump either, and the ESI-marginal firm reduces its total employment as it drops ESI.[17] The small employment effect of dropping ESI is illustrated in Figure 1 by the gray dotted schedule's jump at the 57th percentile.

The same logic applies on the ESI-NGI margin under the ACA: output and cost do not jump at the sector i^* that is in equilibrium on the margin between ESI and NGI. The ESI-marginal firm increases its total employment and reduces skilled employment as it drops ESI, moving along its isoquant. These two effects of dropping ESI for NGI are illustrated in Figure 2 by the jumps of the gray dotted and black dashed schedules, respectively, at the 50th percentile.

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[17] Relative- to high-skilled workers, a larger proportion of low-skilled ESI worker compensation is in the form of ESI. Consequently, the proportional tax exclusion on employer-based health insurance is larger for low-skilled workers, biasing the ESI sector towards low-skilled relative to the uninsured sector.

As we compare industries with insurance coverage in Figures 1 and 2, prices (black series) rise with the industry index i because the administrative costs are rising. The administrative costs are irrelevant for comparing uninsured industries' prices. Equilibrium prices and costs fall with i because those with less skill-intensive technologies have the greater factor market comparative advantage in trading employees with the rest of the industries.

The allocation of labor across industries with the same insurance coverage depends on the preference function $\rho(\cdot)$, which could be assumed to follow any number of patterns. We limit our attention to preference functions that are a linear function of i, and explain later how we calibrate that function. Regardless of the shape of the function, the relative prices and revenues of two sectors i and 0 have to be consistent with their relative amounts produced:

$$(9) \quad \frac{p_i}{p_0} = e^{\rho_i - \rho_0}\left(\frac{y_0}{y_i}\right)^{1/\lambda}$$

$$\frac{p_i y_i}{p_0 y_0} = e^{\rho_i - \rho_0}\left(\frac{y_i}{y_0}\right)^{1 - 1/\lambda}.$$

All industries have revenue equal cost, which means their relative revenues equal their relative costs:

$$(10) \quad \frac{p_i y_i}{p_0 y_0} = \frac{(1 + \tau_{iL})wL_i + (1 + \tau_{iK})rK_i}{(1 + \tau_{cL})wL_0 + (1 + \tau_{cK})rK_0}$$

$$= \frac{L_i}{L_0}\frac{1 + \tau_{iK}}{1 + \tau_{cK}}\frac{MRT_i + \left(MRT_i\frac{1 - \alpha_i}{\alpha_i A_i}\right)^\sigma}{MRT_c + \left(MRT_c\frac{1 - \alpha_0}{\alpha_0 A_0}\right)^\sigma},$$

where we assume that the sector 0 has ESI because it has the least administrative costs and the most skill-intensive technology of all sectors. The second equality in equation (10) is derived from the first by using the *MRT* condition in equation (7).

The relative production in the two sectors can also be examined on the supply side using the production function:

$$(11) \quad \frac{y_i}{y_0} = e^{\delta_0 - \delta_i INS(i) - [1 - INS(i)]\chi}\frac{z_i}{z_0}\left(\frac{\alpha_i A_i}{\alpha_0 A_0}\right)^{\sigma/(\sigma-1)}\frac{L_i}{L_0}\left[\frac{MRT_i^{\sigma-1}\left(\frac{1 - \alpha_i}{\alpha_i A_i}\right)^\sigma + 1}{MRT_c^{\sigma-1}\left(\frac{1 - \alpha_0}{\alpha_0 A_0}\right)^\sigma + 1}\right]^{\sigma/(\sigma-1)}.$$

Substituting equations (10) and (11) into the demand condition in equation (9), we can characterize the allocation of low-skill labor across sectors:

$$(12) \quad \frac{L_i}{L_0} = e^{(\rho_i - \rho_0)\lambda} \left[e^{\delta_0 - \chi - (\delta_i - \chi)INS(i)} \frac{z_i}{z_0} \left(\frac{\alpha_i A_i}{\alpha_0 A_0} \right)^{\sigma/(\sigma-1)} \right]^{\lambda-1}$$

$$\left(\frac{1+\tau_{cL}}{1+\tau_{iL}} \right)^{\lambda} \left[\frac{MRT_i^{\sigma-1} \left(\frac{1-\alpha_i}{\alpha_i A_i} \right)^{\sigma} + 1}{MRT_c^{\sigma-1} \left(\frac{1-\alpha_0}{\alpha_0 A_0} \right)^{\sigma} + 1} \right]^{(\lambda-\sigma)/(\sigma-1)} .$$

Recall that *MRT* and the tax rates are the same for all sectors with the same insurance offering, so that the low-skill labor allocation across those sectors depends only on the taste and technology parameters indicated in equation (12).

An analytical result is helpful for understanding the quantitative sectoral analysis that follows.

> Proposition   Holding aggregate factor supplies constant, sector-neutral sub-
>   sidies have no effect on the sectoral allocation of factors, the
>   composition of output, or sectors' relative prices.

The proof is on line at http://www.nber.org/papers/w19770.

IV. MEASUREMENT OF TAX WEDGES AND CALIBRATION OF BEHAVIORAL RESPONSE RATES

In order to make quantitative predictions, we begin by measuring the tax wedges created by the ACA. We then assume functional forms for the distribution functions $\delta(i)$ and $\alpha(i)$ and relate their key parameters to quantitative estimates of coverage outcomes and sensitivity of those outcomes to tax rates. We also calibrate the utility and production parameters from the labor economics literature. The ACA impacts are found by holding constant the distribution functions, utility parameters, and production parameters and varying the tax parameters from their non-ACA values to their ACA values. Impact sensitivity analysis is performed by varying one of the calibration inputs from the empirical literature while holding the other calibration inputs constant, which requires varying one of the taste or technology parameters in order to continue to match the latter calibration inputs.[18]

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[18] For example, for a sensitivity analysis with respect to the wage elasticity of labor supply η, we must vary the utility parameters γ_L, and γ_K together with η in order to continue to match data on wage rates and the number of people from the two skill groups who work.

A. Functional Forms for Sectoral Taste and Technology Gradients

We assume that the taste function $\rho(i)$ is linear in i. We assume that the skill-intensity function $\alpha(i)$ is logistic and administrative cost function $\delta(i)$ is linear.

Because the slope of the administrative cost function dictates the propensity of employers to change their ESI-offer decision, we set the slope so that the elasticity of ESI offerings with respect to the price of ESI is $-1/3$ in the neighborhood of efficient ESI, assuming that 9 percent of covered employee compensation (plus the implicit tax subsidy) goes to ESI coverage.[19] The calibrated value for the elasticity is based on the same empirical studies reviewed by the Congressional Budget Office (2007), which is why our model's predictions are similar to CBO's if we hold constant the composition of consumer demand.

The level of the net administrative cost function $\delta(i) - \chi$ as well as the level parameter for the taste function $\rho(i)$ are irrelevant because they do not change the relative prices or quantities between sectors. Having previously assumed the slope of $\delta(i)$ directly, this leaves three parameters to solve for. We solve for the two parameters of the skill-intensity logistic function $\alpha(i)$ as well as the slope of the taste function $\rho(i)$ so that our model equilibrium without the ACA matches the data on employee compensation by skill level and the composition of the workforce by skill level and ESI coverage, as measured in the March 2012 Current Population Survey (CPS). Table 2 depicts our targeted moments and our model fit, which match exactly.

B. Other Taste and Technology Parameters

We convert numbers of covered employees into numbers of plan participants by multiplying by 2.0 to account for dependents, which is the ratio of ESI plan participants as measured by the Congressional Budget Office (2013) to the number of non-elderly heads and spouses covered by ESI as measured in the March 2012 Current Population Survey. We use a range of 1 to 2 for the elasticity of substitution in production between high- and low-skill labor, σ, based on Acemoglu (2002). Our benchmark value of σ is 1.5. See also Table 6.

Table 2

Moments in Model and Data

Description	Data	Model
Skilled labor	67.53	67.53
Coverage late	0.79	0.79
Low skill coverage rate	0.59	0.59

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[19] Future work should explore the possibility that the ACA changes the administrative cost of health insurance $\delta(i)$ by changing the nature of the insurance market. Real resources used by firms to, for instance, screen out applicants with expensive conditions could fall, lowering $\delta(i)$. By the same token, resources required to cover employees could increase as real compliance verification costs increase, or more expensive means of subtly excluding unwanted applicants may be used, raising $\delta(i)$.

Appendix I further discusses the calibration of the taste and technology parameters. Of particular interest for interpreting our results is that all potential workers in our model economy are non-poor, non-elderly household heads and their spouses. Potential workers are quantified according to the aggregate number of non-poor non-elderly household heads and spouses who worked some time during 2011, as measured by the March 2012 Current Population Survey and rescaled to reflect 3 percent population growth between 2012 and 2015 (i.e., 98 million rescaled to 101 million).[20] Dependents appear in the model only as people who might have health insurance and thereby might affect incentives for the head or spouse in their household to work or change sectors. Appendix II discusses several alternative calibrations that display sensitivity analyses with respect to the more important parameters.

Model workers are of only two types, low- and high-skill, which refers to whether husband plus wife personal income (including the value of health insurance premiums, if any, paid by employer) are below or above 300 percent of the federal poverty line, respectively.[21] We do not further distinguish workers according to months worked or monthly hours, although we do account for these variables by measuring labor compensation according to average earnings for calendar year 2011 (adjusted for inflation between 2011 and 2014), including the value of employer-paid ESI premiums.[22] Therefore, if our model predicts, for example, that one million low-skill workers move from one sector to another, we interpret that to mean that the one million workers have the same average annual earnings as the other low-skill workers in the economy.[23]

C. Tax Wedge Measurement

We model health reform as changes in the tax and subsidy rates $\{\tau_{cL}, \tau_{cK}, \tau_{nL}, \tau_{nK}, \tau_{uL}, \tau_{uK}, s_L, s_K\}$, and the labor market consequences of health reform as the equilibrium comparative statics with respect to the tax and subsidy rates. Obviously, the quantitative results hinge on the numerical values assumed for the tax parameters with and without health reform. We calibrate the tax rates so that they reflect the combination of (when applicable) employer payroll taxes, employer penalties, subsidies for purchasing health insurance on the exchanges, employer health insurance participation charges, and the tax exclusion of employer health insurance premiums. In practice, the various tax rate components are treated differently by business and personal income tax rules and are collected on different time scales and therefore need to be rescaled into "common units" before they are added to arrive at a combined tax rate.

