The Contribution of Healthcare Costs to Low-Skill Domestic Outsourcing

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Abstract

Between 1975 and 2012, the share of low-skill workers that are domestically outsourced increased by approximately ten percentage points in the US. This development coincided with two trends: rising medical care prices and rising demand for high-skill labor. I explore the relationship between these secular changes using a general equilibrium model. The key ingredient is anti-discrimination regulation from the US tax code, which forces firms to offer the same health plans to all their employees. I find that, qualitatively, an increase in the price of medical care or the demand for high-skill labor increases the cost of the health plans high-skill employees want. Then, the anti-discrimination constraints increase the relative cost of low-skill employees, which increases low-skill domestic outsourcing. I find empirical support for the relationship between high-skill labor demand and low-skill domestic outsourcing using both state level data and cross-sectional industry data, and I use this data to calibrate the model. With the calibrated model I find that the rising price of medical care interacting with the anti-discrimination constraints is responsible for over 50 percent of the increase in low-skill domestic outsourcing between 1975 and 2012. Conversely, rising demand for high-skill labor had a minimal impact on the trend. These results suggest that the rising price of medical care interacting with the anti-discrimination regulations is a major driver of the increase in low-skill domestic outsourcing.

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1 Introduction

Domestic outsourcing — firms' use of domestic workers that are not employees — has increased dramatically in the US in recent decades. Using County Business Patterns data, figure 1 plots the share of private employment in the "Administrative and Support Services" industry. Firms in this industry, like temporary help agencies and janitorial service firms, typically supply establishments with low-skill, domestically outsourced labor. The share of total private employment in this industry more than quadrupled between 1980 and 2020.[1]

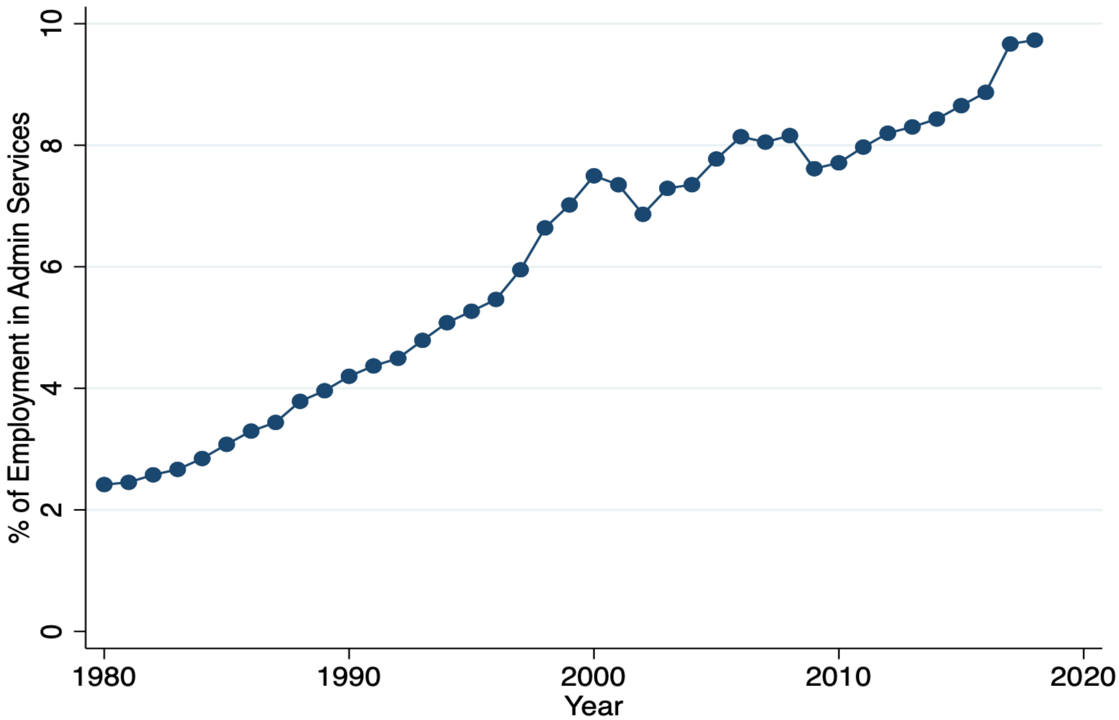
My hypothesis for the increase in low-skill domestic outsourcing centers on employer-provided health insurance. The idea is that employer health plans drive up the cost of in-house janitors, security guards, and other low-skill workers. So, firms outsource these workers to avoid offering them health plans. Over time, an increase in the cost of employer health plans could cause low-skill domestic outsourcing to increase. While this hypothesis is often discussed (e.g., Houseman (2001)), it is difficult to evaluate quantitatively. Empirical approaches are confounded due to a lack of suitable data and large general equilibrium effects, as the price of medical care more than doubled over the past four decades.

