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ABSTRACT

Our paper documents the large labor market wedges created by taxes, subsidies, and regulations included in the Affordable Care Act. The law changes terms of trade in both goods and factor markets for firms offering health insurance coverage. We use a multi-sector (intra-national) trade model to predict and quantify consequences of the Affordable Care Act for the patterns of output, labor usage, and employee compensation. We find that the law will significantly redistribute from high-wage workers to low-wage workers and to non-workers, reduce total factor productivity about one percent, reduce per-capita labor hours about three percent (especially among low-skill workers), reduce output per capita about two percent, and reduce employment less for sectors that ultimately pay employer penalties.

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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 unemployed, and the structure of wages.

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 effects of the ACA hold constant most, if not all, labor market outcomes.[1] The purpose of our paper is to fill this gap by quantifying new incentives created by the ACA and modeling labor market behavioral responses to them.

The ACA is a large and complex piece of legislation. This paper emphasizes four types of provisions in the law: the means-tested subsidies 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 go into effect January 1, 2014), the monetary penalties on employers who do not offer health insurance to their full-time employees (going into effect January 1, 2015), the monetary penalties on uninsured persons, and the major medical reinsurance assessment.[2] 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

[1] 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 effects on the composition of employee compensation and the overall cost of health insurance, but not the level of employee compensation, the size of the workforce, etc. See also the studies surveyed by Buchmueller, Carey and Levy (2013).
[2] The ACA creates health insurance "marketplaces" or "exchanges" where individuals can purchase health insurance. The insurance premium subsidies created by the law are administered so that they reduce what participants pay for insurance plans obtained on the exchanges.

the exchange subsidies.[3] We model the possibility that various ACA provisions may not be fully implemented, enforced, or fully considered by households.

Our model features a health insurance decision that depends on taxes, subsidies, and administrative costs, broadly interpreted. 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. In our model, producers are heterogeneous in terms of the skill-intensity of their production technology and their costs of administering health insurance. Because administrative costs are passed on to consumers through output prices, market forces induce the producers with low administrative costs to hire more employees, especially those with more skill.

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 employer-sponsored insurance (hereafter, ESI) through four types of behavioral responses: the ESI-offer decision, factor market comparative advantage, consumer substitution, and labor supply.

Our model also features non-group health insurance 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 are related to what they would be if they had obtained insurance through their employer. Absent the ACA, our model offers little reason for workers to obtain non-group health insurance 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 to be uninsured 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 health insurance and the composition of that coverage.

Our model features heterogeneous sectors, some of which can be interpreted as "entrepreneurial" or intensive in small establishments. However, we do not model the ACA's

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

significant employer-size provisions in any detail.[4] Our paper does not specifically model health outcomes. 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.

Section I of the paper sets up the model with an algebraic representation of tastes, technologies, public policies, and market equilibrium. Section II characterizes an equilibrium's qualitative properties. Section III calibrates the model, with special emphasis on the startling size of the tax wedges between sectors and skill groups. Section IV looks at wages from the employer side of the market, and Section V from the employee side. Section VI presents quantitative predictions for output and productivity. Section VII concludes. A companion paper (Gallen and Mulligan 2013) presents our model's predictions for the impact of the ACA on the amount and incidence of insurance coverage.

Model Setup

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 health insurance administration, 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

[4] See Gallen (2013), who also models the distinction between part-time and full-time work.

associated with being uninsured. In reality, some of these costs of being uninsured are monetary costs, and others utility costs, but for simplicity we model χ as foregone output. 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). All else the same, employers suffering from ESI administration disadvantages would essentially disappear from the marketplace, but of course all else is not the same. Firms may produce distinct products, and consumers may be willing to purchase the goods and services produced by firms that cannot efficiently administer ESI. 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 utility and (b) allowing consumer preferences to vary across sectors.

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

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

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 share parameters.[5] $INS(i)$ is an indicator variable for

[5] As shown in equation (1), 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. Equation (1) is not well suited for

whether firms in sector i offer ESI or, under the ACA, have employees who obtain affordable non-group coverage through the "exchanges."[6]

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 strictly one-to-one monotonic relationship between α and δ, so that i also denotes quantiles of the α distribution.

Public Policy Parameters

w and r denote the factor rental rates (inclusive of the costs of employee fringe benefits, if any) of low- and high-skill labor, 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:

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

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 below on the INS decision). The four primary examples of these tax rates are employer payroll taxes, the per-employee penalties for failing to offer affordable health insurance, subsidies for purchasing non-group insurance, 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 below).

analysis of public policies, such as capital income taxes, that would change the long run capital-labor ratio. As noted below, our interpretation is related to interpretations of some of the sectoral substitution elasticities.

[6] Medicaid and uncompensated care are included in the INS = 0 category. Thus, INS = 1 might be described as having private health insurance.

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.[7] 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 $(1\text{-}s_L)w$ and $(1\text{-}s_K)r$ 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). Employee compensation is many times defined to exclude employer penalties and employer payroll taxes, and our notation for that compensation concept is shown in Table 1's second row.

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, depending on the sector in which they are employed. 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. Our Harberger (1962) equilibrium assumption that, in the presence of sector-specific taxes, employees are indifferent between sectors is visible in the third and fourth rows because the employee amounts are the same in each column.

Household Preferences

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

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

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

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 (3) subject to the production functions (1), and taking the taste and technology parameters as given. The efficient allocation of INS would be to the sectors $i \le i^*$, with $\delta(i^*) \equiv \chi$.[8] 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:

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

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

Equilibrium Defined

The insurance choice is one of three options: ESI, non-group insurance (hereafter, NGI) and uninsured. Associated with these three options are three statutory employer tax rates 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.

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

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

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 (3) subject to the household budget constraint (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 (1), (d) each industry's coverage decision and composition of labor achieves the minimum production cost, (e) and each industry has zero profits.

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 narrowly defined, 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 (broadly construed to include insurance loadings) for the non-group coverage as they do for ESI. The important assumption is not whether employer (rather than employee) pays the various administrative costs associated with non-group insurance, but a "no free lunch" assumption that the non-group insurance offered on the exchanges will not make insurance administration and overhead costs disappear.[9]

The exchange plans and the subsidies that go with them are administratively complicated (how many workers know their tax unit's annual modified adjusted gross income as a ratio to the federal poverty line?), which is why the federal government is investing a lot in information technology assets and is attempting to create an industry of navigators, assisters, and counselors to help reduce the costs of citizens' learning about and enrolling in the exchange plans. From

[9] As shown below, we find potentially large shifts from ESI to NGI under the ACA, despite assuming no free lunch.

this perspective it might appear that some of NGI administrative costs are falling on the plan participants, in which case our assumption of the placement of the NGI administrative costs should not be taken literally. However, we believe that employers have a comparative advantage, and ultimately an economic incentive, in taking on administrative costs on behalf of their employees: that's why many of them (especially the large employers) continue to offer health insurance to their employees even when the implicit tax subsidy gets small. We suspect that, as a substitute for offering ESI under the ACA, many employers will advise and assist their employees to obtain NGI coverage and the associated tax subsidies, which is behavior conforming literally with our model's placement of the NGI administrative costs.

Qualitative Equilibrium Characteristics

Employment 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, and thereby its own marginal and average costs of production. The log per-unit-output cost function for an employer facing a production function of the form (1) is the minimum of the three possibilities:

$$-\ln z + \min \left\{ \begin{array}{l} \chi + \dfrac{1}{1-\sigma} \ln\left[(\alpha A)^{\sigma} \left[(1+\tau_{uL}) w \right]^{1-\sigma} + (1-\alpha)^{\sigma} \left[(1+\tau_{uK}) r \right]^{1-\sigma} \right], \\ \delta + \dfrac{1}{1-\sigma} \ln\left[(\alpha A)^{\sigma} \left[(1+\tau_{nL}) w \right]^{1-\sigma} + (1-\alpha)^{\sigma} \left[(1+\tau_{nK}) r \right]^{1-\sigma} \right], \\ \delta + \dfrac{1}{1-\sigma} \ln\left[(\alpha A)^{\sigma} \left[(1+\tau_{cL}) w \right]^{1-\sigma} + (1-\alpha)^{\sigma} \left[(1+\tau_{cK}) r \right]^{1-\sigma} \right] \end{array} \right\} \tag{5}$$

which are no coverage, NGI coverage, and ESI coverage, respectively. Each of the coverage possibility terms in (5) reflects the fact that the tax rates associated with a coverage decision affect the optimal the 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 administrative costs. Absent the ACA, non-group insurance receives no subsidy and is therefore (in our model) dominated by ESI. The equilibrium coverage decisions in this case look like the green schedule in Figure 1 with ESI offered by the skill-intensive industries and no insurance offered by the remainder.[10]

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 green and orange schedules in Figure 2.

Equilibrium requires that every sector have the same tax-adjusted marginal rate of transformation between low and high-skill labor, which is equal to a common marginal rate of substitution in utility.

$$\frac{\alpha(i)A(i)}{1-\alpha(i)}\left(\frac{K(i)}{L(i)}\right)^{1/\sigma} = \frac{1+\tau_{iL}}{1+\tau_{iK}}\frac{1-s_K}{1-s_L}\frac{\gamma_L}{\gamma_K}\left(\frac{L}{K}\right)^{1/\eta} = \frac{1+\tau_{iL}}{1+\tau_{iK}}\frac{w}{r}$$
$$L \equiv \int_0^1 L(i)di\,, \quad K \equiv \int_0^1 K(i)di \tag{6}$$

where each employer's tax rates depend on his ESI or NGI decision.

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

[10] 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 below).

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.

Determinants of Aggregate Labor Supply

By imposing the equilibrium allocation of labor across sectors (see our companion paper Gallen and Mulligan (2013) for the cross-sectional labor equilibrium conditions that can be derived from (6)), we can examine the equilibrium supply of labor with (7):

$$\begin{aligned} &\max_{L,K} \quad \ln\frac{Y}{p} - \gamma_L \frac{\eta}{\eta+1} L^{(\eta+1)/\eta} - \gamma_K \frac{\eta}{\eta+1} K^{(\eta+1)/\eta} \\ &\text{s.t.} \quad Y = (1-s_L)wL + (1-s_L)rK + b \end{aligned} \tag{7}$$

where b is a lump sum government benefit (or, if negative, a lump sum tax). Y is aggregate consumer expenditure and p is the price index for consumer goods based on the utility function (3). L and K are the total amounts of low-skill and high-skill labor, respectively, with each sector's labor counted equally. The labor supply first order conditions are:

$$\begin{aligned} &\frac{(1-s_L)}{Y/w} = \gamma_L L^{1/\eta} \quad , \quad \frac{(1-s_K)r/w}{Y/w} = \gamma_K K^{1/\eta} \\ &\frac{(1-s_L)w}{(1-s_K)r} = \frac{\gamma_L}{\gamma_K}\left(\frac{L}{K}\right)^{1/\eta} \end{aligned} \tag{8}$$

Equations (8) are aggregate labor supply relationships that include a substitution effect through an after-tax wage rate and an income effect through consumer expenditure. The government budget constraint and national income identity are:

$$\begin{aligned} b &= \int_0^1 \left[(\tau_{iL} + s_L)wL(i) + (\tau_{iK} + s_K)rK(i)\right] di \\ Y &= \int_0^1 \left[(1+\tau_{iL})wL(i) + (1+\tau_{iK})rK(i)\right] di \end{aligned} \tag{9}$$

Calibration and Wedge Measurement

In order to make quantitative predictions, we assume functional forms for the distribution functions δ(i) and α(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. 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.[11]

Taste and Technology Parameters

We assume that the taste function ρ(i) is quadratic in i. We assume that the skill-intensity function α(i) and administrative cost function δ(i) are linear. Our companion paper Gallen and Mulligan (2013) gives more detail about calibrating and interpreting these functions, which are especially important for quantifying the ACA's impact on overall coverage.