In reality, some of the taxes are proportional to payroll expenditure and others are proportional to the number of employees, but for algebraic simplicity we model all of them as skill-specific proportions of payroll. In calibrating the proportions, we must decide

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[20] Three-quarters of aggregate hours were supplied by these 98 million, with the rest supplied by the elderly, the poor, or persons who are not head of household or spouse.

[21] For unmarried households, head of household personal income is used.

[22] These averages are reported in the middle of Table 6. All dollar amounts in this paper are in 2014 dollars.

[23] Another example: We interpret a 1 percent reduction in low-skill labor supply to be some combination of reductions in the number of low-skill people working some time during the year and the average annual hours worked among low-skill people; our model is not set up to distinguish the two.

whether the various component proportions accumulate additively or multiplicatively.[24] We assume that the employer FICA and Medicare rates are added with each other because (for employees with earnings below the FICA earnings cap) they are levied on the same base, but that they multiply the value of the tax exclusion for employer health insurance because the latter comes out of the tax base of the former. We assume that the various ACA taxes and subsidies are additive with each other, but multiply the non-ACA tax rates.[25]

In our model, all workers of the same skill level receive the same total compensation regardless of the sector of their employment. All of the sector-specific taxes and subsidies are paid and received by employers. As a normalization that streamlines our notation, we assume that all employees receive a cash subsidy (appropriate to their skill level, but sector neutral) as if they purchased health insurance on the exchanges and then employers in the ESI and uninsured sectors are taxed to finance subsidies received by their employees. This means that the exchange subsidies are reflected in $\{\tau_{uL}, \tau_{uK}, \tau_{cL}, \tau_{cK}\}$ but not $\{\tau_{nL}, \tau_{nK}\}$. Our normalization is economically equivalent to paying the subsidies only to employees who work in the NGI sectors, but in the latter case the extra employer costs for the ESI and uninsured sectors would be compensating cash payments to employees for forgoing the exchange subsidies, rather than extra taxes. Because we use the former approach while the actual ACA takes the latter, adjustments to w and r are required before comparing our model to empirical measures of employee compensation.

The monetary penalties on employers who do not offer health insurance to their full-time employees are included in the tax rates $\{\tau_{nL}, \tau_{nK}, \tau_{uL}, \tau_{uK}\}$ of employers operating in the NGI and uninsured sectors. The individual mandate penalties on uninsured persons are included only in $\{\tau_{uL}, \tau_{uK}\}$. Finally, the ACA's insurance participation assessments, discussed later, are included in the ESI sector tax rates $\{\tau_{cL}, \tau_{cK}\}$.

The top and middle panels of Table 3 show the annual tax amounts (excluding employer payroll tax) and percentage rates (including employer payroll tax). Absent the ACA, the tax amounts are zero with the exception of the roughly $2,500 subsidy for ESI employees implicit in the income and payroll tax exclusion of employer health insurance premiums. The employer tax rate without the ACA (the first two columns in Table 3's middle panel) is the sum of 7.65 percent and the ratio of the corresponding tax amount to the average total compensation for the skill level.[26]

We calibrate the tax rates with the ACA (the right two columns of Table 3's middle panel) by building on the without-ACA rates and information about the likely combined

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[24] To a first order approximation in the neighborhood of zero tax rates, it does not matter whether the rates add or multiply. However, actual tax rates are far from zero and the second order interaction terms are not negligible.

[25] If the ACA taxes were additive with the value of the employer tax exclusion, then sector-uniform ACA taxes would nonetheless cause substitution between sectors.

[26] 7.65 percent is the sum of the employer FICA and Medicare tax rates. We use $32,381 and $82,813 for the (pre-ACA) low- and high-skill total compensation amounts, respectively, which are the average annual earnings for working (some time during 2011) non-elderly household heads and spouses in households that are between 100 and 300 percent of the poverty line, and above 300 percent of the poverty line, respectively.

Table 3

Employer Tax Rate Calibration

Tax amounts expressed as an equivalent salary increment, in 2014 dollars. Assumes full implementation.

	Without ACA		With ACA	
	High Skill	Low Skill	High Skill	Low Skill
Employer type	*Tax Amounts, excluding payroll tax*			
ESI	−2,554	−2,421	−1,562	7,363
NGI	0	0	2,694	2,295
Uninsured	0	0	6,027	13,192
Employer type	*Tax Rates, including payroll tax*			
ESI: τ_{cK} & τ_{cL}	4.6%	0.2%	5.8%	36.8%
NGI: τ_{nK} & τ_{nL}	7.7%	7.7%	11.2%	15.6%
Uninsured: τ_{uK} & τ_{uL}	7.7%	7.7%	15.8%	65.9%
Sectoral trades	*Labor market terms of skill trade distortions*			
Uninsured vs. ESI: q_{uc}	1.04			1.11
NGI vs. ESI: q_{nc}	1.04			0.80
Uninsured vs. NGI: q_{un}	1.00			1.38

Notes: Tax rates are employer rates: tax amounts are excluded from the base. See Table 4 for components of the tax amounts.

ACA tax and subsidy amounts R (the top panel of Table 3; see also Table 4) for each sector and skill level:

$$(13) \quad 1+\tau_{iL} = (1+\overline{\tau}_{iL})\sqrt{\frac{1+R_{iL}/\overline{w}}{1-R_{iL}/\overline{w}}}, \quad 1+\tau_{iK} = (1+\overline{\tau}_{iK})\sqrt{\frac{1+R_{iK}/\overline{r}}{1-R_{iK}/\overline{r}}},$$

where the overbars indicate without-ACA values.[27] Table 3's middle panel rates are used in our market simulation.

The impact of the ACA on employer tax rates is astonishing. Rates increase by a factor of about 1.6 for high-skill employees and many times more for low-skill employees.

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[27] The ACA's penalties and subsidies are usually dollar amounts, such as those in Table 3's top panel, as opposed to the more analytically convenient percentages of compensation (Table 3's middle panel). Moreover, in theory the dollar amounts generated by a given percentage tax rate is an equilibrium outcome because the rate's tax base is an equilibrium outcome. The square root formulas in equation (13) are the geometric average of two approaches to guessing, on the basis of pre-ACA data, the equilibrium tax rate that would deliver a specified amount of revenue: one approach that sets the rate as revenue divided by the pre-ACA marginal revenue product of labor and a second approach that sets the rate as revenue divided by the pre-ACA wage rate.

Table 4

Components of Sector-specific Employer Taxes and Subsidies

Assumes full implementation.

		Applicable sector?		
Non-ACA Provisions	Annual Amount	ESI	NGI	Uninsured
Value of excluding health premiums from personal taxes	−2,660	Yes	No	No
ACA Provisions	Annual Amount	ESI	NGI	Uninsured
Employer shared responsibility payment		No	Yes	Yes
Full time, full year amount	2,000			
Adjustment for propensity to work part time[a]	1,656			
Avg. salary equivalent (assuming 39% business tax rate)	2,522			
Major medical reinsurance assessment	126	Yes	No	No
Exchange subsidy clawback[b]		Yes	No	Yes
Full year amount after personal taxes[a]	7,968			
Salary equivalent[a] (assuming 25% personal tax rate)	10,624			
Individual mandate penalty (salary equivalent)[c]	1,348	No	No	Yes
TOTAL[a] = sum of applicable annual salary equivalent amounts		8,090	2,522	14,494
TOTAL[a] adjusted for average weeks worked per year		7,363	2,295	13,192

Notes: [a]The amount shown in the table is for low-skill. We use an alternate amount for high-skill workers.
[b]For use in a model in which all employees receive an exchange subsidy by default.
[c]Scaled down by an estimated 20% of uninsured low-skill workers who are illegal immigrants.

However, the table omits the sector-neutral employee subsidy noted earlier, so the most important information in Table 3's middle panel is the degree to which the tax rates vary by sector and skill level and how the ACA changes and amplifies that variation. Among high-skill workers, the ESI sector's advantage over the other sectors goes from 3.1 percentage points to as much as 10.0 percentage points. Among low-skill workers, the ESI advantage goes from 7.5 percentage points to –21.3 (NGI) or 29.1 percentage points (uninsured).

The middle and bottom panels of Table 3 also show how the ACA distorts the sectors' comparative advantage in the labor market. For each pair of sectors i and j, the bottom panel uses the tax rates in the middle panel to calculate the ratio of $(1 + \tau_{iL})/(1 + \tau_{iK})$ to $(1 + \tau_{jL})/(1 + \tau_{jK})$. The ratio indicates how the tax rates distort comparative advantage relative to taxes that were uniform by skill or by sector. Without the ACA, there would be no distortion between uninsured and NGI (if there were any NGI). The without-ACA rates distort the composition of uninsured factor demand, relative to the ESI sector, by 4 percent in the direction of high-skill workers because the value of the tax exclusion of ESI premiums is a greater percentage of low-skill ESI employee compensation than it is of high-skill ESI employee compensation.[28] The ACA slightly magnifies this distortion from 1.04 to 1.11 because the employer penalties for uninsured employees are also a greater percentage of low-skill compensation than of high-skill compensation.

The ACA creates a remarkable 1.38 distortion of comparative factor advantage between the uninsured and NGI sectors. The 1.38 is not an intended consequence of favoring the NGI sectors over uninsured sectors but is a consequence of failing to favor the NGI sectors in a factor-neutral way.

Table 4 gives more detail behind the tax and subsidy amounts in Table 3 by showing the legislative components, conversion factors, and the sectors to which each component applies. The $2,660 implicit subsidy amount for a full-year worker was derived by multiplying an estimated annual exclusion amount ($7,980: see Appendix I) by an assumed combined marginal tax rate from payroll and personal income taxes (25 percent) and dividing by one minus the same marginal tax rate in order to convert it to an equivalent salary increment.[29] The employer shared responsibility payment is part of the NGI and uninsured annual amounts in Table 3. It is $2,000 per full-time employee, which is $1,656 per low-skill employee if 83 percent of them work full time. An employer payment of $1,656 is not deductible from business taxes and therefore has an employer cost equivalent to a $2,522 annual salary increment (when the tax rate

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[28] Recall that Figure 1 offered a first glimpse at this result in its K/L series that jumps up slightly on the margin between ESI and uninsured.