I explore this hypothesis using a structural model. The model has firms that choose the health plans they offer and the workers they outsource. Workers are heterogeneous in their skill level, and firms vary in how much high-skill labor they demand. The model also features several facets of the US health plan market. Ultimately, the model makes predictions on how these facets interact with aggregate trends to determine the share of low-skill workers that are outsourced.

The model has three types of agents. First are workers. Workers are exogenously heterogeneous in skill, and they inelastically supply labor to firms in exchange for compensation packages composed of wages and health plans. Health plans are like US cafeteria plan; they are an untaxed form of compensation that can only be spent on medical care. Workers are free to choose where they supply their labor, so they work for the firm that offers the highest utility. Second are traditional firms. Their

[1]Section A.1 has more information on the rise of low-skill domestic outsourcing. See Segal and Sullivan (1997) for an early discussion of the growth of temporary help services, a form of low-skill domestic outsourcing.

Figure 1: The Rise in Low-Skill Domestic Outsourcing



Notes: Underlying data is County Business Patterns data with harmonized industry classification from Eckert et al. (2021).

production technology uses labor of all skill levels, but they are heterogeneous in their skill intensity. All traditional firms use labor of every skill level, but some demand more high-skill labor than others. They face competitive labor markets, so they must match each worker's best outside option if they want to hire them as employees. Alternatively, they can outsource workers by engaging the services of an outsourcing firm at the going rate. Third are outsourcing firms, which supply outsourced labor to traditional firms. Each skill level has a single representative outsourcing firm. Like traditional firms, they face the same competitive labor markets. Unlike traditional firms, each outsourcing firm demands only one type of labor.

The model features three facets of the US health plan market. First is the tax advantage of employer health plans; wages are taxed while employer health plans are not. Second, health insurance is cheaper when purchased through the firm than on the private market. This is controlled by an exogenous parameter called the price wedge. Third are anti-discrimination regulations from the US tax code, which force firm to offer all their employees the same health plan.

In equilibrium, firms offer health plans because of the tax advantage and the price wedge. From the firm's perspective, offering health plans is the cheapest way to match a worker's reservation utility level. Either feature alone is sufficient to achieve this result. Further, there is a unique compensation package for each skill level that minimizes the cost of meeting their reservation utility level.

Outsourcing firms have lower labor costs than traditional firms. Because their workforces are homogeneous, they are unaffected by the anti-discrimination constraint. So, they offer the cheapest compensation packages possible while meeting their worker's reservation utility level. Conversely, traditional firms demand low- and high-skill workers, so the anti-discrimination laws prevent them from offering the cheapest compensation packages. This result shows how an outsourcing firm can exist in a competitive equilibrium: they purchase labor at a lower price than the traditional firms, then sell that labor to the traditional firms.

Two aggregate trends cause low-skill domestic outsourcing to increase. First is an increase in the price of medical care. Second is an increase in the demand for high-skill labor. Both trends increase the relative cost of the health plan that minimizes the price of high-skill employees. This causes traditional firms to increase their health plans. The anti-discrimination constraints then increase the cost of low-skill employees, relative to outsourced low-skill workers, thus increasing low-skill domestic outsourcing. While both trends effect outsourcing through a similar mechanism, the former is difficult to test empirically due to data constraints. Conversely, the latter can be tested using publicly-available industry-level data, allowing me to validate my model's main mechanism.