Unel (2010) reviews econometric estimates of the elasticity of substitution in production between high- and low-skill labor (σ in our notation) and reports a range of 1.4 to 1.7 (with some indication that it has increased over time). Acemoglu (2002) reports a wider range of 1 to 2, which we use because our definition of skill groups is not exactly the same as in the econometric studies. Our benchmark value of σ is 1.5.

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 spouses. Potential workers are quantified

[11] 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.

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 three percent population growth between 2012 and 2015 (that is, 98 million rescaled to 101 million).[12] 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.

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.[13] We do not further distinguish workers according to weeks worked or weekly 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.[14] Therefore, if our model predicts, for example, that a 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.[15]

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

[12] 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 or spouse.
[13] For unmarried households, head of household personal income is used.
[14] These averages are reported in the middle of Table 8. All dollar amounts in this paper are in 2014 dollars.
[15] Another example: we interpret a one 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.

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 whether the various component proportions accumulate additively or multiplicatively.[16] 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 for the former. We assume that the various ACA taxes and subsidies are additive with each other, but multiply the non-ACA tax rates.[17]

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

[16] 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.
[17] 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.

$\{\tau_{uL},\tau_{uK}\}$. Finally, the major medical reinsurance assessments are included in the ESI sector tax rates $\{\tau_{cL},\tau_{cK}\}$.

The top and middle panels of Table 2 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 2's middle panel) is the sum of 7.65% (7.7% when rounded to the nearest tenth of a percent) and the ratio of the corresponding tax amount to the average total compensation for the skill level.[18]

We calibrate the tax rates with the ACA by building on the without-ACA rates and information about the likely combined ACA tax and subsidy amounts *R* (see also Table 3) for each sector and skill level:

$$1+\tau_{iL}=\left(1+\overline{\tau}_{iL}\right)\sqrt{\frac{1+R_{iL}/\overline{w}}{1-R_{iL}/\overline{w}}}\,,\quad 1+\tau_{iK}=\left(1+\overline{\tau}_{iK}\right)\sqrt{\frac{1+R_{iK}/\overline{r}}{1-R_{iK}/\overline{r}}} \tag{10}$$

where the overbars indicate without-ACA values.[19] Table 2'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. However, the table omits the sector-neutral employee subsidy noted above, so the most important information in Table 2'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

[18] 7.65% 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.

[19] The ACA's penalties and subsidies are usually dollar amounts as opposed to the more analytically convenient percentages of compensation. 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 (10) 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.

percentage points. Among low-skill workers, the ESI advantage goes from 7.5 percentage points to -21.3 (NGI) or 29.1 percentage points.

The middle and bottom panels of Table 2 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 (zero taxes would be a special case). 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 four 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.[20] 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 a consequence of favoring the NGI sectors over uninsured sectors – presumably the ACA is designed to discourage the uninsured – but is a consequence of failing to favor the NGI sectors in a factor-neutral way. As we show below, the distortion of comparative factor advantage is the primary reason why, in our model, the ACA reduces productivity.

Table 3 gives more detail behind the tax and subsidy amounts in Table 2 by showing the legislative components, conversion factors, and the sectors to which each component applies. A $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%) and dividing by one minus the same marginal tax rate in order to convert it to an equivalent salary increment.[21] The employer shared

[20] 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.
[21] For example, a person earning $50,000 per year with only $41,000 taxable would, at a 25% marginal personal tax rate, have the same income after personal taxes as someone earning $53,000 with no exclusion. $3,000 is the salary

responsibility payment is part of the NGI and uninsured annual amounts in Table 2. 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 on business net income is 39%).

With the ACA, ESI employers owe about $126 per employee-year as an insurance participation assessment.[22] The next three rows of Table 3 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 – $7,795 on average heads and spouses in households below 300% 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.[23]

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, 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.[24]

Illegal immigrants are not subject to the individual mandate and cannot purchase plans in the ACA's marketplaces. They are also among the least skilled workers, and many of them work in sectors that are far enough to the right in Figure 2 that they are not on the margin of being insured (either NGI or ESI). Arguably illegal immigrants are not relevant for any of the margins examined in our model, which would mean that our model should be calibrated with the full penalty and subsidy amounts without any discount for the fraction of work that is done by illegal immigrants. As a middle ground, we discount the individual mandate penalty (but not the

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increment equivalent value of the $9,000 tax exclusion. The two amounts shown in the upper left of Table 2 are the $2,660 adjusted for the average annual weeks worked among non-elderly heads and spouses (by skill level).

[22] The assessment is $63 per plan participant, and we assume that each employee with coverage has covered an average of 1.0 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.

[23] The exchange subsidies have dollar amounts that are skill-specific. Table 3 displays only the low-skill average amounts of $7,968 and $10,624; the high-skill average amounts are $681 and $908.

[24] 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.

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.[25] When converted to a salary equivalent, the amount is $1,348.

The first "TOTAL" row in Table 3 sums the applicable salary equivalent rows above for ESI, NGI, and uninsured sectors. However, these amounts cannot be compared to the wage rate w in our model, which is the average annual compensation of low-skill workers including the weeks of the year (averaging 4.7) that they are not employed. The Table's final row therefore rescales the row above by the average weeks employed per year among low-skill household heads and spouses.[26] Also note that the bottom total row appropriately quantifies incentives to move employees across sectors: for example, if a low-skill employee 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 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. 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.[27] 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 above.[28]

[25] See also our discussion below of the aggregate labor supply distortions.
[26] High-skill persons are employed an average of 49.9 weeks per year.
[27] Members of Congress are required to obtain their family's health insurance through the exchanges (Pear 2012) – a requirement that we presume was intended to ensure that the exchange plans are desirable to middle-income families – but perhaps we do not fully anticipate the ultimate design of those plans, or the public's perception of their design.
[28] For example, a 50% 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

Our model's employer taxes by themselves create a significant wedge between labor supply and labor demand. Assuming full implementation, Table 4 shows that the ACA's impact on the marginal labor income tax rate (expressed as a percentage of total compensation) is 12.6 for low-skill persons and 1.0 for high-skill persons. Because the employee-weighted average of these full-implementation values are close to the ACA overall average impact of 4.9 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.[29]

Real Wage Rates and Labor Demand

Three concepts of real wages help to understand labor market behavior: inflation-adjusted employer cost, inflation-adjusted employee compensation inclusive of the exchange subsidy, and the inflation-adjusted reward to working. Recall that the latter two wage concepts do not vary across sectors, even though many workers are not eligible for the subsidies due to the sector of their employment, because cash wages adjust so that workers are indifferent between sectors.

Figure 3 plots results for the ACA's impact on the log of the inflation-adjusted employee compensation inclusive of the exchange subsidy, respectively, holding aggregate labor supply fixed.[30] Figure 3's results can be interpreted as ACA impacts on worker living standards because the wage measures are inclusive of the subsidies and are adjusted for inflation. The results in Figure 3 can also be interpreted as labor demand shifts, because they have the ACA's taxes and subsidies but fixed aggregate labor supply.

Employer penalties are the primary determinants of wages when subsidy implementation rates are low enough that ESI still dominates NGI. The left half of Figure 3 thereby shows how

CPS data on low-skill workers (we do the same procedure for high-skill workers). One interpretation of the 50% subsidy implementation rate is that workers value the exchange subsidies at only 50 cents per dollar we imputed for them in our CPS averages.

[29] 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.

[30] The real wage inclusive of subsidies is calculated for low-skill (high-skill) workers in our model by deflating the sum of the NGI sector cash wage *w* (*r*) and the value of exchange subsidies by the price index *p*, respectively. The real wage excluding subsidies is w/p (r/p), respectively.

the penalties reduce log real wages at both skill levels, but about twice as much for low-skill people.[31] Both types of workers experience a reduction in the demand for their labor to the extent that employer penalties are positive. In this range, the subsidy implementation rate has little impact on worker living standards because no workers receive subsidies. As we explain further below, the reward to work does vary with the subsidy implementation rate because subsidies are paid to non-workers, which feeds back onto equilibrium wages through endogenous labor supply.

In the range in which ESI no longer dominates NGI, there are sectors where employees can receive subsidies, and the rest of employers have to compete with them for workers. Subsidies increase low-skill log real wages by as much as 0.15 because a number of low-skill employees are receiving a subsidy without a commensurate tax payment by their employer. With small penalties and valuable subsidies, it is therefore possible that low-skill workers experience an increase in the demand for their labor, and high-skill workers experience a decrease, as employers drop ESI and downgrade the skill composition of their workforce.

We explain below that the ACA reduces total factor productivity by about one percent. Because our model has constant returns to the two types of labor, the ACA's impact on average employer real unit labor costs would, holding constant the relative supplies of the two types of labor, be essentially the same as its productivity impact – that is, negative and about one percent – because deviations between productivity and real unit labor costs are inconsistent with zero profits. As we show below, endogenous labor supply results in a positive impact of the ACA on employer real unit low-skill labor costs because more low-skill labor is withdrawn from the labor market than high skill labor.

For the purpose of predicting productivity and real wages, we put more weight on the full penalty case even though many employers are exempted from the penalty because the exemption itself puts an additional marginal cost on hiring. When the penalties and likely subsidies are combined, Figure 3 shows a negative impact on high-skill real wages and little (if any) positive

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[31] The wage impacts are (in levels) essentially the penalty amounts, which means that labor demand is highly wage elastic in our model (not a surprising long-run result in a model with constant returns).

impact of the ACA on low-skill real wages (including subsidies), holding aggregate labor supply constant.[32]

Work Incentives and Labor Supply

The real wage concept shown in Figure 3 tells us about the impact of the ACA on various workers' purchasing power, but is not enough to understand labor supply because people can get the subsidy component of that wage even without working. The subsidy component is especially large for low-skill people: 26 percent of w at a subsidy implementation rate of 80%. Figure 4 therefore shows the ACA's negative impact on the rewards to work ($(1-s_L)w/p$ and $(1-s_K)r/p$, and the s's are constant) as a function of the implementation rates. With full penalty, the log reward to low-skill work can fall as much as 0.26. The impacts on rewards to work are negative for all implementation rates and both skill levels.

Most of the ACA's impact on the reward to work comes from the subsidies, even though the subsidies might not be valuable enough to induce any of the workforce to use them. Take, for example, the part of Figure 4's full penalty with subsidy implementation rates of 0.6 and above. The log reward to low-skill work falls at least 0.20, yet, for implementation rates between 0.6 and 0.7, subsidies are valued too little to induce any worker to get the subsidy (most workers have ESI in this range). The point is that any low-skill non-worker can get subsidized healthcare and the subsidies can be valuable even if they are valued less than their cost to the public treasury.

Because the rewards to work vary by skill but are constant across sectors, their responses to the ACA are well approximated by each skill group's sector-weighted average of its three tax rates, and by the ACA's impact on productivity. In other words, for the purpose of understanding our model's predictions for wages and labor supply, the sectoral allocation of labor can be summarized by the share of each labor type that has ESI, NGI, or no private insurance – they form the weights for averaging tax rates – and by the consequences of those

[32] At a subsidy-implementation rate of 0.8 and a penalty-implementation rate ranging from 1 to 0.5, the low-skill log real wage impact ranges from -0.03 to +0.01 respectively.

schedules for economy-wide average productivity. We therefore display results for skill-specific average tax rates before we display and interpret wages results with endogenous labor supply.