[29] For example, a person earning $50,000 per year with only $41,000 taxable would, at a 25 percent marginal personal tax rate, have the same income after personal taxes as someone earning $53,000 with no exclusion. $3,000 is the salary increment equivalent value of the $9,000 tax exclusion. The two amounts shown in the upper left of Table 3 are the $2,660 adjusted for the average annual weeks worked among non-elderly heads and spouses (by skill level).

on business net income is 39 percent). Most of the taxes are assessed monthly on the basis of the number of employees.[30]

With the ACA, ESI employers owe about $126 per employee-year as an insurance participation assessment.[31] The next three rows of Table 4 pertain to the federal subsidies for purchasing insurance on the exchanges, which in our model are paid to all persons but then clawed back from persons without insurance and from persons employed in ESI sectors. The subsidies — $7,968 on average for heads and spouses in households below 300 percent of the poverty line — are untaxed by personal income and payroll taxes. At a 25 percent combined personal tax rate, the salary equivalent increment is $10,624.[32]

The next row is the individual mandate penalty. The penalty as of 2016 is 2.5 percent of household income, or $695 per uninsured family member (up to three members, with uninsured children counting half), whichever is greater. The median penalty per dollar of wages for each low-skill working uninsured household head or spouse in the March 2012 CPS was 4.2 percent.[33]

Illegal immigrants are not subject to the individual mandate and cannot purchase plans in the ACA's marketplaces. If illegal immigrants are not relevant to any of the margins examined by our model (if, for instance, they were infra-marginal to the choice of employment and insurance coverage), we might ignore them in our calibration. As a middle ground, we discount the individual mandate penalty (but not the exchange subsidy, or the employer penalty) among low-skill workers by 20 percent, which is our guess of the fraction of low-skill workers uninsured before the ACA that were illegal immigrants.[34]

The first "TOTAL" row in Table 4 sums the applicable salary equivalent rows above for ESI, NGI, and uninsured sectors. However, these amounts are built on the assumption that each worker generates a tax liability for his employer throughout the calendar year, whereas actual low-skill workers are out of work part of the year (4.7 weeks, on average). The Table's final row therefore rescales the row above by the average weeks employed per year among low-skill household heads and spouses.[35] Also note that the

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[30] From the perspective of a tax year, monthly employment taxes distort the intensive margin of labor supply and demand. From the perspective of the monthly employment data released by the Bureau of Labor Statistics, these are taxes on the extensive margin. Although assessed monthly, the ACA's employer penalty and implicit employment tax (created by the exchange subsidies' eligibility rules) are in reality more complicated because they do not apply to anyone working less than 120 hours per month. Also note that the income-test parts of the exchange subsidies and the individual mandate are based on tax-year income and thereby distort both months per year and hours per month.

[31] The assessment is $63 per plan participant, and we assume that each employee with coverage has covered an average of 2.0 dependents (126 = 63*2). Exchange plans also pay the assessment, but the aggregate revenue from the assessment effectively goes to the exchange plans, purportedly to offset losses from admitting participants with pre-existing health conditions (another ACA provision).

[32] The exchange subsidies have dollar amounts that are skill-specific. Table 4 displays only the low-skill average amounts of $7,968 and $10,624; the high-skill average amounts are $681 and $908.

[33] For high-skill workers, we assume that the individual mandate penalty is 2.5 percent of household income and convert it to a salary equivalent using the same marginal tax rate factor.

[34] See also our discussion of the aggregate labor supply distortions.

[35] High-skill persons are employed an average of 49.9 weeks per year.

bottom total row appropriately quantifies incentives to move employees across sectors: If a low-skill employee, for example, were moved from an uninsured sector to the ESI sector, that would not reduce the employer shared responsibility payment by $2,000 per year because the uninsured sector employer was paying the assessment only for the part of the year when the employee was on the payroll.

All of the amounts and rates shown in Tables 1, 3, and 4 assume full implementation in the sense that the ACA is fully enforced, all employers not offering ESI are penalized, and households value the subsidies at the dollar amounts we have assigned to them. However, part of the population may not value the insurance options offered by the insurance exchanges, and therefore forgo participation in those plans and forgo the ACA subsidies. In addition, states may fail to set up insurance exchanges, and perhaps thereby make their residents ineligible for premium support and cost sharing subsidies, even those who comply with the individual mandate (Pear, 2012). It is beyond the scope of this paper to explicitly model compliance choices, or even exhaustively catalog all of the possible margins of implementation, take-up, compliance and enforcement that are possible with a significant law that is unpopular with large segments of the population, but we do introduce a penalty "implementation rate" and a subsidy "implementation rate" as model parameters on the unit interval that multiply the tax and subsidy amounts noted earlier. We analyze the effects of changing these implementation rates in the next section.

For example, a 50 percent subsidy implementation rate means that we calibrate the tax wedges for low-skill workers based on a $3,984 average annual subsidy for exchange coverage rather than the $7,968 average we estimated from CPS data on low-skill workers in the low-skilled ESI tax amount in Table 3 (with a similar calculation for high-skilled workers). It is important to note that our implementation rate is not simply the statutory implementation of subsidies: A 50 percent implementation rate can be achieved under full statutory implementation if agents only value the subsidies at 50 cents for every dollar of cost to the treasury. Because the subsidy implementation rate is so important to our results, our paper makes clear that offering desirable plans are of first-order importance when considering the impact of the ACA on coverage.

V. THE COVERAGE DECISION: QUANTITATIVE RESULTS

Our model has predictions for the effect of the ACA on the amount and composition of insurance coverage.[36] Both predictions utilize pre-ACA measurements of various aspects of insurance coverage, but quantitative results also require functional form assumptions. For predicting ESI coverage, the functional form assumptions serve the purpose of interpolating pre-ACA measurements and in principle would not be necessary

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[36] In the language of Cutler and Gruber (1996), the ACA's three-month coverage gap exemption allows for a significant amount of "conditional coverage" of households. As a consequence, point-in-time estimates of enrollment may differ by as much as 25 percent from the number of people actually able to acquire medical care covered by the exchange plans: If 12 million people were enrolled in exchange plans in March 2016, 16 million may be conditionally covered.

if the pre-ACA firm measurements were sufficiently disaggregated by worker skill level. For predicting the number of people without insurance, functional form assumptions are needed to extrapolate outside the range of historical experience. For these reasons, ESI predictions might be more reliable than the predictions for the number uninsured.

A. Cost Functions, the Break-Even Test, and Empirical Indicators of the Relative Demand for ESI and NGI

The model's coverage decision involves the choice, summarized in equation (6) among three possible cost functions: ESI, NGI, or non-private-insurance. Four factors potentially affect equilibrium prevalence of each decision: (a) the distribution of administrative costs δ net of the disutility χ of being uninsured, (b) the tax rates, (c) the distribution of the skill-intensity parameter α, and (d) the relative factor price w/r. However, recall from Table 3 that the tax factor q_{uc} is fairly close to one without the ACA, which means that the log term in equation (6) for ESI coverage differs from the log term for no coverage by essentially the same constant for all sectors so that the distribution of administrative costs is the primary determinant of the margin (if any) between ESI and not insured. As noted earlier, we calibrate that distribution from the microeconometric literature on the historical sensitivity of ESI offering decisions to the price of ESI.

Absent the ACA, employees find that NGI is strictly dominated by ESI: recall from Table 3 that both skill levels are taxed less under ESI coverage than under NGI coverage. Therefore, marginal changes in any of the four factors (a)–(d) in the neighborhood of the no-ACA allocation have no effect on the model's (zero) prevalence of NGI among employees. For larger changes — think of varying the ACA subsidy implementation rate between zero and 100 percent — some of the employers offering ESI absent the ACA find it optimal to offer NGI instead. Because administrative costs are the same between ESI and NGI, the distribution of administrative costs is irrelevant for the ESI-NGI switching decision except insofar as it has general equilibrium effects (such as by changing the wage). What really matters for the decision to replace ESI with NGI is the employer's propensity to use low-skill labor.

The cost functions in equation (6) highlight the importance of skill intensity as a determinant of the type of coverage, conditional on having private coverage. Holding w/r constant and assuming that $\sigma > 1$, an employer achieves minimum cost by replacing ESI with NGI if and only his ACA-absent compensation ratio satisfies:

$$(14) \quad \frac{(1+\overline{\tau}_{cL})wL_i}{(1+\overline{\tau}_{cK})rK_i} \geq \frac{1-\left(\dfrac{1+\tau_{cK}}{1+\tau_{nK}}\right)^{\sigma-1}}{\left(\dfrac{1+\tau_{cK}}{1+\tau_{nL}}\dfrac{1+\overline{\tau}_{cL}}{1+\overline{\tau}_{cK}}\right)^{\sigma-1} - \left(\dfrac{1+\tau_{cK}}{1+\tau_{cL}}\dfrac{1+\overline{\tau}_{cL}}{1+\overline{\tau}_{cK}}\right)^{\sigma-1}},$$

where bars indicate the ACA-absent tax rate values. The critical compensation ratio on the right-hand side of the inequality in equation (14) is just a function of the tax

parameters and the elasticity σ of factor substitution. For our benchmark tax calibration and $\sigma = 1.5$, the critical ratio is 0.32, which means that any ESI employer with pre-ACA low-skill compensation that is at least 32 percent of its high-skill compensation would reduce costs by replacing ESI with NGI.[37]

As σ approaches zero, equation (14) reduces to the break-even or "money's worth" test (Rennane and Steuerle, 2011) that compares the aggregate subsidy net of penalties received by a firm and its employees if it had NGI coverage rather than ESI to the value of ESI's tax exclusion (aggregated for all employees of the firm):

$$
(15) \quad \lim_{\sigma \to 0} \frac{1 - \left(\dfrac{1 + \tau_{cK}}{1 + \tau_{nK}} \right)^{\sigma-1}}{\left(\dfrac{1 + \tau_{cK}}{1 + \tau_{nL}} \dfrac{1 + \overline{\tau}_{cL}}{1 + \overline{\tau}_{cK}} \right)^{\sigma-1} - \left(\dfrac{1 + \tau_{cK}}{1 + \tau_{cL}} \dfrac{1 + \overline{\tau}_{cL}}{1 + \overline{\tau}_{cK}} \right)^{\sigma-1}} = \frac{1 + \overline{\tau}_{cL}}{1 + \overline{\tau}_{cK}} \frac{\tau_{nK} - \tau_{cK}}{\tau_{cL} - \tau_{nL}}.
$$