I find empirical support for model's relationship between high-skill demand and low-skill outsourcing using industry level data. I draw on several publicly available sources: the Annual Survey of Manufacturers, Services Annual Survey, the Occupational Employment and Wage Statistics, and Input-Output tables from the BEA. I find that as expenditure on high-skill labor increases across industries, so does health plan expenditures and ultimately low-skill domestic outsourcing expenditures. I also use this industry data to calibrate the model. The key parameter is the elasticity of substitution between low-skill employees and low-skill outsourced workers. This parameter is identified by how much variance in low-skill outsourcing expenditure can be explained by variance in low-skill labor costs. My estimate of this parameter is positive, large, and statistically significant.

I use the calibrated model to measure how much of the growth in low-skill domestic outsourcing was due to trends in the price of medical care and the demand for high-skill labor. The rising price of medical care is responsible for over half of the growth, while the trend in high-skill labor demand has a small effect. I also use the quantitative model to perform several policy counterfactuals. Removing the anti-discrimination laws increases the welfare of all workers by decreasing the cost of labor and thus increasing labor demand. Removing the tax advantage of employer health plans increases the welfare of high- and low-skill workers while having minimal effect on inequality. Forcing traditional firms to offer outsourced low-skill workers the same health plans as their employees increases the cost of low-skill outsourced workers, decreasing their demand and utility. Ultimately, this policy decreases the welfare of low-skill workers and slightly increases inequality.

I make four contributions to the literature on domestic outsourcing. First, I assess the health plan hypothesis. While media outlets, economists, politicians, and the general public often discuss this hypothesis, it has never been assessed qualitatively or quantitatively.

Second, while a common explanation for domestic outsourcing is that outsourced labor is cheaper than in-house labor, I contribute a new theoretical explanation for why outsourced labor is relatively cheaper. That is, compared to traditional firms, outsourcing firms are less affected by anti-discrimination health plan regulations because their workforces are more homogenous. Other explanations are centered on unions or worker power (Holmes and Snider, 2011), upward slopping labor supply curves (Bilal and Lhuillier, 2021; Bergeaud et al., 2021; Chan and Xu, 2017), or within-firm wage compression (Weil, 2019). More broadly, this is a new theoretical explanation for why firms outsource. Other explanations are centered on firing costs (Bostanci, 2021; Autor, 2003; Houseman et al., 2003) or specialization by the outsourcing firms (Abraham and Taylor, 1996).

Third, I contribute two new theoretical explanations for the growth of low-skill domestic outsourcing: rising medical care prices and rising demand for high-skill labor. The theory also clarifies what features are necessary for these trends to affect domestic outsourcing: the anti-discrimination constraints are crucial. Further, I assess both these explanations with my calibrated model. Alternative explanations for the increase in low-skill domestic outsourcing include rising firing costs (Autor, 2003), increased protection of trade secrets (Bostanci, 2021), and decreasing communication costs between firms (Bergeaud et al., 2021).

Fourth, with the calibrated model, I perform several policy counterfactuals, assessing changes in welfare and inequality from policies that affect domestic outsourcing. Broadly, this contributes to the literature that discusses how domestic outsourcing affects welfare. There is a large empirical literature that explores its effect on wages (Goldschmidt and Schmieder, 2017; Dube and Kaplan, 2010; Drenik et al., 2023; Dorn et al., 2018; Felix and Wong, 2021; Daruich et al., 2023). A smaller structural literature explores its effect on welfare and efficiency (Bostanci, 2021; Chan and Xu, 2017; Bilal and Lhuillier, 2021).

This paper is organized as follows. Section 2 discusses the US legislation concerning employer-provided health insurance. Section 3 and 4 presents the theoretical model and characterize equilibrium results. Section 5 uses cross-sectional industry data to find empirical support for the model's main predictions. Section 6 calibrates the model and discusses the main accounting exercise and policy counterfactuals. Section 7 concludes.

2 Institutional Background: Employer Health Plans

In the US, employer-provided health plans are widespread. In 2015, of all people covered by private plans, almost 90 percent were covered by employer-provided plans (Kaiser Family Foundation, 2021b). Further, in the same year, employer contributions to employer health plans were 7 percent of total employee compensation, according to NIPA data.[2]

Employers commonly provide health plans for two reasons. First is that firms face lower prices for health insurance than individuals do. One reason for this is because of adverse selection (Currie and Madrian, 1999). People who tend to be unable to

[2]Specifically, NIPA Section 6 Tables 6.2 and 6.11.

work and thus do not have access to health plans through their employers also tend to have high medical care expenditures, like old and sick people. So, the price of health insurance on the private market reflects this selection. Second is the favorable tax treatment. Compensation in the form of health plans is generally not taxed, while conversely, wages are. The tax rate on wages is high; Heathcote et al. (2017) estimates that the average marginal tax rate in the US was 34 percent in the early 2000s.