Formally, the skill-specific average tax rates are:

$$
\begin{aligned}
\tau_L &\equiv \omega_{cL}\tau_{cL} + \omega_{nL}\tau_{nL} + (1-\omega_{nL}-\omega_{cL})\tau_{uL} \\
\tau_K &\equiv \omega_{cK}\tau_{cK} + \omega_{nK}\tau_{nK} + (1-\omega_{nK}-\omega_{cK})\tau_{uK} \\
\omega_{cL} &\equiv \frac{\int_0^1 L(i)ESI(i)di}{\int_0^1 L(i)di}, \quad \omega_{nL} \equiv \frac{\int_0^1 L(i)NGI(i)di}{\int_0^1 L(i)di} \\
\omega_{cK} &\equiv \frac{\int_0^1 K(i)ESI(i)di}{\int_0^1 K(i)di}, \quad \omega_{nK} \equiv \frac{\int_0^1 K(i)NGI(i)di}{\int_0^1 K(i)di}
\end{aligned}
\tag{11}
$$

where *ESI*(*i*) and *NGI*(*i*) are indicators for sector *i*'s insurance status. Both labor and insurance status are measured under the ACA for the purpose of equation (11). None of possible penalty and subsidy implementation rates result in a large fraction of skilled workers in the NGI or uninsured sectors, which means that the weighted average τ_K is never far from τ_{cK}, which ranges from 4.6 to 5.8 percent depending on the implementation rates, and the impacts on the log rewards to high-skill work are in a tight range in Figure 4.

Figure 5's horizontal axis shows the results for τ_L. Each curve is a different penalty implementation rate {0, 0.5, 1} and is traced out by varying the subsidy implementation rate on the interval [0,1]. Three subsidy implementation rates are shown on the middle curve to demonstrate how the curves bend at a 60% subsidy implementation rate: τ_L is most sensitive to the subsidy implementation rate when the rate is low enough that NGI is dominated by ESI and no weight is put on τ_{nL} in the average. For the same reason, the impact on the reward to low-skill work is most sensitive to the subsidy implementation rate in this range (see Figure 4). τ_L and the reward to low-skill work are always sensitive to the penalty implementation rate, even when NGI is dominated by ESI.

By introducing large wedges between rewards to work and employer cost, the ACA will reduce the quantities of both high- and low-skill labor.[33] For the full penalty case and our benchmark parameters –including a wage elasticity of labor supply of 0.5 – Figure 6 shows the ACA's impact on the logs of low- and high-skill labor. Log low-skill labor falls 0.08 or 0.09 unless the subsidy implementation rate is less than 0.6. For lower subsidy implementation rates, the low-skill labor impact ranges from -0.07 to -0.02. High-skill labor also falls, although at least an order of magnitude less (in logs). Overall log labor (not shown) falls about a third of the change in log low-skill labor, and therefore about 0.03 for implementation rates at 0.6 or above.

The greater the wage elasticity of labor supply, the greater is the ACA's impact on the amount of labor, but not proportionally so. For example, at a wage elasticity of 1.0 rather than 0.5, a fully implemented ACA's impact on the log of low-skill labor is -0.145 rather than -0.092. At a wage elasticity of 0.25, the impact on the log of low-skill labor is -0.053. As long as the wage elasticity of labor supply is economically different from zero, the ACA will have an economically significant effect on low-skill labor supply.

Because labor supply responds to the ACA, the labor-supply-constant wage results from Figures 3 and 4 are not enough to predict the ACA's ultimate impact on the structure of wages. With labor supply endogenous according to a wage elasticity of 0.5, Figures 7 and 8 show results for wages including (excluding) subsidies, respectively. Even with a full penalty, the ACA likely increases living standards for low-skill workers a couple of percent (see Figure 7) – even those who do not receive the exchange subsidies – because it reduces the quantity of low-skill workers and thereby induces a movement along the aggregate demand curve for low-skill labor. For the same reason, high-skill living standards fall somewhat more than they would with fixed labor supply. With endogenous labor supply, the equilibrium log reward to low-skill work falls no more than 0.21 (Figure 8).

Because some employers will be compensating their employees for a foregone exchange subsidy and others will not (because none is foregone: recall Table 1), none of the wage concepts above will correspond to the usual aggregate measures of wages. Figure 10 shows the results for

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[33] Our model does not distinguish hours per employee from number of employees, but the ACA introduces wedges on both margins (Mulligan 2013), so we expect both measures of labor to be reduced by the ACA, primarily among less-skilled workers.

(employee-weighted, using the weights from (11)) average employer real unit low-skill labor cost, which is the product of w/p and one plus the average tax rate τ_L examined above.[34] Each curve is a different penalty implementation rate and each point on a curve is a different subsidy implementation rate.

As noted above, the ACA increases equilibrium real unit low-skill labor costs despite its negative impact on total factor productivity because it reduces the relative supply of low-skill labor. With implementation rates at or above 0.5, the ACA increases log average real unit low-skill labor cost about 0.04. Output falls between one and three percent, and closer to three percent at our preferred implementation rates.

The real wage results are also important for understanding the interaction between the ACA and other safety net programs. Many programs such as SNAP offer benefits of a fixed dollar value, which will automatically loom larger as the low-skill reward to work falls. Unemployment insurance indexes benefits to past wages, so those benefits will eventually decrease with w, but during the transition period unemployment insurance benefits will increase as a fraction of the wage that an unemployed person would get on his next job. We have not modeled these effects, but we expect them to further depress labor supply among low-skill workers.

Output and Productivity

Aggregate Productivity Losses from Factor Substitution

The aggregate output of commodities represented by the CES term in the utility function (3), and is equivalent to the aggregate incomes of workers Y deflated by the price index p. Figure 9 shows the ACA's impact on the log of Y/p as a function of the implementation rates for penalties and subsidies, holding labor supply fixed. For these purposes, we believe that the penalty implementation rate will be something between 50 and 100 percent. As long as the

[34] As of the time of writing, we do not know whether the national accounts will treat the ACA's employer penalties as employee compensation (as employer payroll taxes are), or indirect business taxes (as taxes on business property are), or direct business taxes (as taxes on corporate income are). If not the former, then employer penalties will need to be added to employee compensation for the purpose of comparing the national accounts to our Figure 10.

subsidies are valuable enough that ESI no longer dominates NGI, the ACA will reduce total factor productivity somewhere between 0.2 and 1.3 percent. Given our estimates of the ACA's effect on the number of people with private insurance, the ACA's production loss is $5,000 or $6,000 per person per year (including dependents) moved from uninsured to private insurance without even counting the reduction in aggregate labor supply.

In our model, productivity is not maximized absent the ACA in part because the tax exclusion of employer health insurance distorts the composition of output and the sorting of workers to sectors. One symptom of the pre-ACA distortions is the jump in Figure 1's red schedules for the composition of labor by sector. The employers at the 58th and 59th percentiles have essentially the same production technologies and face essentially the same demand conditions, yet their differential tax treatment causes them to use different amounts and composition of labor. Another distortion is that 58 percent of the sectors offer ESI even though it is efficient for only 52 percent of them to do so.

Economists have long described distortions in the economy associated with the tax preference for employer health insurance, and some of them hope that the ACA would alleviate this distortion and thereby enhance productivity. The productivity possibilities are not that significant in our model: aggregate output would increase by only one-tenth of one percent, holding labor supply fixed, by subjecting all factors and all sectors to the same tax 7.65% employer tax rate.[35]

However, with a caveat noted below, our tax measurements suggest that the ACA will reduce productivity by exacerbating previous distortions and adding new ones. To see this, hold labor supply fixed and consider a zero subsidy-implementation rate and a small but positive penalty-implementation rate. The penalty further expands the number of sectors offering ESI, which was already beyond the efficient number. The penalty also adds to the comparative factor market advantage distortion – that the ESI sector had been distorted in the direction of too much low-skill labor – because the penalty in the other sectors is a much greater percentage of low-skill compensation than it is of high-skill compensation. To put it another way, the penalty

[35] Note that the efficient allocation in our model has less coverage than the allocation we associate with pre-ACA conditions, which itself has less coverage than the allocation we associate with ACA conditions.

increases the terms of trade distortion term q_{uc}, which already was 1.04 and thereby beyond its efficient value of one.

Adding subsidies does not change anything as long as ESI continues to dominate NGI. Once NGI is viable, subsidies rather than penalties expand the extent of coverage at the margin and thereby increase the fraction of the population that incurs administrative costs that exceed the value of coverage as quantified by the parameter χ. Output is also lost because labor is not efficiently allocated to the various sectors.

We interpret the results in Figure 9 as total factor productivity impacts, because they hold L and K constant. In order to (someday, after the ACA is in place) compare empirical productivity measures to Figure 9's predictions, the former must hold constant the quantity and quality of labor and capital.[36] Take, for example, the log changes shown in Figure 6 at our preferred implementation rates (100 and 80%): -0.0033 and -0.091 for high- and low-skill labor, respectively. Log real output changes -0.024. Without adjusting for labor quality, log total labor changes -0.032 and the log of output per unit labor increases 0.007. Adjusting for labor quality, the changes are -0.016 and -0.008, respectively.

The productivity losses from the ACA are the result of behavioral changes by employers and customers. Using the methodology described in Appendix II, Figure 11 shows the contribution of the three kinds of behavioral change in our model. If NGI is dominated by ESI, employer coverage choices reduce productivity because high-administrative-cost employers take on health insurance in order to avoid the employer penalty. Consumers also move their purchases to avoid the penalties (experienced in the form of higher prices), which is the sectoral shifts component of Figure 11. Employers also mitigate the contribution of the penalty, and enhance the contribution of the exchange subsidies, to their prices and costs by changing the skill composition of their workforce: the factor-substitution effect shown in Figure 11.

[36] Our model does not have physical capital, but by assuming constant returns to labor, we implicitly assume that physical capital is proportional to labor and do not account for any impact of productivity on the constant of proportionality.

Output and Employment by Sector

Our equilibrium model has a continuum of sectors that differ in the skill-intensity of their technology and thereby differ in terms of their compensation ratios absent the ACA, but otherwise the sectors are not readily identifiable as, say, "home construction in the Southwest" or "hospitals in New England." The Current Population Survey (CPS) data helps bridge this gap, and to estimate which industries and regions will disproportionately experience the various labor market changes created by the ACA. By naming some of the sectors in our model, we can generate additional testable implications and obtain a fuller set of incidence results.

We cannot know for sure the skill-intensity of a CPS respondent's employer because the data does not have employer identifiers. We do have state and industry indicators, so we estimate low-skill-intensity of a respondent's employer as the fitted value from a regression in the March 2012 CPS sample of non-elderly household heads and spouses (employed sometime during 2011) of a below-300-percent-FPL indicator on indicator variables for state of residence and three-digit industry. Among the industries employing at least 0.5 percent of working non-elderly household heads and spouses (about 400 respondents in the March CPS; 54 civilian industries satisfy this criterion), the top half of Table 5 lists the top and bottom five industries in terms of propensity of its workers to be in households below 300 percent FPL. The bottom of the table lists the top and bottom five states. Also listed in the table is the fraction of the subsample (state or industry) with ESI in their own name as of March 2012.

Workers in some of the most low-skill intensive industries are not especially likely to lose ESI coverage because, as Table 5 shows, ESI coverage was already rare before the ACA. Restaurants, for example, have more than 70 percent of its workers from households below 300 percent FPL, but only 23 percent of its workers have ESI from their employer.

Gruber (2009), Gruber (2012), and Blumberg, Corlette and Lucia (2013) suggest that entrepreneurship will expand significantly as a consequence of national health reform because a reform would help the self-employed get non-group health insurance that they wouldn't have without it. A comparison of our Figures 1 and 2 suggests that a number of sectors will expand their employment as a consequence of the ACA, especially those that are at a labor-market disadvantage without the ACA because they cannot efficiently offer ESI. The employment-expanding sectors in our model are 45-84, near the margin of ESI and no insurance without the

ACA, and without the ACA employ 20 percent of the workforce. Figure 12, which assumes full implementation of subsidies and penalties, shows how the sectors getting insurance as a consequence of the ACA expand about 0.13 log points if aggregate labor supply is held fixed (see the employment share series) and about 0.08 log points overall. Perhaps entrepreneurs are disproportionately represented in these sectors, at least if an "entrepreneur" is someone who tends to work without health insurance (absent the ACA), but is skilled relative to the rest of the uninsured.