In other words, the break-even test is equivalent to a comparison of the pre-ACA compensation ratio (the left-hand side of inequality in equation (14)) to the right-hand side of equation (15). As long as $\sigma > 0$, employers are expected to adjust the composition of their workforce according to the skill gradient of employer costs, and the break-even test is only a rough indicator of which insurance offering will minimize employer costs under the ACA. For example, some of the employers in our model (those with pre-ACA compensation ratios between 0.24 and 0.29) retain ESI even though the break-even test conducted before the ACA would suggest that they had enough low-skill employees to gain from dropping ESI because the incentives created by the ACA made it too expensive to retain so many low-skill employees.[38]

Aside from quantifying the tax rates, the essential quantitative determinant of our prediction for the prevalence of ESI under the ACA is the fraction of ESI employers for whom the compensation ratio was at least 0.32 (equivalently, a log ratio of −1.13). Figure 3 illustrates why we think a large minority of ESI employers might reduce costs by switching from ESI to NGI under the ACA. The horizontal axis orders employees according to their employers' pre-ACA cost of ESI relative to no insurance. A vertical line is drawn at workforce quantile 0.79 because 79 percent of the workforce (of non-poor household heads and spouses) had ESI before the ACA. Dashed horizontal lines in the chart indicate the log average compensation ratio for ESI employers (−2.03) and non-ESI employers (−0.36). While we do not have the exact empirical distribution, we discipline our choice by matching these two known conditional moments of the distribution.

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[37] For this purpose, and as indicated in equation (14), compensation includes employer payroll taxes and net of the subsidy implicit in the exclusion of health insurance premiums from the personal and payroll tax bases. The critical ratio also depends somewhat on the elasticity σ of factor substitution, ranging from 0.29 to 0.36 as σ ranges from 1 to 2.

[38] All of the employers in our model (100 percent implementation) who drop ESI pass the break-even test (conducted before the ACA) by a non-trivial margin: about $1,000 per employee-year.

Figure 3

Compensation Ratios and the Surplus from ESI
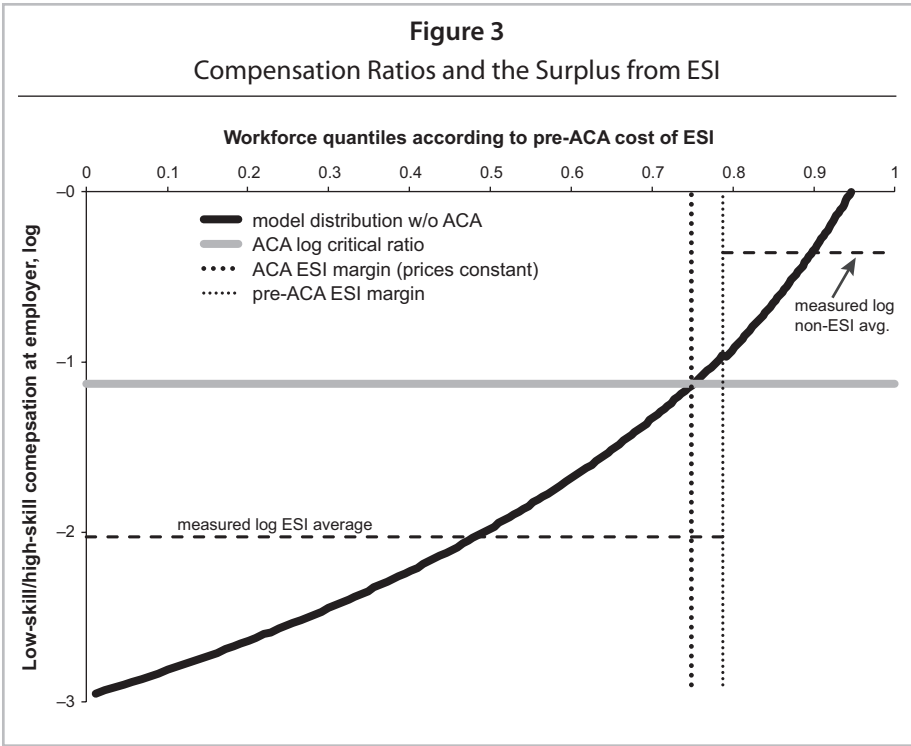
The solid curve is the distribution of pre-ACA compensation ratios in our benchmark parameterization, which fits the two conditional averages by construction and assumes that $\alpha(i)$ is logistic in the quantile i. Because the ACA critical compensation ratio shown as a solid horizontal line crosses this curve at quantile 0.75, we predict that (holding constant w/r and the distribution of employment across sectors) the ACA would reduce the ESI coverage rate from 0.79 to 0.75. Alternative shaped compensation distributions would result in somewhat different quantitative results.[39]

To the degree that employers can avoid the ACA penalties levied on them for not offering health insurance — perhaps by designating their employees as part-time, keeping fewer than 50 full-time equivalent employees, challenging the penalty in court, or

---

[39] It is theoretically possible that most employers have essentially the same skill intensity parameter α and that the ESI average of 0.25 is due to the extreme skill-intensities of employers far from the margin between ESI and no insurance, in which case the ACA could cause essentially all employers to replace ESI with NGI. The other extreme is also theoretically possible: that the α distribution is a step function, with the step coincidentally at the employer on the margin between ESI and no insurance, in which the ACA has no effect on ESI coverage holding w/r constant.

obtaining a waiver — the critical ratio drops sharply. For example, at half of the penalty the critical ratio drops from 0.32 to 0.18. Note that the average compensation ratio among employers with ESI before the ACA is 0.13, which means that a half penalty might induce many more ESI employers to drop their coverage.

With full implementation of penalties and subsidies, and holding factor prices constant, our model predicts that 4.1 percent of all workers and 5.2 percent of ESI workers are (without the ACA) at employers that would drop their ESI offering as a consequence of the ACA.[40] Those employees are in workforce quantiles 0.75–0.79 in Figure 3. According to the model, none of the employees in quantiles 0.8–1 can lose ESI because they do not have it without the ACA. However, the data show that 9 percent of ESI workers are in firms that are quite low-skill intensive — to the right of Figure 3's vertical band where, according to the model, no one has ESI. Their employers are especially likely to drop their health plans because of the exceptionally high fraction of their workers who would be eligible for significant exchange subsidies. Because our model assumes that none of the most low-skill-intensive employers have ESI without the ACA, we expect that our model somewhat underestimates the tendency of the ACA to cause employers to drop their coverage.

The aforementioned 4.1 percent of workers in the model lose ESI because they work for employers who were at the margin of offering ESI in the sense that the ACA tax rates reverse the inequality in equation (14) from what it was with the pre-ACA tax rates. In other words, the pre-ACA log compensation ratios for those employers was between –0.97 and –1.13. One way to measure how many workers are at the ESI-NGI margin is to create "firms" from aggregated state-industry cells in the CPS. Table 5 compares the (untargeted) fraction of the population at the margin in our model and calculated from the CPS. With 6.7 percent of the CPS workers at this margin, it seems that our model's coverage results may be understated because it has relatively little labor at marginal firms.
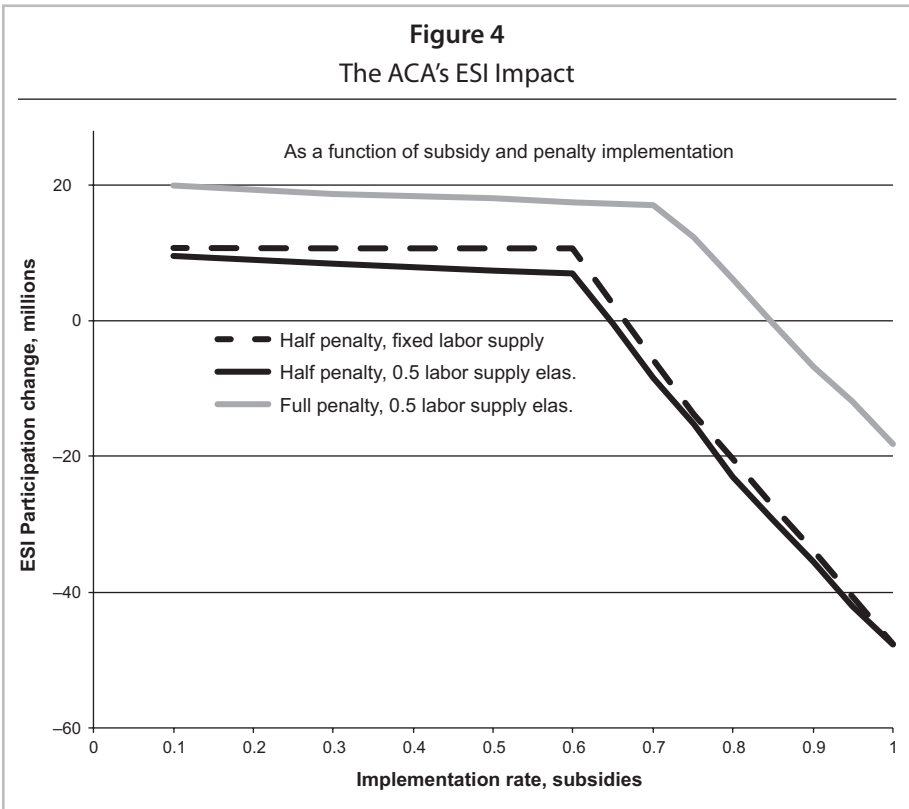
Table 5

Model and CPS Compensation Ratios

Workforce Quantiles at Pre- and Post-ACA Margins	CPS	Model
Quantile at the non-ACA critical ratio	0.790	0.792
Quantile at the critical ratio	0.722	0.751
Percent of labor at the ACA margin	6.7%	4.1%

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[40] Our model also predicts that factor prices change, which induces employers to change the skill composition of their workforce and thereby cause still more of them to drop their ESI offering. Moreover, people move off ESI on the model by switching sector of employment. But we point to the 4.1 percent result as one that can be readily compared with cross-sectional models that do not account for the full range of labor market behavioral changes.