While employer health plans are generally not taxed, they are taxed just like wages if they violate anti-discrimination provisions of the US tax code. These laws force firms to offer all their employees the same menu of health plans. If they violate these laws, then compensation in the form of health plans is taxed just like wages. The anti-discrimination laws apply to two of the most common types of health insurance plans: self-funded plans and cafeteria plans. A self-funded plan is a health insurance plan in which the employer assumes direct financial responsibility for the costs of enrollees' medical claims (Kaiser Family Foundation, 2020). In 2021, 64% percent of employees with employer-provided health plans were covered by self-funded plans (Kaiser Family Foundation, 2021a). Under IRS Code section 105(h), self-funded benefit plans cannot discriminate in favor of the highest-paid 25 percent of all employees (Legal Information Institution, n.d.a). Cafeteria plans are plans in which employees can choose between receiving their compensation from the plans in the form of cash or as a benefit; if taken as a benefit, the compensation is not taxed (Society of HR Management, 2023). In 2006, 49% percent of all workers had access to some type of cafeteria health plan (Stolzfus, 2007). Under IRS Code section 125(c), cafeteria plans cannot discriminate in favor of highly compensated participants, which includes employees making over $80,000 a year (Legal Information Institution, n.d.b). Section 105(h) and 125 were both enacted in 1978 (Jensen et al., 1998; Government Publishing Office, n.d.).

The anti-discrimination laws force firms to offer all employees the same menu of health plans, but firms could offer multiple plans in an attempt to skirt these laws. A firm could offer a generous health plan with high employer premiums to satisfy its high-wage employees but make the employee premiums prohibitively expensive for the low-wage workers. Hence, the firm could attempt to induce low-wage workers into choosing cheap health plans. If this were the case, a significant amount of variance of employer health plan costs would be within firm, not between.

I find suggestive evidence that this is not the case in the 1990s — the period with the most growth in low-skill domestic outsourcing — as a majority of the variance of employer health plan costs was between firms. The 1993 Robert Wood Johnson Foundation Employer Health Insurance Survey has data on 22,000 plans offered by 15,000 employers (Long and Marquis, 2006). For each plan, the data set has the employer that offers the plan, the number of employees enrolled, and employer premiums. I use a simple variance decomposition to understand how much of the total dispersion of employer premiums is between firms. The decomposition is

$$\underbrace{Var(x_{ij} - \bar{x})}_{\text{Total dispersion}} = \underbrace{Var(x_{ij} - \bar{x}_j)}_{\text{Within firm}} + \underbrace{Var(\bar{x}_j - \bar{x})}_{\text{Between firm}}$$