However, our Figure 12 also shows that hardly any sector will expand its output (see Figure 12's solid red and blue curves). The sectors expanding employment as a consequence of the ACA are doing so in part because NGI induces them to substitute low-skill employees for high-skill ones, which increases employment holding output constant. Perhaps ironically, firms in these sectors that employ 50 or more people have been complaining about the penalties they will face from a law that will cause their sectors to expand employment.

In order to make predictions for the likely industries and regions for entrepreneurship and other activities experiencing employment expansions, we assign an indicator to each CPS worker that equals one if and only if they do not have ESI and they are located between the 45th and 84th percentiles on the skill-intensity distribution. We then rank industries and states by their average value for the indicator among their employees and show the leaders in Table 6. The highest ranked industries are, according to our model, animal production, automotive repair, beauty salons, business support services, construction, independent artists and religious organizations. Their employment may grow more (or fall less) than the rest of the nation because they have somewhat more workers under 300% FPL and because ESI rates are low.

Our model economy produces a continuum of consumer commodities *plus coverage*. We noted above how our model parameter χ can be interpreted as foregone healthcare product attributes that influence insurance decisions by employers and employees, in which case one might consider a second aggregate output impact measure that incorporates that value of expanding coverage according to χ. It is also likely that the social value of insurance coverage exceeds the private value, in which case one might consider a third aggregate output measure, or consider the divergence between social and private values in our model by calibrating a non-ACA subsidy for the uninsured. Lacking further information about the size of these effects and the degree to which conventional output measures might conform to the second and third output measures, we leave examination of them to future research. For now, we note that commodity productivity losses, if any, from the ACA may be offset by valuable coverage gains.

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, a fully implemented ACA's tax wedges would be about the same as tripling employer payroll taxes. 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 Affordable Care Act, 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.

The ultimate incidence of ACA provisions is dramatically different from the legal incidence. Employees from low income families (below 400 percent of the poverty line) would appear to forgo premium subsidies by working for an employer offering affordable health insurance, and high-income employees working at employers no longer providing health benefits appear to forgo the long-standing tax advantages of employer-provided insurance, but this fails to recognize competition in the labor market. We predict that employees will pay for access to either subsidy in the form of less cash compensation, and the new premium subsidies by themselves will help essentially all low-skill workers, even those who do not receive them. Similarly, the new employer penalties will reduce essentially all low-skill wages, even those working for employers that are not penalized. We also find that the sectors that will be paying the most employer penalties are the sectors most induced by the ACA to increase (sic) employment because the penalties are highly correlated with subsidy access for their employees.

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 degree (ranging from 0 to 100 percent) to which the ACA's subsidies and taxes are implemented. For the purposes of forecasting behavioral responses, our preferred long-run subsidy implementation rate (if we have a preferred rate: see below) is about 80 percent. Our preferred rate is greater than 50 percent because the exchanges are intended as places where well-to-do people like, say 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.[37] On the other hand, our preferred rate is less than one hundred 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 exchange plans and employer-sponsored insurance.[38] The size of this barrier will likely vary across states, because insurance plans are regulated by states. The barrier may also change over time as information disseminates, the technology "glitches" are solved, and regulators at both the state and federal levels react to political and budget pressures.

Under the ACA, any legally resident low-skill non-worker can get subsidized healthcare and the subsidies can be valuable even if recipients value them significantly less than their cost to the public treasury. As a result, the ACA sharply reduces the reward to low-skill work,

[37] 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).

[38] 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).

primarily with its subsidies, even though the subsidies might not be perceived well enough to induce any worker to use them.

An entire study could be devoted to labor supply aspects of the ACA, with special attention to the various margins of labor supply, the opportunities created by the ACA for people out of work or otherwise underemployed (such as “job lock” effects), and the sensitivity of labor supply to such incentives. In order to simultaneously examine workforce size and composition by industry and skill, our present paper includes just a single labor supply margin, and leaves some of the aforementioned details for later research. For now, we expect the ACA to reduce total labor by about three percent and low-skill labor about nine percent. The reduced labor supply will feed back on wages, with the net result possibly a small increase in living standards for low-skill workers.

Our tax measurements suggest that the ACA will reduce aggregate output about two percent and reduce total factor productivity about one percent, by exacerbating previous distortions and adding new ones. In particular, the ACA introduces a wedge, of more than 0.20 in logs, between the relative rental rates of skilled labor between otherwise identical employers that differ only in their decision to offer health insurance to their employees. At the expense of economic efficiency, employers trade workers with each other to reduce penalties and enhance subsidies, with some of them increasing the skill-intensity of their workforce and others reducing it. To put it another way, the ACA reduces output both because of the level of its implicit tax rates and because of their variability across sectors and types of labor.

More work is needed to fully understand the sectoral effects of the ACA. This paper does not give any details about the law’s Medicaid expansions; our model just aggregates Medicaid participants with all other people lacking private health insurance. We do not give special attention to the health and insurance sectors, but perhaps the ACA also shifts consumer demand toward those sectors and away from the rest of the economy. Our model does not have any elderly workers, or workers who are not heads (or spouses) of their own household. Such workers supply less than a quarter of aggregate hours, but their supply is still not negligible.

Physical capital is only implicit in our model, which assumes constant returns to the two types of labor. Our results should therefore be interpreted as long-run results: measures of the behavioral changes that would occur in the long run in response to a permanent change in the various tax rates. Because the capital stock adjusts slowly, wages should fall less, or increase more, in the short run than they do in the long run.

Our model features heterogeneous sectors, some of which can be interpreted as "entrepreneurial" or intensive in small establishments, and expand as a consequence of the ACA. However, we do not model the ACA's significant employer-size provisions in any detail. Our paper does not specifically model health outcomes, which may well improve enough to compensate for the labor market costs that we do model. 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.

Appendix I: Model Calibration

Table 7 displays our benchmark model parameters.[39] 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. 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 2 and 3). 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).

[39] "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.

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 movements 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 (that is, 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% 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.[40] 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.[41]

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

[41] 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.

Appendix II: 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.[42]

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.[43]

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 log output is the outcome, sector *i*'s factor substitution effect is:

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[42] 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.

[43] 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.

$$\ln \frac{y_i'}{y_i} - \frac{\ln R_i + \ln R_i'}{2}$$
$$R_i \equiv \frac{wL_i' + rK_i'}{wL_i + rK_i}, \quad R_i' \equiv \frac{w'L_i' + r'K_i'}{w'L_i + r'K_i} \tag{12}$$

where primes (ʻ) indicate outcomes with the ACA and no prime indicates no-ACA outcomes. Equation (12) is sector *i*'s difference between the ACA's log output impact and its log (quality-adjusted) labor impact. The factor substitution effect on log aggregate productivity is the average across all sectors, weighted by industry revenue shares, which are the average of no-ACA and ACA revenue shares for the sector.

Table 1. Components of Compensation and Employer Costs
Low-skill employees

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

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

Table 2. 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 3 for components of the tax amounts

Table 3. Components of Sector-specific Employer Taxes and Subsidies
Assumes full implementation.

Non-ACA Provisions	Annual Amount	Applicable sector? 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			
Majormedical 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.

Table 4. Combined Employer and Employee Labor Income Tax Rates
by sector and skill level, expressed as a percent of marginal product
Inclusive of tax rates implicit in unemployment and other safety net benefit rules. Assumes full implementation.

	without ACA	with ACA	ACA impact on log after-tax share
ESI, low-skill	50.0%	63.4%	-0.31
NGI, low-skill	50.0%	53.4%	-0.07
uninsured, low-skill	50.0%	67.6%	-0.43
weighted average	50.0%	62.6%	-0.30
ESI, high-skill	44.0%	44.7%	-0.01
NGI, high-skill	44.0%	45.8%	-0.03
uninsured, high-skill	44.0%	47.9%	-0.07
weighted average	44.0%	45.0%	-0.02

Note: Weighted average uses the sector allocation of labor. The sectoral allocation is a simple average of the measured 2012 allocation and the allocation simulated with our benchmark parameters and fixed aggregate labor supply.

Table 5. Industries and States With Low and High Fractions of Workers under 300% Poverty
March 2012 CPS

Top 5 Low-Skill Intensive Industries	Low-skill share	Share of workers with ESI in own name
Services to buildings and dwellings	0.72	0.18
Restaurants and other food services	0.71	0.24
Landscaping services	0.65	0.22
Employment services	0.63	0.29
Crop production	0.63	0.20
Bottom 5 Low-Skill Intensive Industries		
Securities, commodities, funds, & other financial	0.10	0.71
Architectural, engineering	0.12	0.69
National security and international affairs	0.13	0.78
Computer systems design	0.14	0.73
Electric power generation and distribution	0.15	0.89
Top 5 Low-Skill Intensive States		
Idaho	0.46	0.52
Arkansas	0.45	0.56
South Carolina	0.45	0.57
Utah	0.45	0.54
New Mexico	0.45	0.46
Bottom 5 Low-Skill Intensive States		
New Hampshire	0.23	0.58
District of Columbia	0.25	0.65
Connecticut	0.25	0.60
Massachusetts	0.25	0.59
Maryland	0.25	0.60

Notes: Low-skill is defined to be living in a family under 300% of the Federal Poverty Line. Industries are limited to those 54 employing at least 0.5% of non-elderly heads and spouses.

Table 6. Industries and States with More Positive (less negative) Employment Impact
March 2012 CPS, limited to industries employing at least 0.5% of non-elderly heads and spouses

<u>Top 7 industries</u>
Animal production
Automotive repair and maintenance
Beauty salons
Business support services
Construction
Independent artists, performing
Religious organizations

<u>Top 7 states</u>
New Mexico
Utah
Montana
Idaho
Vermont
Kentucky
Oklahoma

Note: excludes demand-side effects on health and insurance industries.

Table 7. Model Parameters

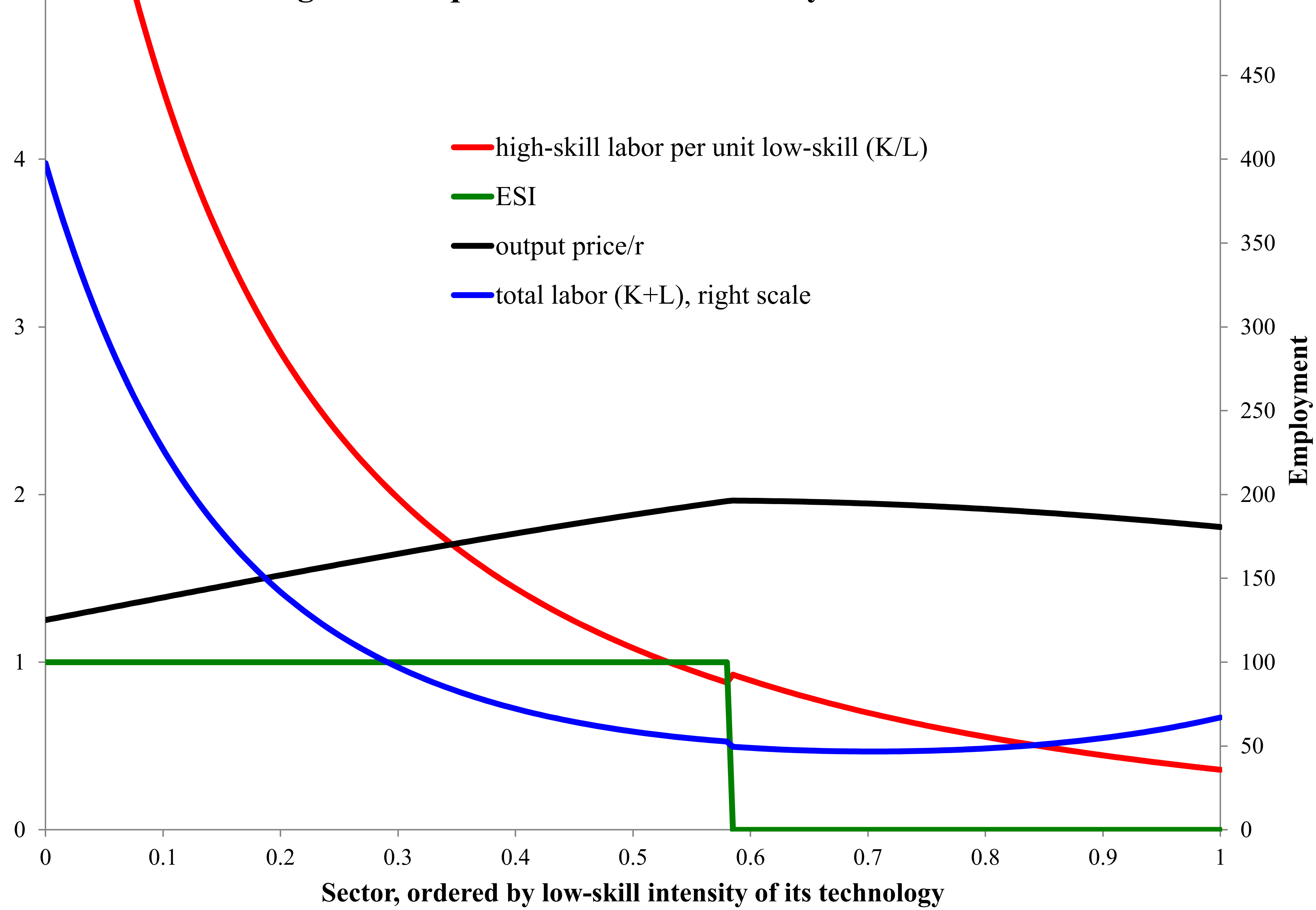
Baseline Factor Allocation		
low-skill employees with ESI	20.1	March 2012 CPS
total low-skill employees	33.9	
high-skill employees with ESI	59.8	
total high-skill employees	67.5	
ESI participants per covered worker	2.0	ratio of total ESI plan participants (CBO) to ESI employees
Substitution Parameters		
ESI offer elasticity with respect to the price of ESI	0.333	
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-intenstive sector	0.09	fits baseline factor allocation and productivity
the least skill-intenstive sector	0.44	
Other Taste Parameters		
sectoral gradient of consumer preferences	-2.8	fits baseline factor allocation and skill-specific productivity
slope of sectoral gradient of consumer preferences	4.2	
Employer Tax Rates		
See Table 2 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)