In any implementation of the ACA, some industries shrink in terms of total labor and production, and other industries expand. Those firms near the break-even ratio that adopt NGI and have a worker base that gains access to the ACA's subsidies expand, while firms that are far from offering health insurance typically contract.[41]

B. Quantitative Estimates of the ACA's Impact on ESI Coverage

Figure 4 displays our model's predictions for the change in the number of persons on ESI as a function of the rate at which the penalties and subsidies are implemented. As long as the subsidy implementation rate is no greater than 0.6, ESI continues to dominate NGI under the ACA and ESI participation remains at or somewhat above where it was before the ACA. In these cases, the only people getting the NGI subsidy are those who get insurance on the exchanges after leaving a job with ESI. The magnitude of the ESI impact is composed of two opposing effects: the tendency for the employer

Figure 4
The ACA's ESI Impact

As a function of subsidy and penalty implementation

- - - Half penalty, fixed labor supply
—— Half penalty, 0.5 labor supply elas.
—— Full penalty, 0.5 labor supply elas.

ESI Participation change, millions

Implementation rate, subsidies

[41] More information about what industries and states can be expected to be "winners" and "losers" can be found in a previous version of this paper (Gallen and Mulligan, 2013).

and individual penalties to expand the number and size of ESI sectors for a fixed labor supply and the reduction in overall employment due to the additional assistance given to people while they are not working in the form of NGI subsidies. The latter effect dominates only when the penalty implementation rate is low enough and/or the wage elasticity of labor supply is high enough.

Recall from Table 4 that we estimate the average fully-implemented subsidy for low-skill workers to be $7,968 per year working in a NGI sector. If that average subsidy were perceived to be worth $4,550 or less to the participants — perhaps because NGI participation is significantly more costly in terms of inconvenience, red tape, equilibrium switching costs, or perceived value deficiencies — then the applicable parts of Figure 4 are those with subsidy implementation rates at or below 0.6 and we conclude that the ACA might not significantly reduce ESI participation.[42] However, because the law is currently written with Congressmen and their staffs required to get their health insurance on the exchanges, a cap on participant costs for those under 400 percent of the poverty line, the distinction between the exchange plans and anti-poverty health programs like Medicaid, our humble guess is that NGI subsidy take-up rates will be high within a few years and that actual behavior will be better represented in our model by a subsidy implementation rate that exceeds 0.6.

With subsidy implementation rates above 0.6, the ACA can easily reduce ESI participation by ten million or more, although the impact is sensitive to the penalty implementation rate. In our model, a fully-implemented penalty means that it is paid on all full-time employees without health insurance, but the actual ACA does not levy the penalties on employers with fewer than 50 employees, which collectively employ about half of employees without health insurance (Congressional Budget Office, 2007). Thus, for purposes of quantifying coverage decisions, the half penalty case is arguably more interesting. If the subsidy implementation rate were 80 percent or so, our model predicts that ESI enrollment (including dependents) could be 19 million less than it would be without the ACA.

The Congressional Budget Office (2013) estimates the ACA's ESI impact by assuming that the variables affecting the ESI-NGI margin are analogous to the variables affecting the ESI-no insurance margin, which have been examined by previous empirical studies. But, given that the uninsured far outnumbered those with NGI among non-elderly workers before the ACA, many fewer people may have been on the ESI-NGI margin than on the ESI-uninsured margin. If the ACA introduced only a small subsidy for NGI, then subsidies might have essentially no effect on ESI prevalence, as we find in our model for subsidy implementation rates less than 0.6 (see Figure 4).[43]

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[42] This particular conclusion depends on our assumption that ESI cannot be offered to high-skill employees in a sector without also offering it to low-skill employees. The ACA might still significantly reduce ESI participation without any sector dropping coverage if employers "window dress" their benefit offerings in order to exploit possible loopholes in the exchange subsidy eligibility rules.

[43] The nonlinearity of the response of ESI to the exchange subsidies suggests that stigma, quality perceptions, state government interference, or some other barrier that significantly discourages subsidy take-up could have surprisingly large effects on ESI. Perhaps this helps explain why Massachusetts' 2006 health reform, which offered subsidized care to a smaller segment of the population and even then did so by expanding the scope of its Medicaid program, resulted in surprisingly little (if any) reduction in ESI coverage.

Even when the subsidy implementation rate exceeds 0.6, our model of ESI prevalence is radically different from the CBO's. In this range, shifts between ESI and NGI have little to do with worker desires to avoid being uninsured, because they are insured either way.[44] As noted in connection with Figure 3 and in the break-even literature cited earlier, employer offering decisions are about the composition of their workforce especially as measured by the amount of the subsidy the average employee would get on the ACA's exchanges. Moreover, our approach adds labor supply, output-substitution, and factor-substitution effects to the breakeven calculus: households change the sectors to which they allocate their time and purchases and businesses change the composition of their factor demand.

For penalty and subsidy implementation rates of 50 and 80 percent, respectively, Figure 5 decomposes the ESI impacts into the three "behavioral" components, using

Figure 5
The ACA Affects Coverage through Labor Market Behavior

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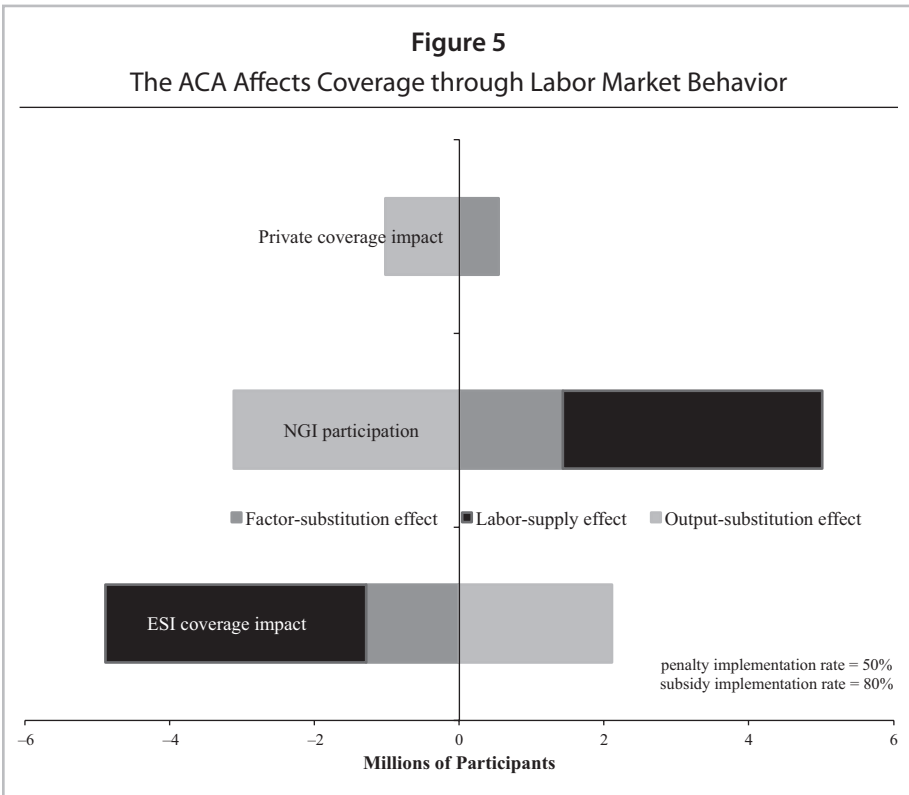
[44] There is a small range of subsidy implementation rates near 0.6 for which the ACA both puts workers on NGI and induces a group of employers to offer ESI; the latter occurs to avoid individual and employer mandate penalties.

the methodology shown in Appendix III. The full effect is the sum of these three components, plus the effects of employer-level coverage decisions (not shown in Figure 5). Factor-substitution adds about one and a half million people (including dependents) to NGI: sectors with NGI increase the low-skill intensity of their workforce while the sectors that retain ESI do the opposite, which by itself moves employees from ESI to NGI sectors even without moving output across sectors. By offering subsidized health coverage to people not working full-time, the ACA reduces aggregate hours worked, in part by moving workers out of ESI jobs into non-employment or part-time work with NGI, and thereby moving about 3.6 million ESI participants to exchange plans.[45]

The ACA raises costs for the sectors that did not have coverage before the ACA (see also Figure 2), which they pay in some combination of insurance administrative costs, employer penalties, and individual mandate penalties. The extra costs are passed on to consumers who shift their demand toward the ESI sectors, which is why the output-substitution effects shown in Figure 5 are positive for ESI coverage. As we show later, the output-substitution effect has relatively little effect on output or productivity, whereas the other — perhaps unintended — effects in Figure 5 do.

While the output-substitution effect on ESI is positive, the NGI sectors experience two output-substitution effects: one because they have higher costs relative to the ESI sectors, but a second in the opposite direction because they have lower costs relative to the sectors that remain uninsured. The net output-substitution effect for the NGI sectors is large and in the direction of decreasing their output share. Combined with the small increase in ESI coverage, output-substitution decreases private coverage by about one million participants.

Figure 5 shows that, overall, nearly two million additional exchange participants come from the reallocation of labor among sectors (including the not-employed sector) in response to sector- and skill-specific ACA taxes and subsidies. Our accounting for behavioral changes is an important reason why we conclude that the exchange plans could ultimately have 30–36 million participants rather than the 25 million predicted by the CBO (2013).[46]

Because ESI may primarily compete with NGI under the ACA, it is possible that the individual mandate — the requirement that uninsured persons pay a tax — has little effect on ESI. The individual mandate penalty encourages employers to offer ESI only in the part of the parameter space in which ESI dominates NGI so that ESI competes with uninsured status. In that case, Figure 4 shows that the ACA increases ESI participation by about one million (half penalty case).

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[45] A model with a binding minimum wage is not part of this paper, but would like show even more of a decrease in ESI for low skill workers because ESI is nonmonetary compensation and because the ACA will be reducing labor productivity in the ESI sector..