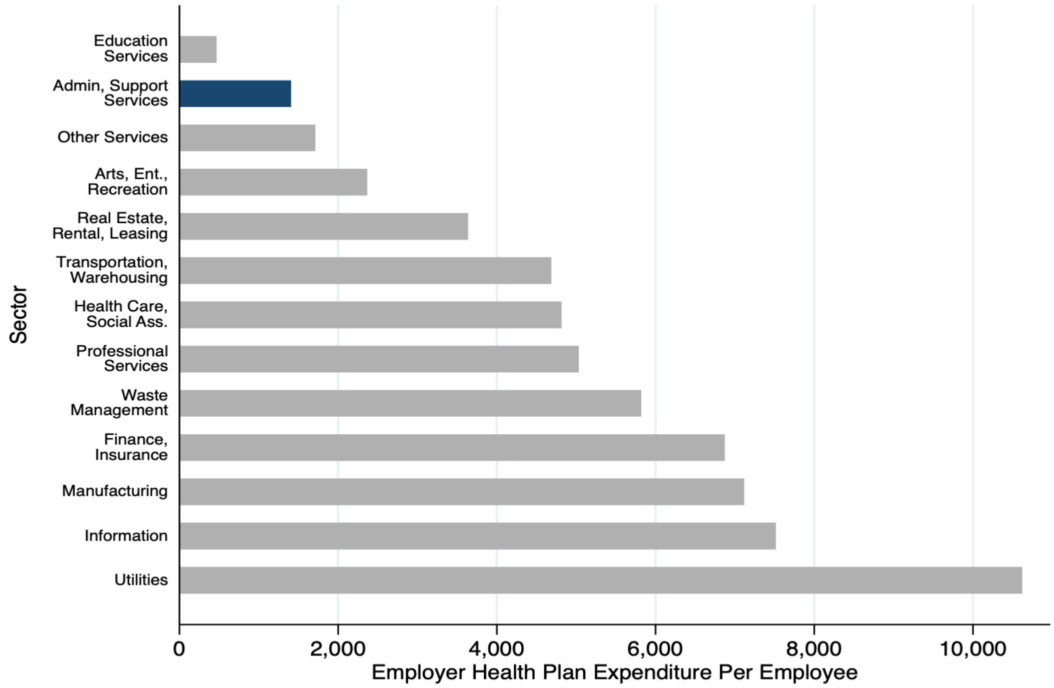
where i denotes a health plan, j is employer, x is employer premium, and the overbar denotes mean.[3] I run the above decomposition separately for single and family coverage, assuming singles and people with families operate in separate markets. I find that 83% of the total variation of single plan employer premiums is between firms. For family plans, 86% is between firms. of The results are not sensitive to weighting by employees.

One potential reason we do not see much evidence of within-firm variation in health plan costs over this period is that an alternative mechanism is available to firms that want to offer different plans to different workers: they can outsource their low-wage workers. Firms could outsource their janitors, security guards, and other low-wage workers so that they do not have to offer them the generous health plans that lawyers, computer scientists, and other high-wage workers want. This hypothesis is supported by figure 2, which shows health plan costs by industry using data cross-sectional industry data, which I decribe in section 5. As pictured, the "Administrative and Support Services" industry (NAICS 561), which supplies establishments with low-skill outsourced labor, has the second lowest health plan costs.

If the health plans that high- and low-skill workers want are identical, then the anti-discrimination laws have no effect. However, two trends over the past four decades could theoretically have increased the relative cost of the health plans preferred by high-skill workers. This would increase the cost of low-skill employees through the

[3]For a similar decomposition, see Haltiwanger et al. (2022).