Table 8. ACA Impacts with and without Window Dressing

	Percentage of low-skill employees at ESI employers who receive subsidies	
	0%	25%
Penalties Implemented 50%		
ESI participation	-25.4	-12.8
NGI participation	40.5	28.1
participation in private insurance	15.0	15.2
log productivity (fixed labor supply)	-0.005	-0.005
Penalties Implemented 100%		
log real low-skill wage (fixed labor supply)	-0.01	0.01
log reward to low-skill work (fixed labor supply)	-0.25	-0.23
log productivity (fixed labor supply)	-0.008	-0.008
full-implementation tax rate on low-skill ESI labor, τ_{cL}	36.8%	28.5%

Note: Subsidies are assumed to be 80% implemented. Participation is measured in millions.

Figure 1. Equilibrium Allocations by Sector: no ACA



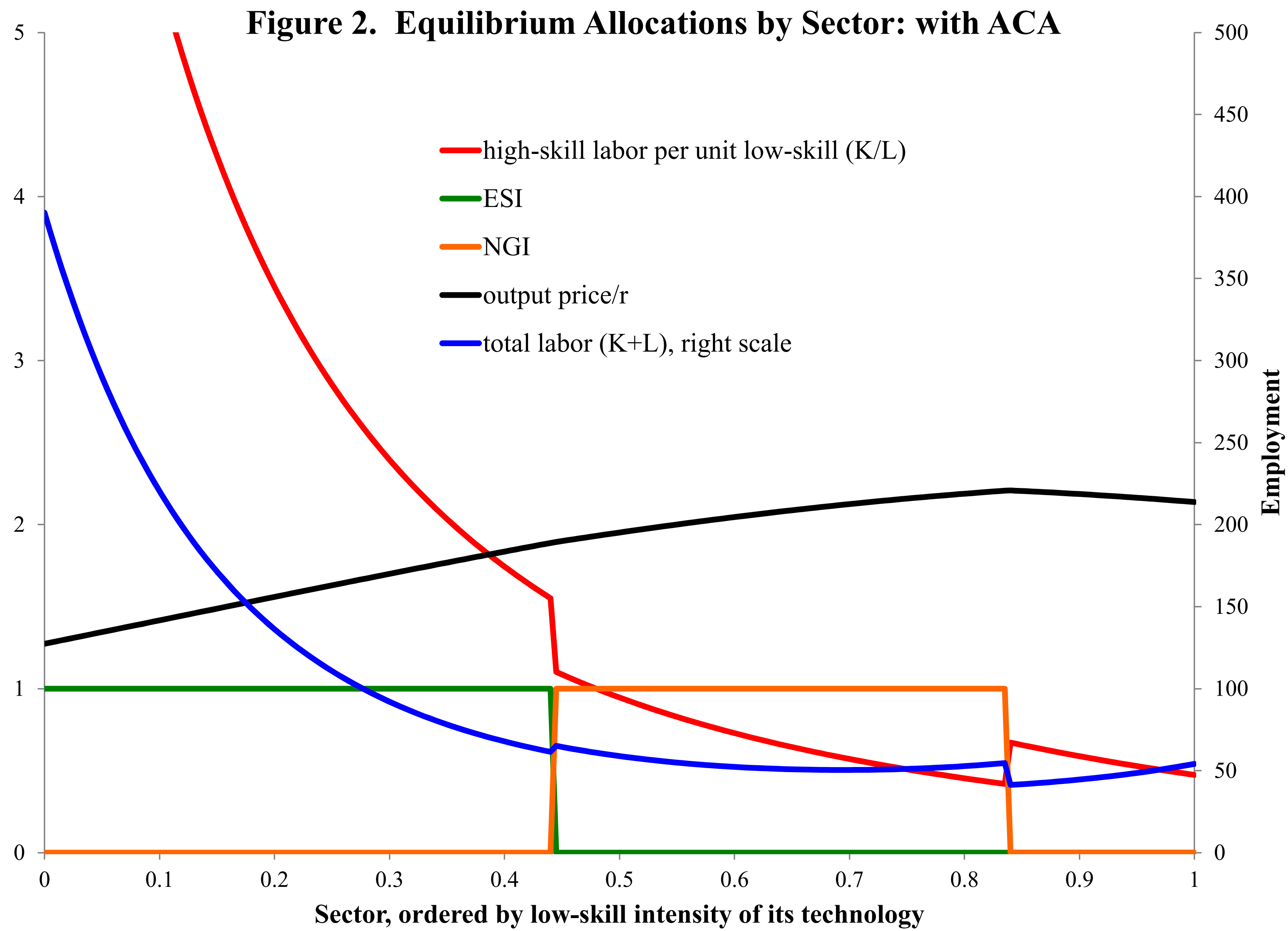


Figure 2. Equilibrium Allocations by Sector: with ACA
high-skill labor per unit low-skill (K/L)
ESI
NGI
output price/r
total labor (K+L), right scale
Employment
Sector, ordered by low-skill intensity of its technology
0
1
2
3
4
5
0
50
100
150
200
250
300
350
400
450
500
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

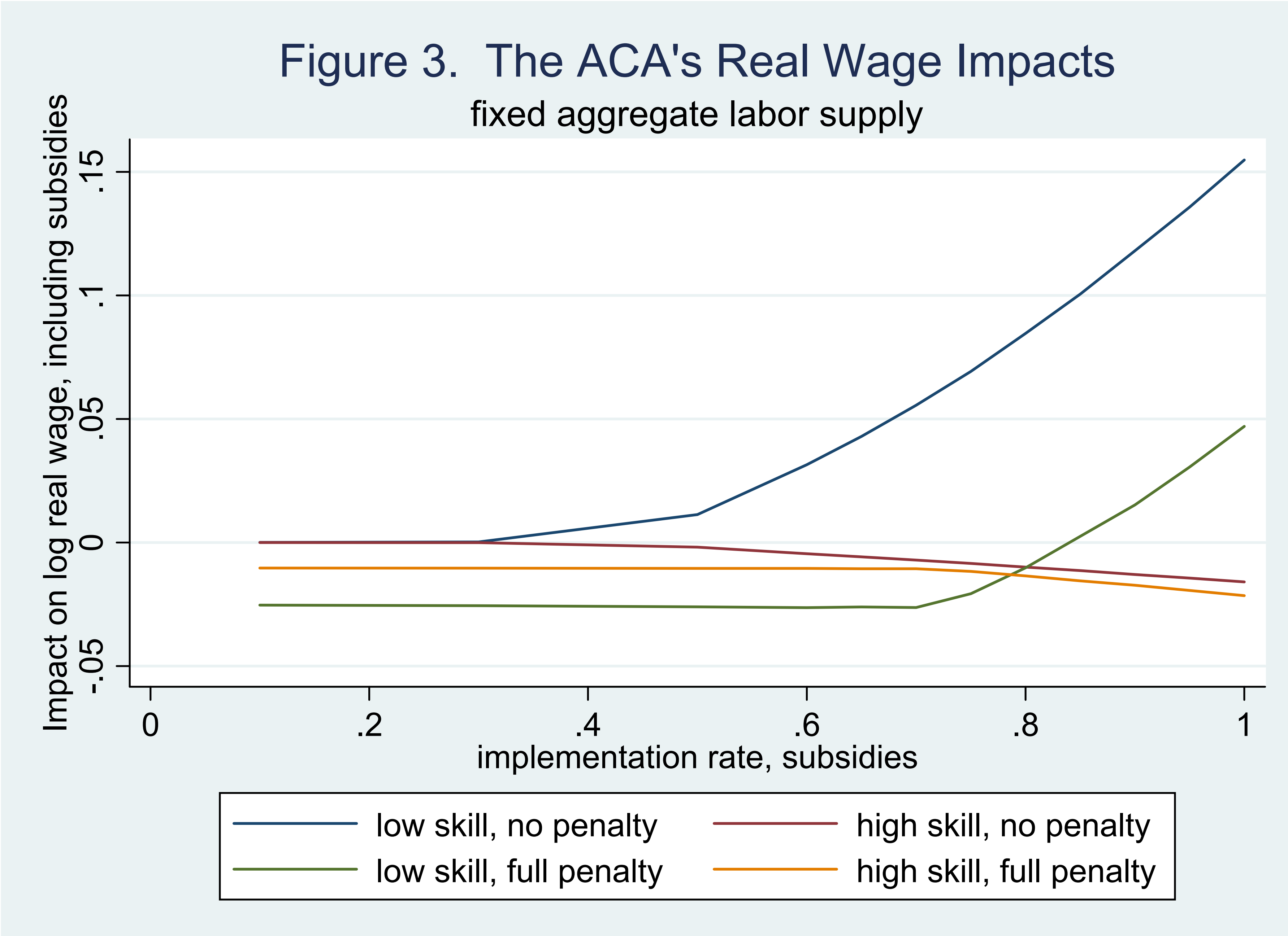


Figure 3. The ACA's Real Wage Impacts
fixed aggregate labor supply
Impact on log real wage, including subsidies
-.05
0
.05
.1
.15
0
.2
.4
.6
.8
1
implementation rate, subsidies
low skill, no penalty
high skill, no penalty
low skill, full penalty
high skill, full penalty