[46] On the other hand, if NGI plans were perceived as sufficiently inferior to ESI plans, that would make the output-substitution effect on NGI coverage more negative, and the labor-supply effect less positive, so that all three behavioral components combined would be reducing NGI coverage (relative, say, to the CBO's estimate).

C. Quantitative Estimates of the ACA's Impact on Overall Private Coverage

The ACA also helps NGI compete with the no-insurance option. Without the ACA, persons without insurance forgo tax savings equivalent to a reduction in their salary of about $2,700. Under the ACA, low-skill persons without insurance would forgo a subsidy (net of the employer penalty) of about $8,000 and high-skill persons would incur a net penalty of more than $7,600 relative to their next best alternative (ESI).

This large change is outside the range examined by the previous literature on the sensitivity of coverage decisions to the cost of insurance, so these results are an extrapolation (unlike the ESI impact discussed in Figure 3). But if we were using a constant elasticity of insurance coverage with respect to the non-administrative cost of insurance, we would predict that the ACA would essentially eliminate the uninsured option. We use the more conservative linear functional form for administrative costs noted earlier, so that each dollar of savings increases coverage by approximately the same number of participants.

The stated goal of the ACA is to reduce the fraction of the population without health insurance, and primarily intends to do so by getting more people to participate in private plans. Figure 6 displays the impact of the ACA on private insurance coverage (ESI and NGI combined). Our benchmark parameterization with 80 percent subsidy implementation and 50 percent penalty implementation implies that the ACA ultimately increases the number of people with private coverage by 20 million, which is seven million more than the CBO's estimate (Congressional Budget Office, 2013) and on the high end of the five studies surveyed by Buchmueller, Carey, and Levy (2013).

Along with Figure 4, Figure 6 allows for counterfactual comparisons of existing health-care proposals, as varying levels of subsidy implementation map to changes in the value of exchange plans to recipients, ease of receiving subsidies, aggressiveness of government clawbacks, and actual subsidy levels themselves making NGI more attractive. Penalty implementation captures changes to a number of implicit and explicit penalties for non-coverage. For instance, the June 2017 Better Care Reconciliation Act (BCRA) proposes repealing both employer and individual mandate penalties. Compared to our benchmark scenario, a zeroing out of penalties from 50 percent implementation (while keeping exchange subsidies at 80 percent) reduces private coverage's increase by nearly six million individuals, or 30 percent of our predicted benchmark effect. Figure 4 and Figure 6 make clear that if NGI plans are not valued, increases in the insured rate comes primarily from penalties imposed for noninsurance that expand ESI. If instead the NGI plans are viewed as good substitutes for ESI, then ESI is likely to decline and the coverage rate is likely to increase no matter the penalty level, as workers switch from ESI to exchange plans.

Our implementation rates may also be used to understand the (otherwise unmodeled) size-based provisions of the ACA. If, for instance, half of all pre-ACA uncovered employment was at employers with fewer than 50 full-time-equivalent employees, so that the employer penalties only fell in half-measure on NGI and non-insuring employers, using Table 4 the relative benefit of switching to NGI or uninsured for low-skilled individuals could increase by $1,148 in average annual salary amounts, comparable to our half-penalty amount, in agreement with our benchmark calibration.

Figure 6

Insuring the Uninsured

As a function of subsidy and penalty implementation
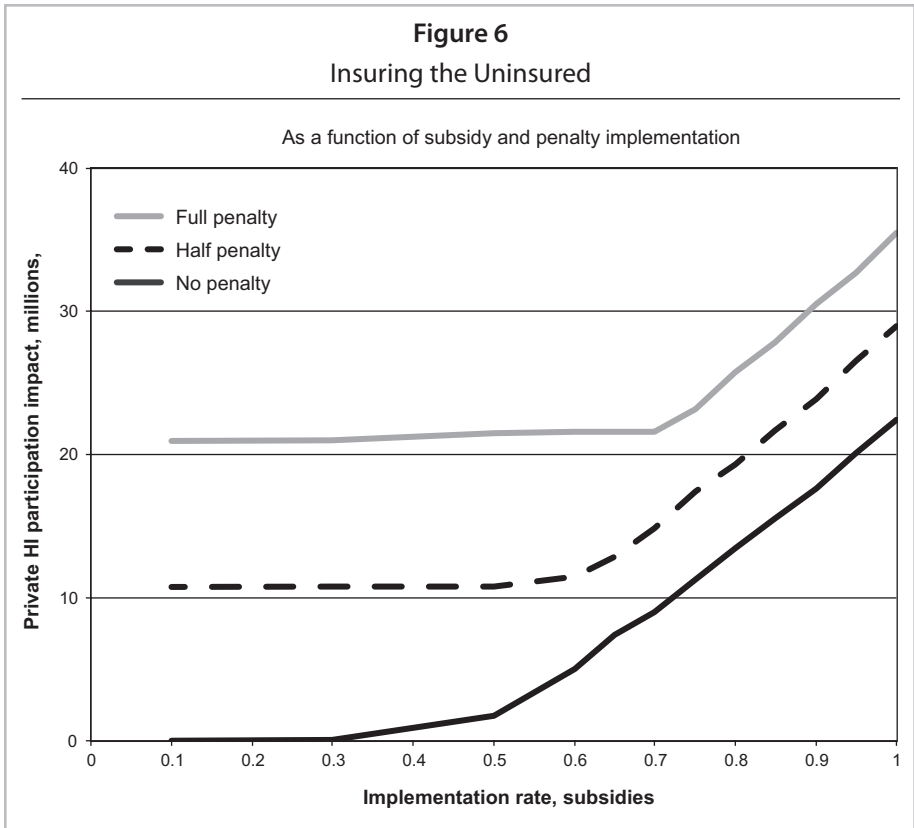
However, the overall coverage impact hinges critically on the degree to which subsidies and penalties are implemented. At a 50 percent penalty implementation rate, the impact on private coverage ranges from 11 to 29 million. The exchange subsidies do not really matter in the range in which ESI dominates NGI because the no-insurance option does not compete with NGI in that case. What really matters in this range are the individual and employer penalties from which the ESI sector is exempt: note the wide gap between the black dashed and black curves in Figure 6 for subsidy implementation rates at or below 0.5.

Over the range of subsidies that are valued enough that NGI can compete with ESI, the employer penalties hardly matter for getting people insured because the no-insurance option competes with NGI, both of which create employer penalties. In other words, in order to achieve the goal of reducing the fraction of the population without health insurance, either the NGI plans must be perceived as valuable, or the employer penalties must be enforced. With "success" on the former, employer penalties would not be necessary for expanding coverage. The full penalty gray line increases coverage by

Table 6

Model Parameters

Baseline Factor Allocation		
Low-skill employees with ESI	20.1	
Total low-skill employees	33.9	March 2012 CPS
High-skill employees with ESI	59.8	
Total high-skill employees	67.5	
ESI participants per covered worker	2.0	Ratio of total ESI plan participants (CBO) to ESI employees
Substitution Parameters		
ESI offer elasticity with respect to the price of ESI	0.33	
Elasticity of factor substitution in production	1.5	
Elasticity of sectoral substitution in utility	1.0	Also Leontief preferences
Wage elasticity of labor supply	0.5	Also inelastic labor supply
Other Technology Parameters		
Baseline marginal revenue product of low-skill labor	32,381	March 2012 CPS annual compensation, including fringes
Baseline marginal revenue product of high-skill labor	82,813	
ESI post-tax expenditures per $ of covered earnings	0.09	
Productivity parameters A and z	1	
Factor intensity parameter α for:		
The most skill-intensive sector	0.09	Fits baseline factor allocation and productivity
The least skill-intensive sector	0.50	
Other Taste Parameters		
Sectoral gradient of consumer preferences	−2.3	Fits baseline factor allocation and skill-specific productivity
Production share parameter midpoint	1.0	
Production share parameter heterogeneity	0.43	
Employer Tax Rates		
See Table 3 for full-implementation tax rates by sector and skill level		
Additional Employee Tax Rates (uniform by sector, and unaffected by the ACA)		
Low skill	50%	Mulligan (2013)
High skill	44%	Mulligan (2013)

nearly 22 million even with almost no subsidies. Alternatively, the no penalty black line increases coverage by the same amount with full implementation of subsidies.

VI. CONCLUSIONS

A previous literature has noted the ACA's creation of remarkable incentives to change behavior among a variety of labor market participants. This paper takes a couple of next steps, one of which is to systematically quantify the incentives in a common metric of "tax wedges" that recognizes interactions between ACA provisions and pre-existing tax laws. For low-skill workers, fully-implementing the ACA's tax wedges would be about the same as tripling employer payroll tax rates. The wedges also vary by sector and skill type, with some sectors and skill types being implicitly taxed dozens of percentage points (of payroll) more than others. The ACA encourages workers to be insured, but not in a factor-neutral way.

Economists cannot reasonably conclude that consumers, employers, and employees would all continue their prior behavior in the face of such large new tax wedges. This paper therefore builds a model of the labor market that is rich enough to explicitly and quantitatively represent a number of the major provisions in the ACA, such as the shared responsibility penalties and the subsidies for making purchases on the Act's "health insurance exchanges." The model allows, in response to the new terms of trade in goods and factor markets, employers to change the quantity and composition of their employment and fringe benefits, employees to change sectors or not work at all in order to obtain the maximum return on their labor hours, and consumers to change the amount and composition of their purchases.

Because of the various political, legal, and economic challenges to implementing the law, the body of our paper displays a range of results according to the perceived value of exchange plans, which are the means by which the ACA's primary subsidies and credits are distributed. At one extreme, which we refer to as a 100 percent subsidy "implementation rate," people value the subsidies like cash because the exchange plans offer value similar to what people would buy on their own. At the other extreme is the zero percent subsidy implementation rate, which represent consumers who value the exchange plans solely because of the individual mandate. For the purposes of forecasting behavioral responses, our preferred long-run subsidy implementation rate is about 80 percent (but see our discussion later). Our preferred rate is greater than 50 percent because the exchanges are intended as places where well-to-do people, such as United States Senators, would be able to purchase health insurance that was to their liking, while at the same time the subsidies received by households can be applied toward any plan sold in the exchanges.[47] On the other hand, our preferred rate is less than 100 percent because it is likely that political uncertainty, equivocal consumer perceptions, bureaucracy costs, product differentiation, and other factors act as a bit of a barrier between

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[47] Also note that employer insurance itself is beginning to look more like the ACA's exchanges, as employers join "private exchanges" in order to encourage employees to shop for doctors and hospitals (Hancock, 2013; Murphy, 2013).

exchange plans and employer sponsored insurance.[48] But the more important conclusions for future policy analysis are that: (a) the subsidy-implementation rate is itself a matter of policy because the ACA's Grassley amendment, provider-network adequacy requirements, healthcare.gov functionality, state-level insurance regulations, and a host of other policies can affect the perceived quality of exchange plans and (b) the coverage effects of health reform are sensitive to perceived quality of health insurance plans.