Figure 2: Admin and Support Services has Low Health Plan Costs

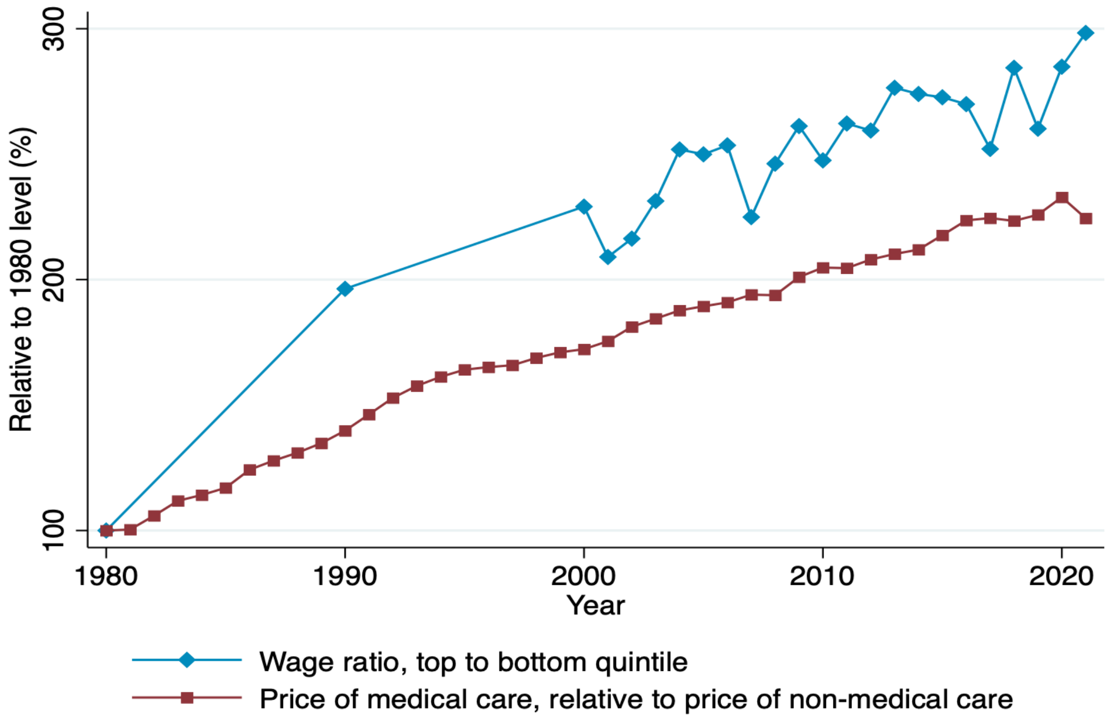


Notes: Data is drawn from the Annual Survey of Manufacturers, the Services Annual Survey, and County Business Patterns, as discussed in section 5. Sectors are 2-digit NAICS codes with several aggregations. Several sectors are missing because they are missing from the Services Annual Survey. Sector 56 is split into Admin and Support Services (NAICS 561) and Waste Management (NAICS 562). "Other Services" is the 2-digit NAICS code 81, not a grouping of all other services.

anti-discrimination laws. The first trend is the increase in the price of medical care, as seen in figure 3, which uses CPI data from FRED. The relative price of medical care more than doubled between 1980 and 2020. The second trend is the increase in the demand for high-skill workers. Figure 3 shows wages paid to the top quintile of earners divided by wages paid to the bottom quintile, using data from the American Community Survey. This ratio tripled between 1980 and 2021. As the supply of high-skill workers increased over this period, as measured by college completion rates, this increase is due to an increase in demand for high-skill workers.[4] These trends could increase the relative cost of the health plans that high-skill workers want. This could increase the relative cost of low-skill employees because of the anti-discrimination laws, increasing low-skill domestic outsourcing.

[4]For more information on the increase in income inequality or the increase in compensation paid to high-wage workers, see Krusell et al. (2000), Card and DiNardo (2002), Song et al. (2019), or Braxton et al. (2021).

Figure 3: Two Rising Trends: Medical Care Prices and the Skill Premium



Notes: The wage ratio series is drawn from the American Community Survey and the US Decennial Census, accessed through IPUMS (Ruggles et al., 2020). Wage quintiles are calculated for privately employed full-time workers, and the ratio is total wages paid to the top quintile divided by that of the bottom quintile. Price data is drawn from the Federal Reserve Bank Economic Data (FRED).

This paper aims to measure how much of the growth of low-skill domestic outsourcing can be attributed to the increases in both the price of medical care and the demand for high-skill labor. Because these trends happened over several decades and plausibly have significant general equilibrium effects, a general equilibrium model is necessary to test these hypotheses. Section 3 develops a general equilibrium theory with firms that choose what health plans to offer and which workers to outsource. Section 4 explains how each trend can increase low-skill domestic outsourcing by interacting with the anti-discrimination constraints. Section 5 calibrates the model, which section 6 uses to measure how much of the increase in domestic outsourcing can be accounted for by each trend.

3 A Theory of Outsourcing and Health Plans

The model has three types of agents: traditional firms, outsourcing firms, and workers. Workers vary exogenously in their skill level. They value wages and health plans and choose to supply their labor to the employer that offers the most attractive pair. Traditional firms vary exogenously in the skill intensity of their production process. They view labor markets as competitive and choose wages, health plan generosity, and how much of each type of worker to outsource. Each outsourcing firm hires only one type of labor and sells labor to traditional firms. The model makes predictions on how the legislation environment, aggregate trends in the price of medical care and the demand for high-skill labor, and differences in skill-intensity across firms effect domestic outsourcing.

3.1 Environment

There is a single time period. The economy has three types of agents: workers, traditional firms, and outsourcing firms. Workers are heterogeneous in skill; the discrete set of skills is $\mathcal{S}$, and the mass of workers of skill $s \in \mathcal{S}$ is N_s. The worker's utility function u is CES and turns (non-medical care) goods c and medical care m into utility,

$$u(c,m) = (\psi c^{1-1/\eta} + (1-\psi) m^{1-1/\eta})^{\eta/(\eta-1)}.$$

The parameter $\eta < 1$ is the elasticity of substitution between goods and medical care, and $\psi \in (0,1)$ is a weight.