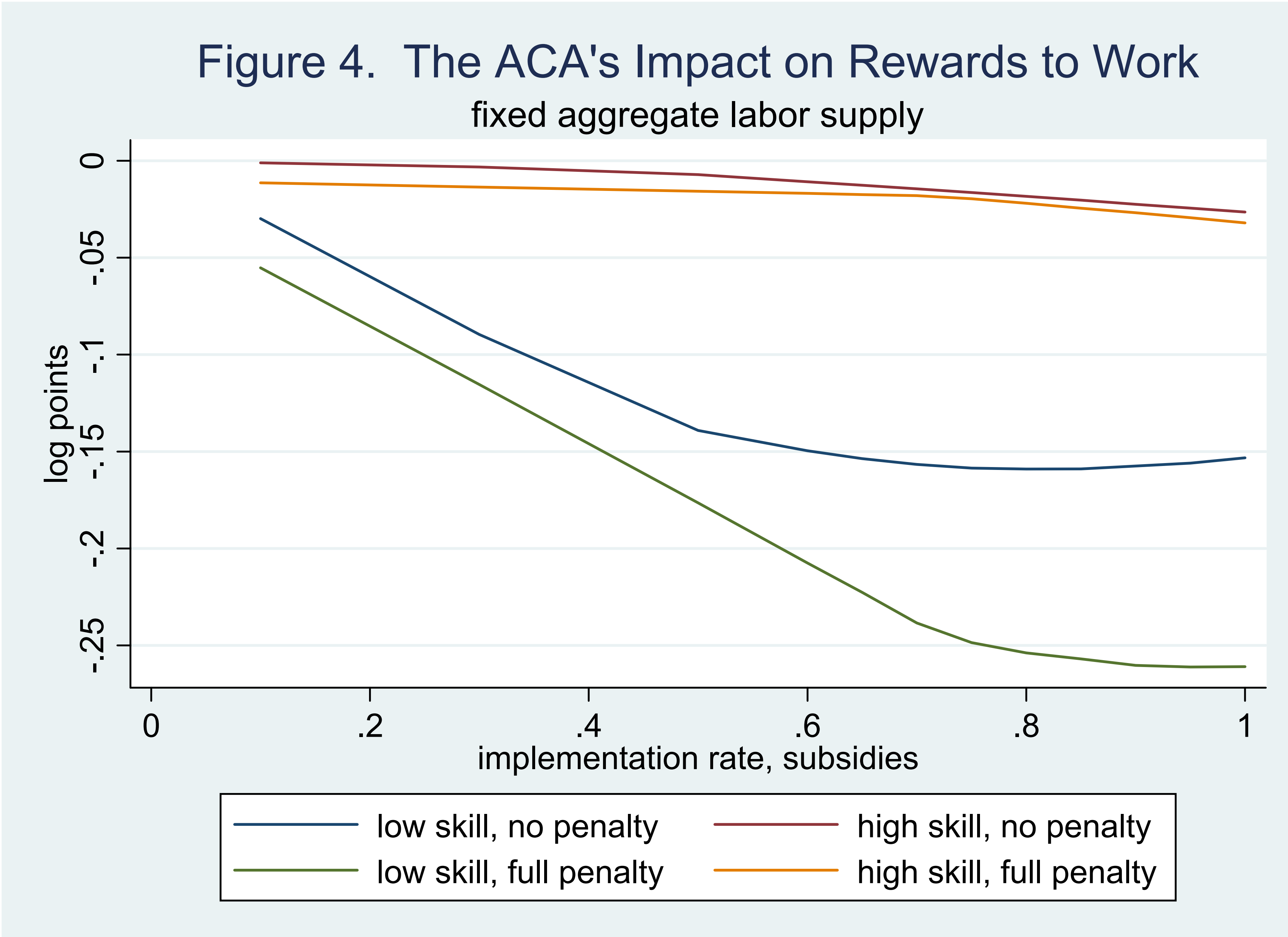


Figure 4. The ACA's Impact on Rewards to Work
fixed aggregate labor supply
log points
0
-.05
-.1
-.15
-.2
-.25
0
.2
.4
.6
.8
1
implementation rate, subsidies
low skill, no penalty
high skill, no penalty
low skill, full penalty
high skill, full penalty

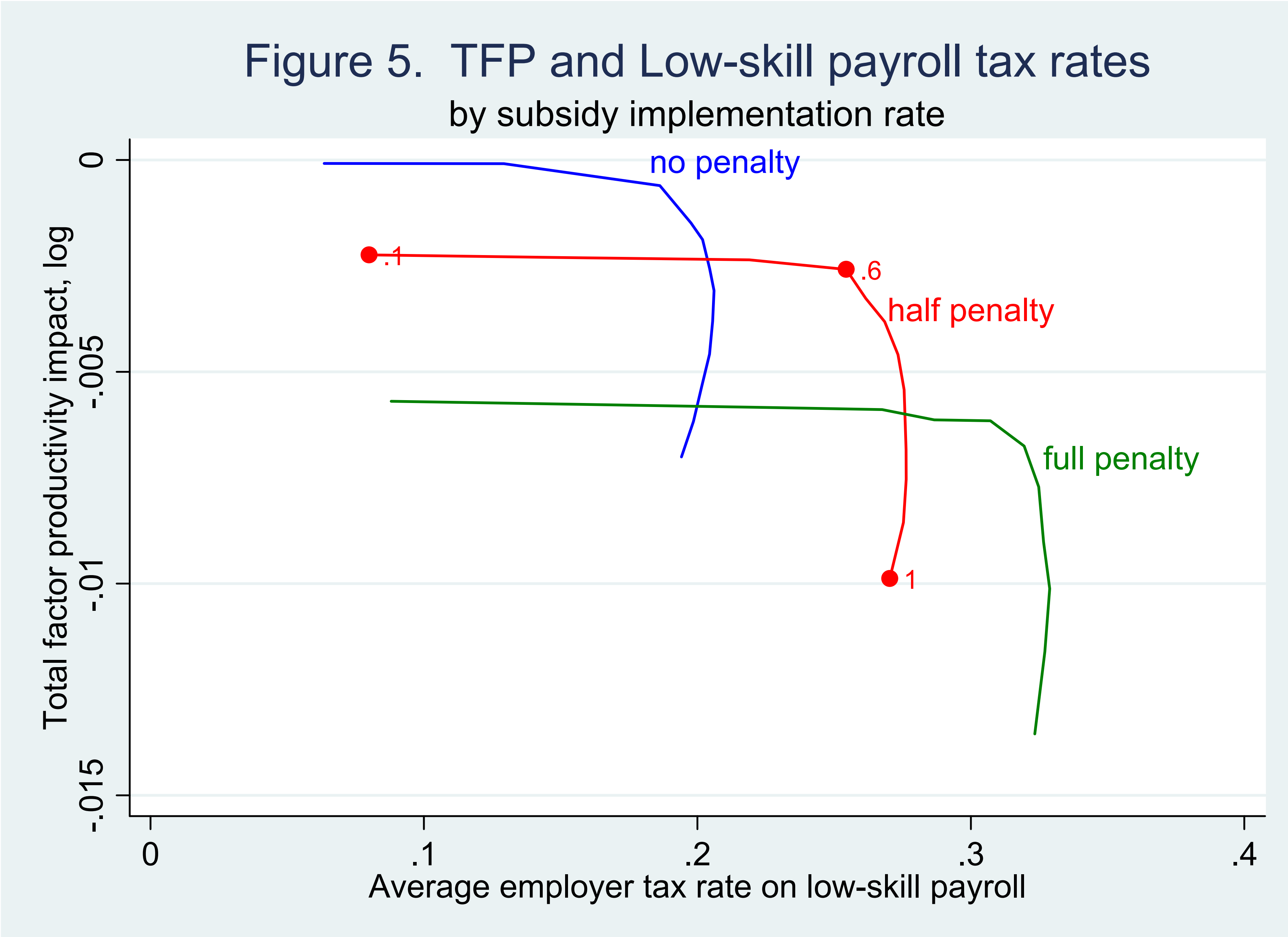


Figure 5. TFP and Low-skill payroll tax rates
by subsidy implementation rate
no penalty
half penalty
full penalty
.1
.6
1
0
-.005
-.01
-.015
.1
.2
.3
.4
Total factor productivity impact, log
Average employer tax rate on low-skill payroll

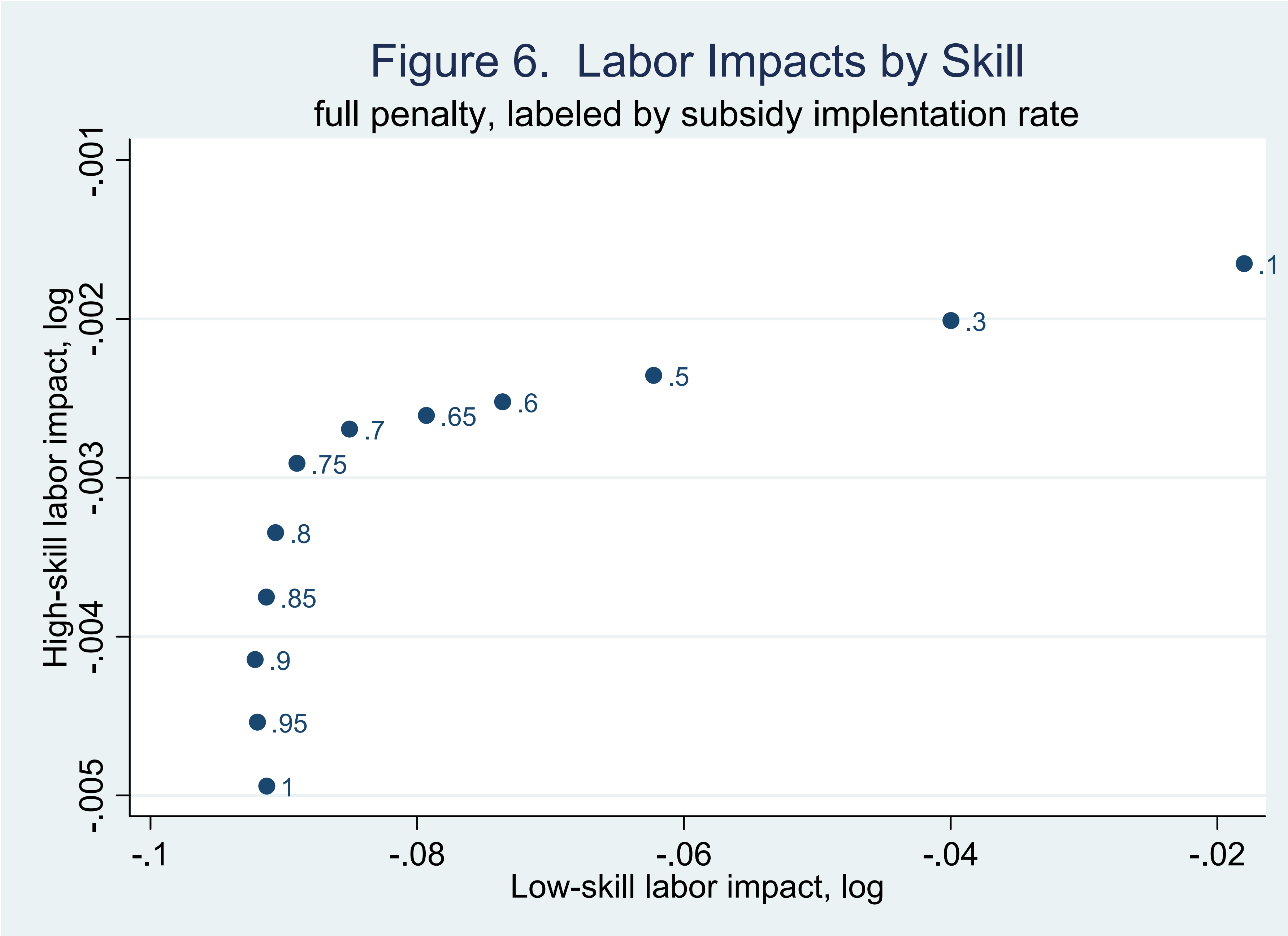


Figure 6. Labor Impacts by Skill
full penalty, labeled by subsidy implentation rate
High-skill labor impact, log
-.001
-.002
-.003
-.004
-.005
.1
.3
.5
.6
.65
.7
.75
.8
.85
.9
.95
1
-.1
-.08
-.06
-.04
-.02
Low-skill labor impact, log