Figure 7 displays the likely range of the ACA's national coverage impacts, assuming half penalty. It is possible that the law increases ESI participation, but in that case our estimate of the number of people moved from uninsured to private coverage (the sum of ESI and NGI coverage) is at the low end: about 11 million. If the exchange subsidies are perceived to be valuable, then we expect the ACA to expand private coverage by 20 million or more, but in the process to reduce ESI coverage by more than 22 million. Another important determinant of the ACA's impact on ESI is the degree, if any, to which ESI participants can work for the same employer as workers receiving the ACA subsidies.

Even if every single employer retained its current health insurance offering, behavioral changes could add about two million participants to the new exchange plans as employers pass on costs to their customers and change the size and composition of their workforce, and individuals react to the penalty for being uninsured.

Our model's presence in the middle ground between models that hold the labor market constant and models that explicitly account for richer details regarding health providers, worker heterogeneity, employer heterogeneity, and various means of dynamic adjustment, allows it to play an important diagnostic role. For instance, it highlights conditions under which the primary policy lever expanding coverage is the employer penalty and other conditions in which it is the perceived value of insurance plans; in the latter case it would be especially important to carefully model the industrial organization and regulatory forces that determine the non-price attributes of health insurance products. The approach also permits a ready demonstration of why some behavioral effects may largely offset, while others are quantitatively significant. For instance, we find that for private health insurance coverage, labor-supply effects likely offset while output-substitution effects (the fact that different industries will expand and contract based on their factor use) likely will not. Results like these help to understand which parts of a more granular model would be worthy of the most emphasis.

Our analysis also helps reconcile the literature's apparently disparate approaches for understanding the consequences of the ACA for ESI coverage. If the exchange subsidies were perceived to be small enough, we predict that the ACA would increase ESI coverage due to the individual and employer penalties, which would agree with those who conclude that nationwide ESI coverage will react to the ACA much the same way

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[48] Pear (2013) gives examples of insurers whose plans on the exchanges offer narrower provider networks than the plans they offer through employers, and examples of exchange plans that exclude major medical centers. See also Terhune (2013) and PricewaterhouseCoopers (2013). It is possible that narrow provider networks would increase exchange participation, rather than decrease it, by giving healthy persons an opportunity to buy relatively inexpensive coverage (Mathews, 2013).

Figure 7

The ACA's Coverage Impact

by subsidy implementation rate (0.5 penalty implementation)
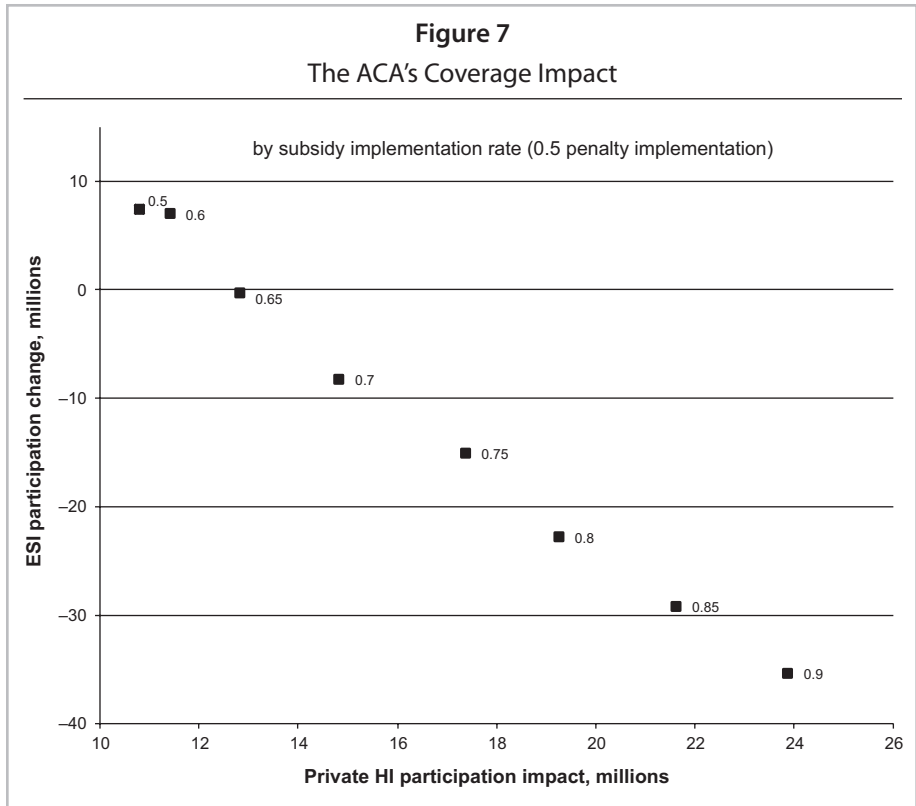
that statewide coverage reacted to Massachusetts 2006 health reform.[49] Ignoring the behavioral effects, this parameterization of our model also has some common features with the CBO's (2013) assumption — implicit in their use of historical estimates of the "demand for" ESI — that the primary alternative to ESI for employees at marginal firms is no private insurance. When the subsidies are valued by eligible families closer to their cost to the treasury, an employer's decision to keep or drop coverage is (holding factor prices constant) entirely about the skill intensity of his production technology and has little to do with his employees' preferences to be insured because under the ACA they will be insured either way.[50]

More work is needed to fully understand the sectoral effects of the ACA. This paper does not examine the Medicaid expansions or some of the loopholes that may help employers avoid the penalties.[51] The paper does explicitly model health and insurance sectors, elderly workers, or workers who are not a head of household or their spouse.

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[49] See Dubay, Long, and Lawton (2012), Gruber (2011), and Mulligan (2015, Chapter 10).

[50] This is essentially the approach of the money's worth calculations by Rennane and Steuerle (2011) and others that suggest that ESI participation could drop sharply as a consequence of the ACA.

[51] For discussion and analysis of some of the ACA's loopholes see Appendix III of Gallen and Mulligan (2013).

Similarly, while many of our heterogeneous sectors could be interpreted as "entrepreneurial" and intensive in small establishments which might expand as a consequence of the ACA, we do not model the ACA's size-based provisions in any detail. Nevertheless, our model provides a framework for understanding the quantitative implications of several of the more important provisions of the ACA and their long-run impacts on a heterogeneous and flexible labor market.

DISCLOSURES AND ACKNOWLEDGMENTS

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APPENDIX I: MODEL CALIBRATION

Table 6 displays our benchmark model parameters.[52] The baseline factor allocation refers to millions of non-poor non-elderly household heads and spouses represented in the March 2012 CPS who worked some time during calendar year 2011, and then rescaled by a factor of 1.03 to account for population growth between 2012 and 2015. They total 101 million.[53] A worker is considered "with ESI" if he or she is covered by ESI, even if a family member is the policy holder. Tax rates are measured accordingly (see Tables 3 and 4). For example, the average ESI subsidy implicit in the exclusion of ESI premiums from payroll and income tax bases is based on the average ESI premiums ($7,980, regardless of whether they are "paid by" employer or employee) among employees with ESI. We count zeros in that average for employees that obtain their ESI through a family member.

Note that illegal immigrants are represented by our calibration, to the extent that illegal immigrants are detected by the CPS and are above the poverty line. Part-time workers, some of which have ESI, are also included, although they are a small minority of working non-poor non-elderly heads and spouses (even low-skilled workers without ESI are 83 percent full-time). However, conditional on skill and ESI, part-time workers are not modeled separately from full-time workers, which means that our calibrated model cannot account for the possibility that the incidence of part-time work for sectors on the margin of ESI might be different from the population average. We do have endogenous labor supply, and some of that response can be interpreted as move-

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[52] "Benchmark" refers to our preferred or focal parameter vector. "Baseline" refers to economic outcomes without the ACA, which we associate with economic outcomes before January 2014 when the premium subsidies go into effect.

[53] Because we use calendar year earnings to distinguish between baseline levels of high- and low-skilled workers, it is possible to misstate the true proportion. If a low-skilled worker was unemployed for the entire calendar year, they are not in our calibration. An unemployment spell may also reclassify a high-skilled worker at the margin of being classified as a low-skilled worker.

ments of workers between full- and part-time status, but we cannot decompose the labor supply response between weekly hours and other margins.

We estimate ESI premiums and hypothetical NGI premiums using the Kaiser Foundation's silver plan premium calculator (hereafter, "KFF calculator") for calendar year 2014. The calculator reports, among other things, the full cost premium (i.e., with no premium assistance) for individuals on the basis of their age. We convert the premium into "expected" (in the actuarial sense) medical expenses by dividing by 0.7. We sum the expected medical expenses across family members who participate in an actual ESI plan or would, under the ACA, hypothetically participate in an NGI plan. The ESI premium is assumed to be 83 percent of expected medical expenses, with the other 17 percent covered by various forms of out-of-pocket payments (Gabel et al., 2012). The NGI premium (without subsidies) is assumed to be 70 percent of expected medical expenses.