The discrete set of traditional firms is $\mathcal{J}$. Firms' production technology inputs in-house labor and outsourced labor of each skill and outputs goods. Across skill levels, the technology is Cobb-Douglas. Within each skill level, the technology is CES between in-house labor n_{js} and outsourced labor l_{js}. Firm j's production technology is

$$y_j = z_j \left(\prod_{s \in \mathcal{S}} \left(n_{js}^{1-1/\theta_s} + \alpha_{js}^{1/\theta_s} l_{js}^{1-1/\theta_s} \right)^{\frac{\varphi_{js}\theta_s}{\theta_s - 1}} \right)^{\nu},$$

where $\nu < 1$ is the returns to scale parameter, $z_j > 0$ is efficiency, $\alpha_{js} > 0$ is a weight on outsourced labor, and $\varphi_{js} > 0$ is a skill weight. The skill weights sum to one,

$\sum_{s\in\mathcal{S}} \varphi_{js} = 1$. The parameter $\theta_s > 1$ is the elasticity of substitution between in-house and outsourced labor of skill s. For now, I assume that $\theta_s > 1\ \forall s \in \mathcal{S}$, implying that in-house and outsourced workers are gross substitutes; later, I estimate this parameter from the data.

The microfoundation for the CES aggregator is a discrete choice model. The firm must complete a continuum of tasks and decides to hire in-house or outsourced labor for each task. If the productivities of in-house and outsourced labor for each task are drawn from the appropriate extreme value distribution, the resulting problem is equivalent to the CES aggregator. The microfoundation is in appendix section A.3.

There is a single outsourcing firm for each skill $s \in \mathcal{S}$. The s-skill outsourcing firm's technology inputs s-skill labor n_{os} and outputs outsourced labor of the same skill, L_s. The technology is constant returns to scale, $L_s = n_{os}$.

3.2 Compensation Packages

Firms attract labor by offering compensation packages composed of wages w_{js} and health plans a_{js}. Wages and health plans are different in three ways. First, wages can be spent on goods or medical care, while health plans can only be spent on medical care. Second, wages are taxed at rate T while employer health plans are not. Third, medical care is exogenously more expensive when purchased with wages, with the magnitude controlled by the parameter γ. Medical care bought with wages and health plans are perfect substitutes. Health plans are simply an un-taxed form of compensation that is only spent on medical care, which is similar to how cafeteria plans work in the US.

3.3 Workers

Workers supply labor inelastically. Given a compensation package $\{w_{js}, a_{js}\}$, a worker chooses consumption c and medical care m to maximize utility u. Given the compensation packages offered by each firm, the worker's problem is to choose which firm to work at to maximize utility,

$$\max_{j \in \mathcal{F}} v(a_{js}, w_{js}; p_m)$$

where $\mathcal{F}$ is the set of all firms (traditional and outsourcing) and v is the indirect utility function

$$v(a_{js}, w_{js}; p_m) = \max_{c,m} u\left(c, m_1 + \frac{a_{js}}{p_m}\right)$$
$$s.t. \quad c + (1+\gamma)p_m m_1 \leq w_{js}(1-T)$$

where T is the average tax rate on wages and γ is an exogenous wedge that increases the price of medical care purchased with wages.

3.4 Traditional firms

Traditional firms choose in-house labor, outsourced labor, wages, and health plans for each skill level. Their objective is to maximize profits, which is revenue minus labor costs,

$$\pi_j = y_j - \sum_{s \in \mathcal{S}} \left((w_{js} + a_{js})n_{js} + p_{os} l_{js}\right) \tag{1}$$

where p_{os} is the price of outsourced labor. The firms' choices are subject to two constraints. First, firms must offer all in-house workers the same health plan.

$$a_{js} = a_{js'} \quad \forall s, s' \in \mathcal{S}. \tag{2}$$

Second, because workers move to whichever firm offers the highest utility, firms must offer each skill level a compensation package that yields at least as much utility as each skill's best-outside option, denoted $\tilde{v}_s$,

$$v(a_{js}, w_{js}; p_m) \geq \tilde{v}_s \quad \forall s \in \mathcal{S}. \tag{3}$$

The best outside option $\tilde{v}_s$ acts as a worker's reservation utility level; workers will not work for a firm offering a utility level less than it. Note that the price of medical care

p_m, the tax on wages T, and the price wedge γ enters into the firm's problem through this constraint.