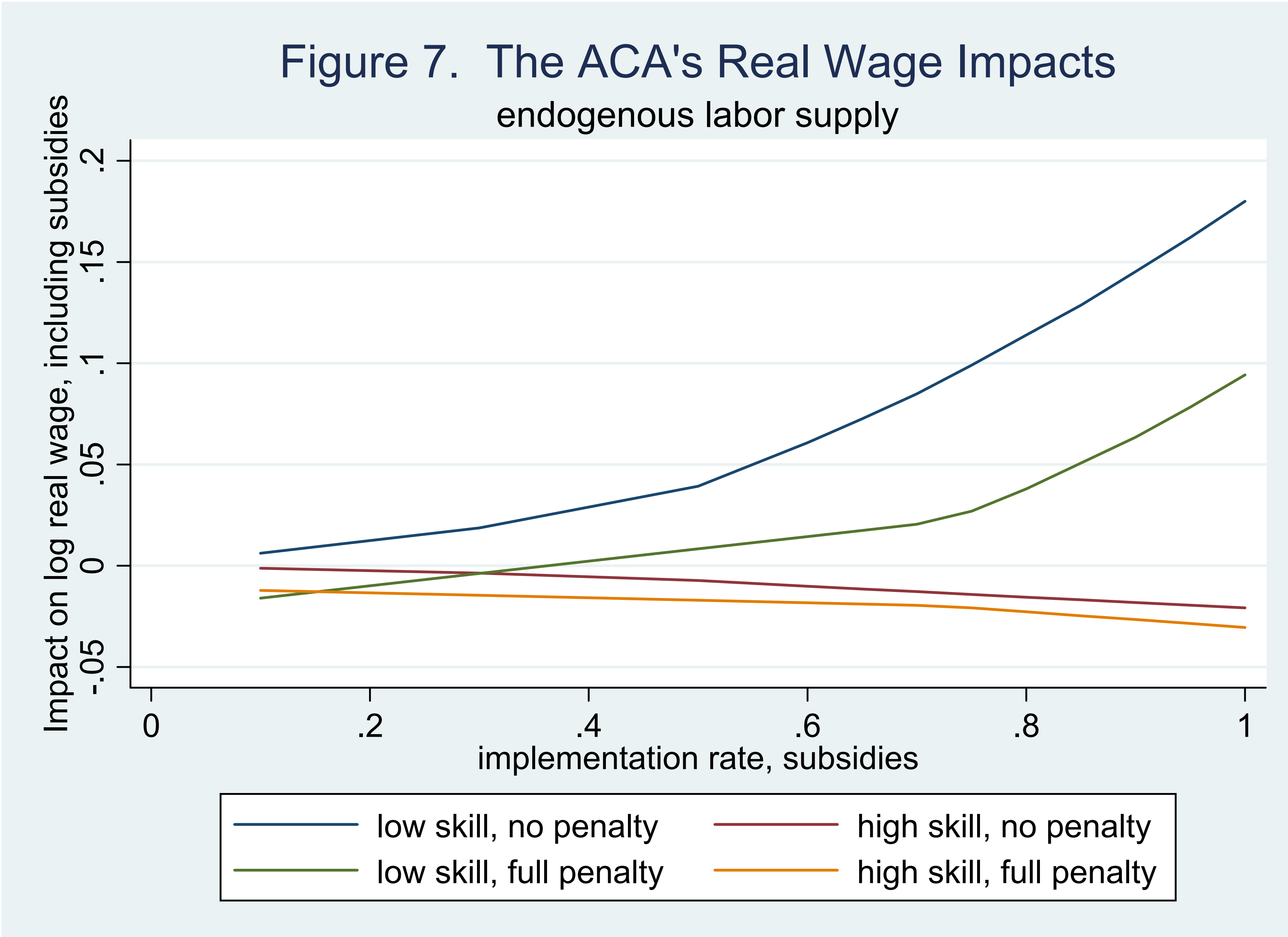


Figure 7. The ACA's Real Wage Impacts

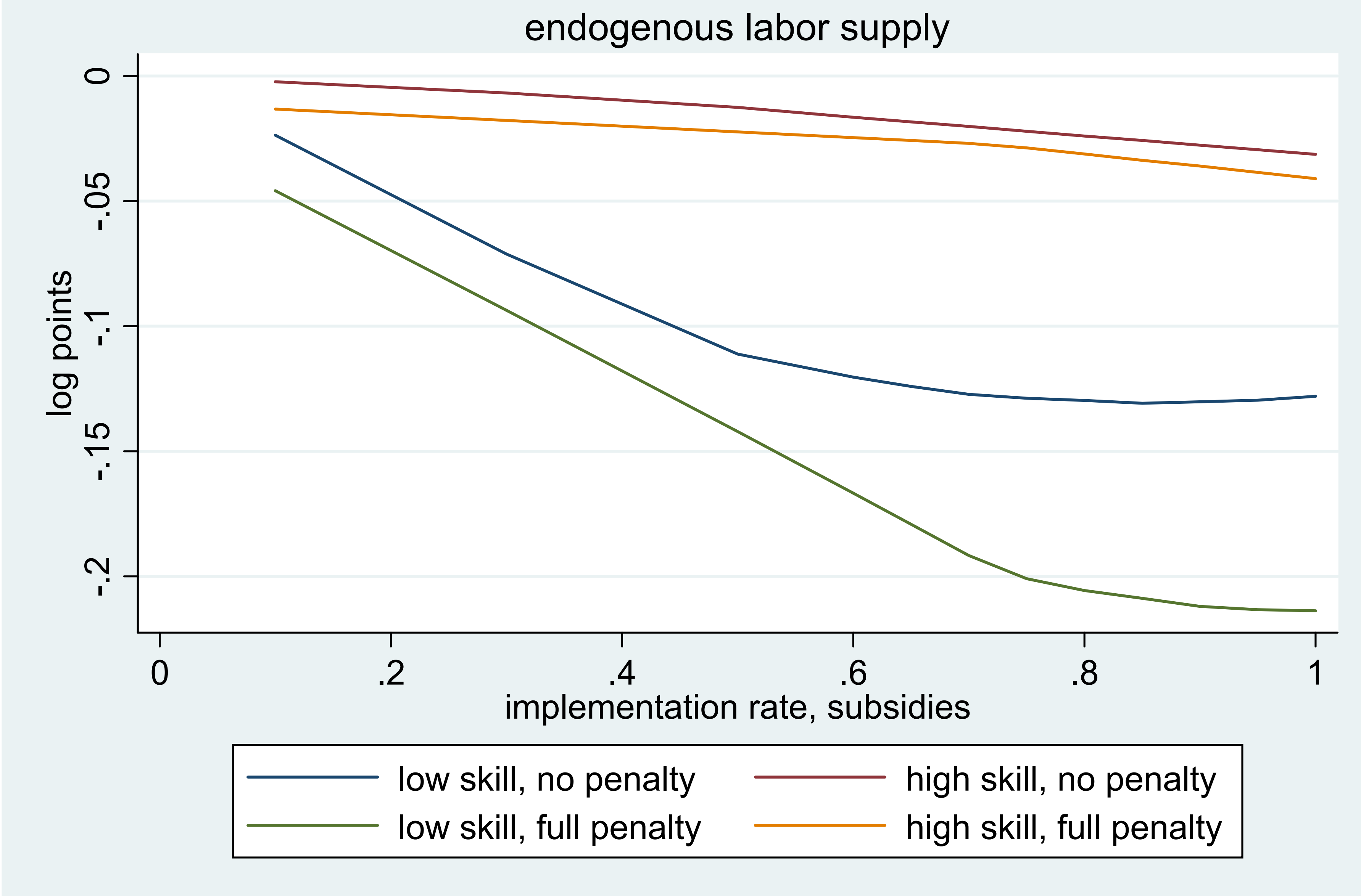


Figure 8. The ACA's Impact on Rewards to Work

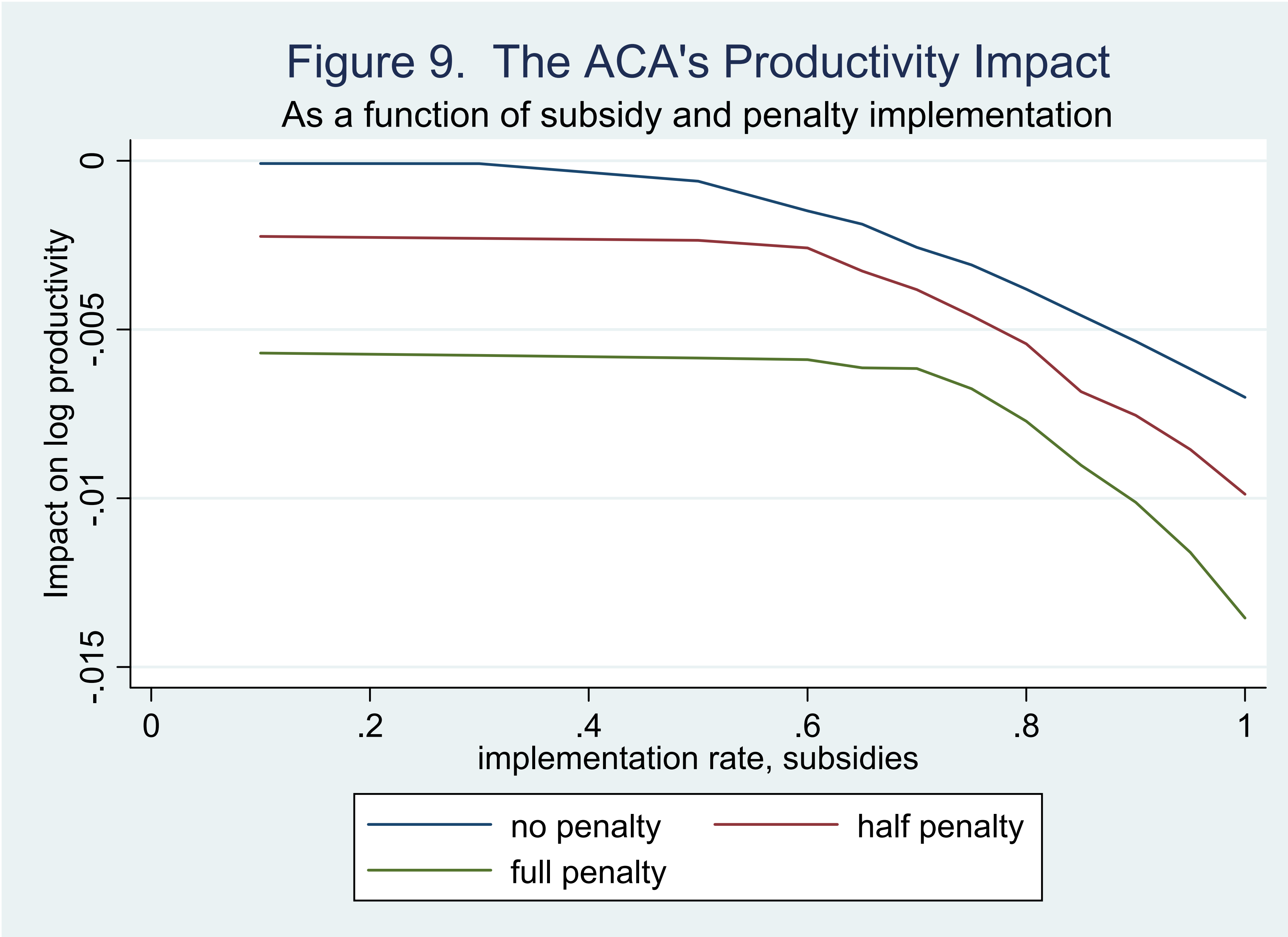


Figure 9. The ACA's Productivity Impact
As a function of subsidy and penalty implementation
Impact on log productivity
0
-.005
-.01
-.015
0
.2
.4
.6
.8
1
implementation rate, subsidies
no penalty
half penalty
full penalty