The hypothetical NGI subsidy is zero if family income (including the cash value of employer ESI contributions) is outside the range for which premiums are capped by the ACA, or if the caps for premiums and out-of-pocket costs exceed the expected medical expenses themselves. The subsidy is also zero for a married person with an ESI-worker spouse because that person can leave or enter the NGI sector with no consequences for the family's exchange subsidy because the spouse's job and the ACA's so-called "family glitch" by themselves render the entire family ineligible for exchange subsidies.[54] Otherwise, the subsidy relevant for an earner's decision to work in one sector or another is the difference between expected family medical expenses and the applicable cap based on family income.[55]

Our model's employer taxes by themselves create a significant wedge between labor supply and labor demand. Because the employee-weighted average of the full-implementation tax rates are close to the ACA overall average impact of 4.9 percentage points reported in Mulligan's (2013) study of marginal labor income tax rates (assuming somewhat less than full implementation), we do not model any additional ACA impact on after-tax shares and therefore calibrate s_L and s_K as 0.50 and 0.44, respectively, regardless of the presence of the ACA.[56]

APPENDIX II: SENSITIVITY ANALYSIS

Our model depends on calibrating a number of parameters to the literature or to fit empirical moments. This section discusses several motivations for deviations in various parameters from our benchmark specification, potentially important parameters, and how our results for the ACA's impact vary with the parameter values. Our results are summarized in Appendix Table 1, with benchmark specifications bolded.

Distribution of Employer Administrative Costs

We calibrate the slope of employer administrative costs, δ_i, to the elasticity of ESI takeup with respect to price (1/3, as reported in Congressional Budget Office (2007)). We test how our coverage impact changes as we change responsiveness to the price of ESI, examining a range of 0.09 to 0.58.

Our coverage results for the elasticity of ESI takeup with respect to price are depicted in the first panel of Appendix Table 1. Because the elasticity of ESI takeup controls the proportion of

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[54] See also Burkhauser, Lyons, and Simon (2011).

[55] Note that, for the purposes of calculating wedges between sectors, the family subsidy is counted twice for dual-uninsured-worker couples and counted zero for dual-ESI-worker couples because either spouse can unilaterally render the family ineligible for exchange subsidies by taking an ESI job.

[56] Because neither of these calculations account for illegal immigrants, the aggregate and skill-specific labor supply results are best understood as predictions for the legally resident (non-poor) population.

Appendix Table 1

Sensitivity Analysis

The table entries show the ACA's impact on economic outcomes, with one outcome per column. Each panel deviates one model parameter from its benchmark value (shown in bold).

		ESI, Millions	Private Coverage, Millions	Low-Skill Wage/ High-Skill Wage, log
	0.09	−10.2	2.7	−0.17
	0.21	−10.5	5.8	−0.16
Elasticity of Takeup	**0.33**	**−11.5**	**9.6**	**−0.14**
	0.46	−12.2	15.7	−0.12
	0.58	−13.0	21.6	−0.09
	1.0001	−10.9	9.4	−0.13
	1.25	−11.3	9.6	−0.14
Elasticity of Substitution	**1.5**	**−11.5**	**9.6**	**−0.14**
	1.75	−11.6	10.0	−0.15
	2	−12.2	10.0	−0.15
	0	−10.2	9.6	−0.19
	0.25	−11.2	9.6	−0.16
Labor Supply Elasticity	**0.5**	**−11.5**	**9.6**	**−0.14**
	0.75	−12.0	9.6	−0.13
	1	−11.9	9.6	−0.11
	0.01224	−11.7	10.4	−0.141
	0.00918	−11.6	10.1	−0.142
$\tau_{uL} - 0.0765$	**0**	**−11.5**	**9.6**	**−0.144**
	−0.0092	−11.3	9.4	−0.145
	−0.0184	−11.2	8.9	−0.146

marginal firms, our results for the impact in private coverage varies greatly with the elasticity. Reducing the elasticity by 72 percent from one-third to 0.09 reduces the impact on coverage by nearly 72 percent, from 9.64 to 2.72. There is some convexity in response, as increasing the elasticity by 76 percent increases coverage by 124 percent. The impact on ESI is much more robust, as the elasticity of takeup does not affect firm-worker decisions along the ESI-NGI margin. Similarly, the log ratio of low-skilled to high-skilled wages varies, from a decline of 0.094 log points to a decline of 0.167 log points.

Elasticity of Substitution between High- and Low-Skilled Labor

We calibrate the elasticity of substitution between high- and low-skilled labor to 1.5, a value that lies in the middle of the range reported in Acemoglu (2002). Because our tax measurements

vary so much by sector and by skill type (with ESI's tax advantage increasing from 3.1 percent pre-ACA to 10 percent post-ACA for the high-skilled, while decreasing from 7.5 percent to –21.3 percent over NGI for low-skilled), we predict significant substitution between types of labor by industry, controlled primarily by the elasticity of substitution between high- and low-skilled labor.

Our coverage results for the elasticity of substitution are depicted in the second panel of Appendix Table 1. We test elasticities between one and two, finding that they do not greatly change our coverage or wage ratio results. For instance, with a benchmark result of a decline in ESI of 11.5 million and an increase in coverage of 9.6 million, decreasing the elasticity of substitution to one slightly mitigates the decline in ESI to –10.9 million and the increase in private coverage to 9.6 million. On the positive side, the results are largely symmetric. Similarly, the impact in the log ratio of low-skilled to high-skilled wages ranges from –0.13 to –0.15.

Wage Elasticity of Labor Supply

We calibrate to a wage elasticity of labor supply of 0.5. Because income-contingent exchange subsidies act as a significant implicit marginal tax on labor income for low-skilled workers, this elasticity is potentially important. We examine a range of 0 to 1.

Our coverage results for the elasticity of substitution are depicted in the third panel of Appendix Table 1. While we find our coverage results change very little in response to the wage elasticity of labor supply. As we discuss in our behavioral decomposition in Figure 5 of the main text, labor shifting to non-employment or part-time employment with NGI will cause a shift between ESI and NGI, but not change the impact on private coverage. As a consequence, increasing the elasticity of labor supply from zero to one would cause 1.76 million more people to leave ESI while leaving private coverage unchanged.

Skill-Specific Demand for Insurance

Our model loads heterogeneity on firm administrative costs, δ_i, and models the cost of staying uninsured χ as a constant. As a consequence, but for the different benefits of insurance on households' taxable income, households value insurance (relative to noninsurance) in proportion to their wage, with the same proportionality factor for all of the households in our model.

It is possible, however, to consider skill-specific proportions by interpreting the tax parameter $\tau_{u,L}$ more broadly. If $\tau_{u,L}$ were lower than our benchmark calibration, which considers only public-finance determinants of $\tau_{u,L}$, then low-skilled households would (proportionally) prefer non-insurance more than high-skilled households.[57] Because we calibrate to the high- and low-skilled coverage rate, the covered sector becomes relatively more low-skill intensive to keep the same proportion of low-skilled workers in the sector.

The fourth panel of Appendix Table 1 depicts the how predicted coverage impacts are affected by the preference for uninsured status, controlled by $\tau_{u,L}$. The top and bottom rows display the ACA's impact for a significant difference in initial value, equivalent to more than 1.8 percent of pre-tax low-skilled wages, (i.e., the low-skilled value coverage nearly $600 less (or more) than our benchmark calibration, while holding high-skilled valuation constant). When non-coverage is more (less) desirable for low-skilled workers, the ACA impacts private coverage by 10.4 million

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[57] This isomorphism between skill-specific preferences and skill-specific taxes does not apply to welfare analysis or analysis of the government budget, neither of which is the subject of this paper.

(8.9), rather than 9.6, and ESI coverage by −11.7 (−11.2) rather than −11.5. Predictions for ESI and the low-skill wage/high-skill wage ratio impact are relatively unchanged. Because there is little change in the impact on ESI or log wage ratio in response to a change in the initial values of health insurance for the low-skilled, the ACA's impact on the sectoral profiles of output and employment (not shown in the table) are not sensitive to $\tau_{u,L}$.

APPENDIX III: DECOMPOSING ACA IMPACTS INTO BEHAVIORAL COMPONENTS

Our model has several types of decisions by employers, employees, and consumers. Aggregate labor supply decisions can be isolated by comparing the model with a positive wage elasticity of labor supply to the otherwise identical model with inelastic labor supply. Sectoral shifts in consumer demand by sector can be isolated by comparing the model with a positive substitution elasticity in consumer preferences to the otherwise identical model with Leontief consumer preferences. We isolate employer decisions to drop ESI by comparing our equilibrium model with a variant of the model that requires each sector to have the same ESI offering under the ACA as they have in the equilibrium model without the ACA.[58]

Among these three behaviors, we can shut down any of the three, or all three at a time, or none. Because the behaviors interact with each other, this makes four ways to calculate the impact of any one of the behaviors; we take the average of the four.[59]

When the model has inelastic labor supply, Leontief consumer preferences, *and* fixed ESI offerings, the ACA's impact on coverage and other variables are the combination of two additional forms of behavior: factor-substitution effects and the decision to be uninsured. In order to isolate the factor-substitution effect on employment or any other outcome, we take each sector and calculate what its outcome would be under the ACA if it changed its factor ratio to coincide with its non-ACA factor mix, holding constant its employee compensation ($wL + rK$, evaluated at ACA factor prices). We do the same by achieving the non-ACA factor ratio with the ACA wage bill, and average the two results (the two components in the average are essentially the same). Factor substitution effects are summed across groups of sectors to get aggregate factor substitution effects for the group, using weights when appropriate.

For example, if employment is the outcome, sector i's factor substitution effect is:

$$(16) \quad (K_i' + L_i')\frac{1 + R_i^{-1}}{2} - (K_i + L_i)\frac{1 + R_i'}{2}$$

$$R_i \equiv \frac{wL_i' + rK_i'}{wL_i + rK_i}, \quad R_i' \equiv \frac{w'L_i' + r'K_i'}{w'L_i + r'K_i},$$

where primes (′) indicate outcomes with the ACA and no prime indicates no-ACA outcomes. The factor substitution effect on, say, ESI coverage is the sum of the factor substitution effect of each ESI sector, rescaled to convert from employment to plan participants.

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[58] That is, we take the no-ACA equilibrium sectoral profile for *ESI*(*i*) and calculate an ACA equilibrium that imposes *ESI*(*i*) on employers. Those sectors that have *ESI*(*i*) = 0 choose NGI or uninsured status in order to minimize their cost.

[59] For example, to calculate the aggregate labor supply component of, say, the ESI coverage impact, we compare a model with inelastic labor supply to an otherwise equivalent model with elastic labor supply. The two models being compared can both have Leontief consumer preferences, or both impose the non-ACA *ESI*(*i*) profile, or both have Leontief preferences and impose a profile, or both have endogenous sectors and endogenous ESI. In practice, the four approaches yield similar quantitative estimates.