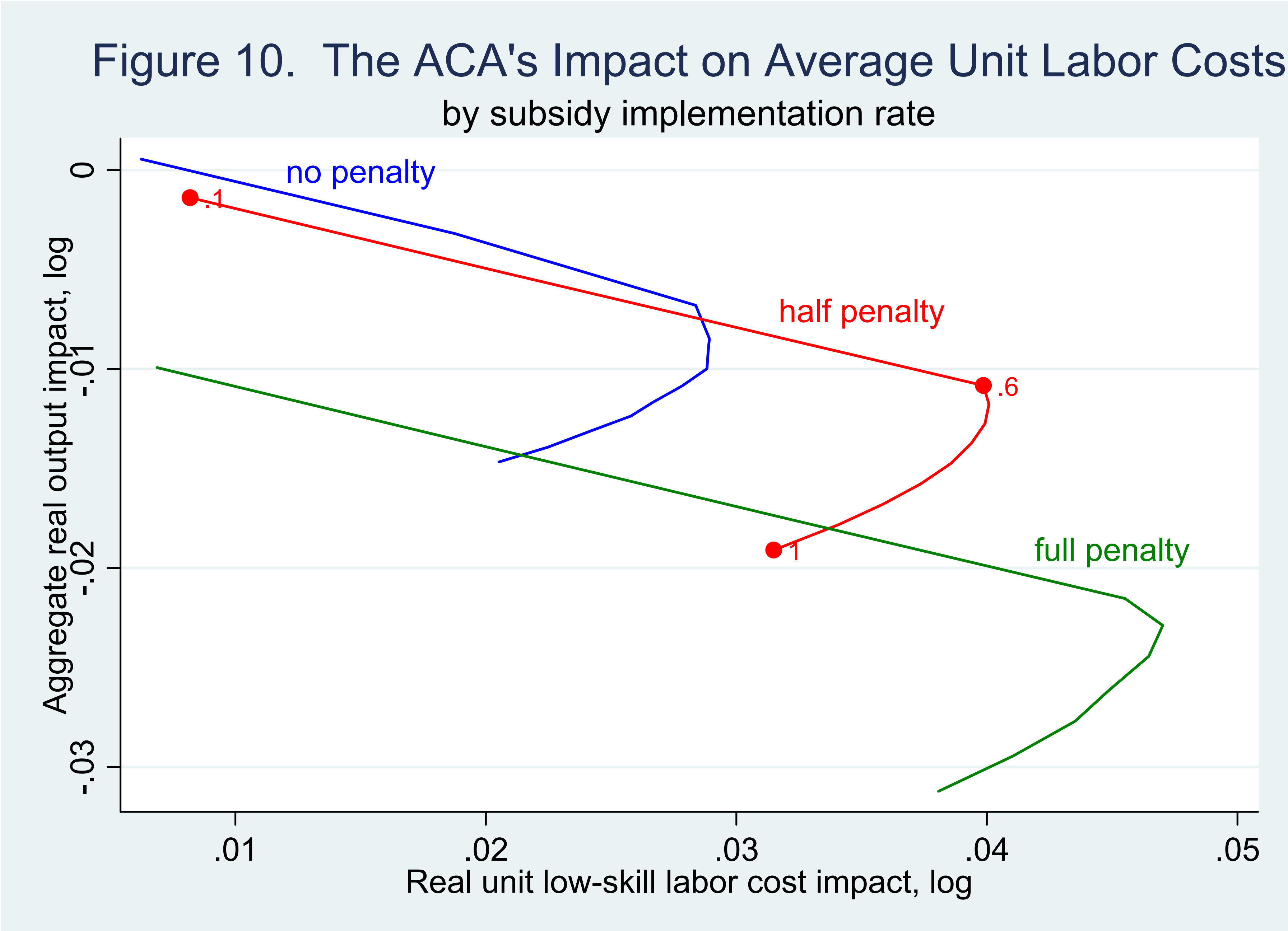


Figure 10. The ACA's Impact on Average Unit Labor Costs
by subsidy implementation rate
no penalty
half penalty
full penalty
.1
.6
1
0
-.01
-.02
-.03
Aggregate real output impact, log
.01
.02
.03
.04
.05
Real unit low-skill labor cost impact, log

Figure 11. The ACA Affects TFP through Labor Market Behavior

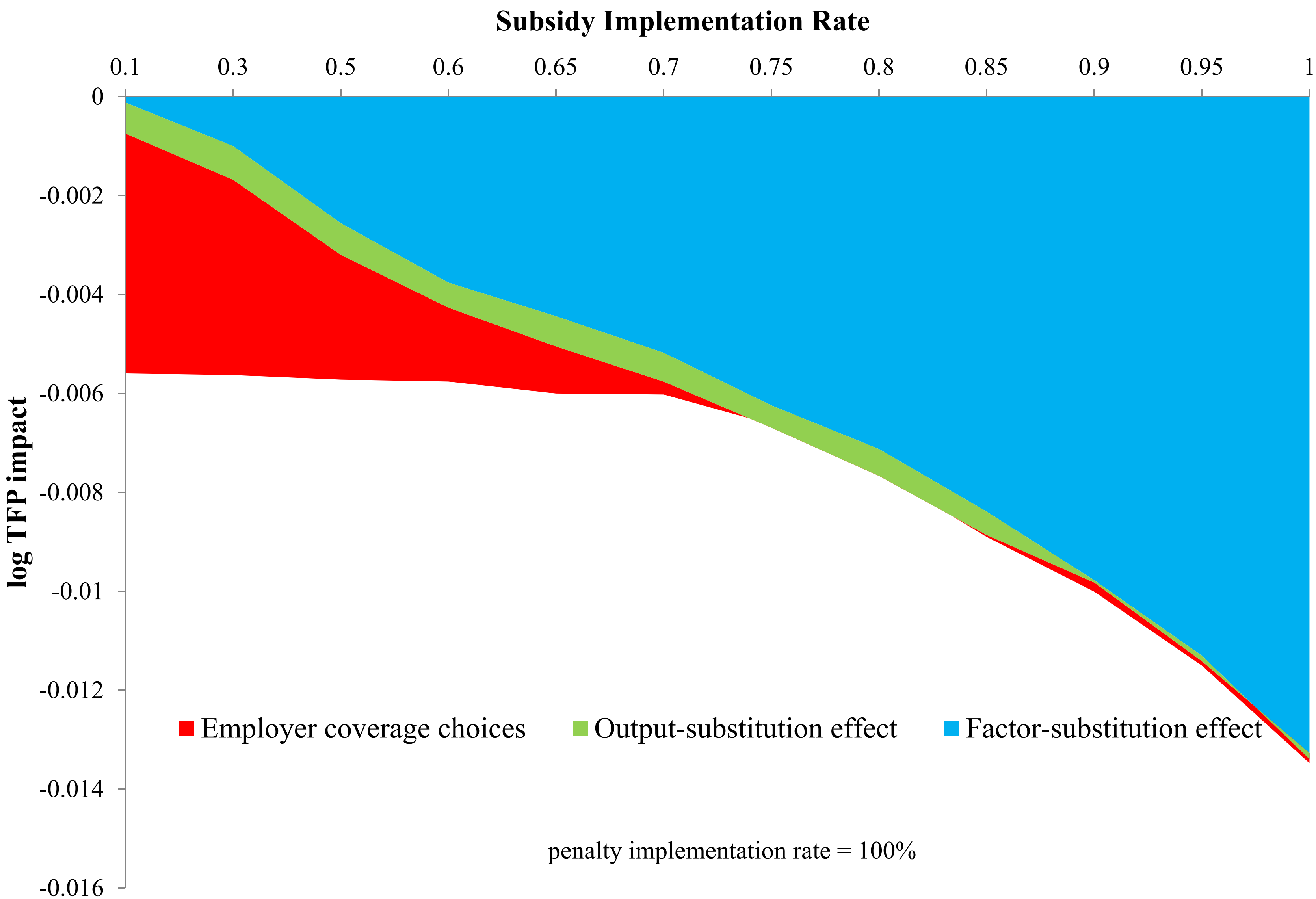
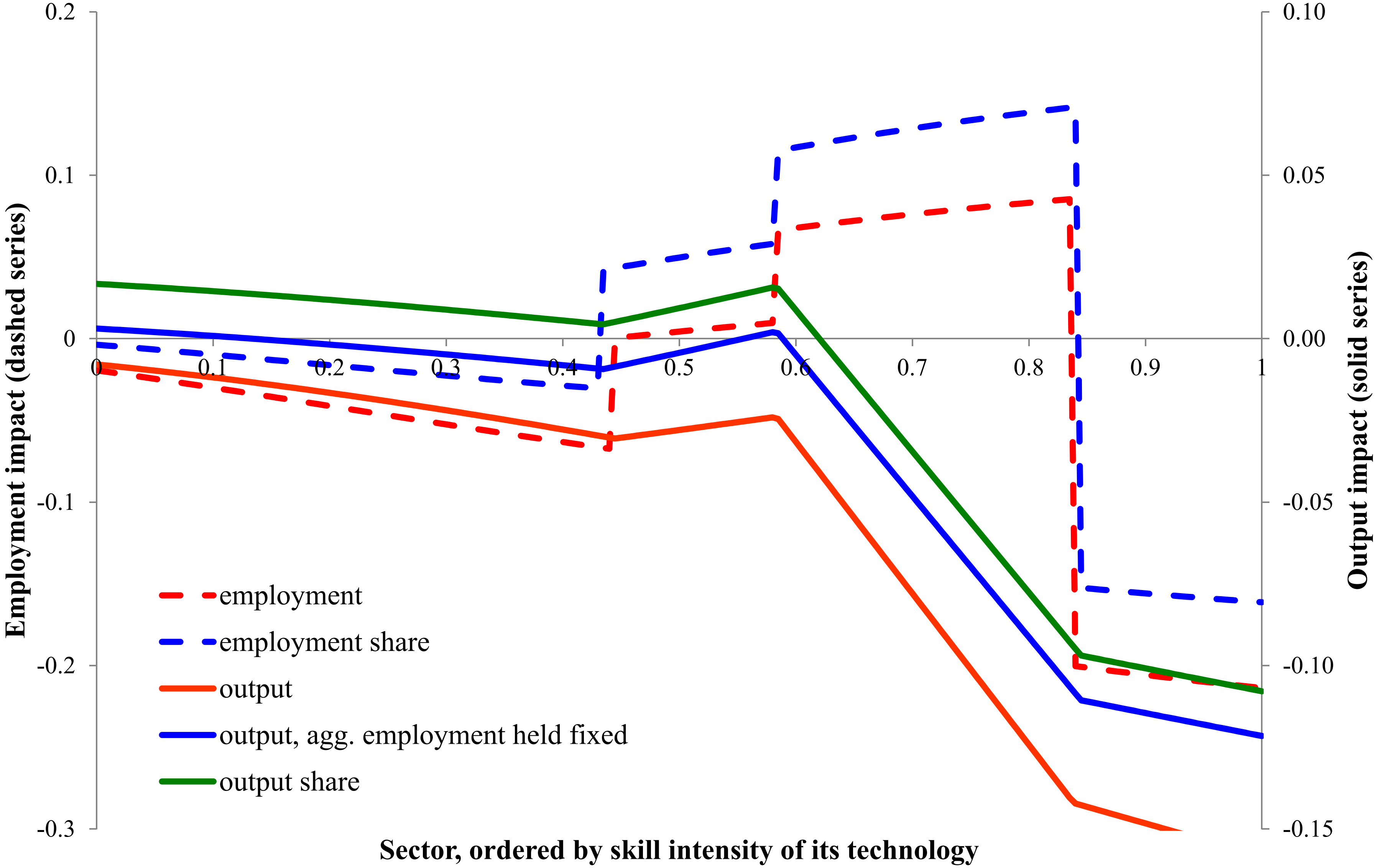


Figure 12. Sector-specific Impacts on Employment and Output

measured in log points



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