The traditional firm's problem follows. Given reservation utility levels $\{\tilde{v}_s\}_{s\in\mathcal{S}}$ and the prices for outsourced labor $\{p_{os}\}_{s\in\mathcal{S}}$, firms choose employees n_{js}, outsourced labor l_{js}, wages w_{js}, and health plan a_{js} to maximize profits (1) subject to offering all employees the same health plan (2) and offering compensation packages that at least yield the reservation utility levels (3).

The baseline economy features two aspects of the US policy: the tax advantage of employer health plans and the anti-discrimination laws. Later, I compare the baseline economy to ones without these features.

3.5 Outsourcing firms

Recall the s-skill outsourcing firm only uses s-skill labor. Given the price of outsourced labor p_{os} and reservation utility level $\tilde{v}_s$, the s-skill outsourcing firm picks labor n_{os}, wages w_{os} and health plan a_{os} to maximize profits

$$p_{os}n_{os} - n_{os}(w_{os} + a_{os}).$$

subject to offering all in-house workers the same health plans (2) and offering a compensation package that at least yields the reservation utility level (3). Looking ahead, because they each use only one type of labor, by construction the anti-discrimination law does not effect the outsourcing firms in equilibrium.

3.6 Equilibrium Definition

Given the price of medical care p_m and other exogenous parameters, an equilibrium is reservation utility levels $\{\tilde{v}_s\}_{s\in\mathcal{S}}$, prices for outsourced labor $\{p_{os}\}_{s\in\mathcal{S}}$, choices for each traditional firm $\{n_{js}, l_{js}, a_{js}, w_{js}\}_{(j,s)\in\mathcal{J}\times\mathcal{S}}$, and outputs and choices for each outsourcing firm $\{L_{os}, n_{os}, a_{os}, w_{os}\}_{s\in\mathcal{S}}$ that satisfy the following: the compensation packages for each skill level yield their respective reservation utility levels so workers are indifferent to where they supply their labor; given prices and the reservation utility levels each firm solves their profit maximization problem; labor markets for in-house and outsourced labor clear,

$$n_{os} + \sum_j n_{js} = N_s \quad \forall s \in \mathcal{S},$$
$$\sum_j l_{js} = L_s \quad \forall s \in \mathcal{S}.$$

In the background, traditional firms produce the good that workers consume. The medical care firm purchases this good and uses a constant returns to scale technology to transform c_m units of goods into $z_m c_m$ units of medical care. Following from the medical care firm's profit maximization problem, the price of medical care is pinned by an exogenous parameter, $p_m = \frac{1}{z_m}$. Hence, I treat the price of medical care as exogenous. An entrepreneur uses profits from traditional firms — caused by the fact their production technology is decreasing returns to scale — to purchase this good. The resource constraint for this good clears by Walras's Law and thus is unnecessary to include in the equilibrium definition. Lastly, tax revenue entirely finances wasteful government spending.

4 Equilibrium Results

To simplify the discussion, I assume that the economy has only two skill levels. Without loss of generality, denote the skill level that has higher utility with an h for "high-skill", and denote the one with lower utility with an l for "low-skill".

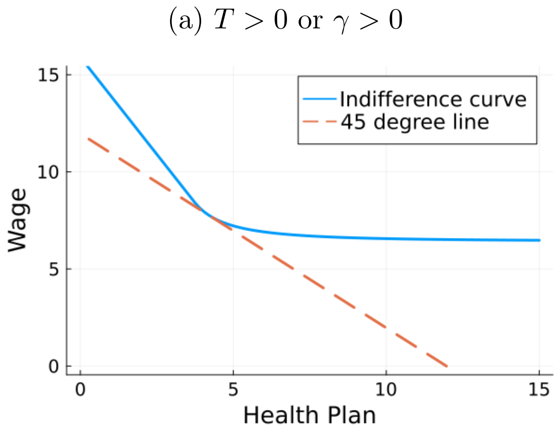
4.1 Optimal Compensation Packages and Labor Costs

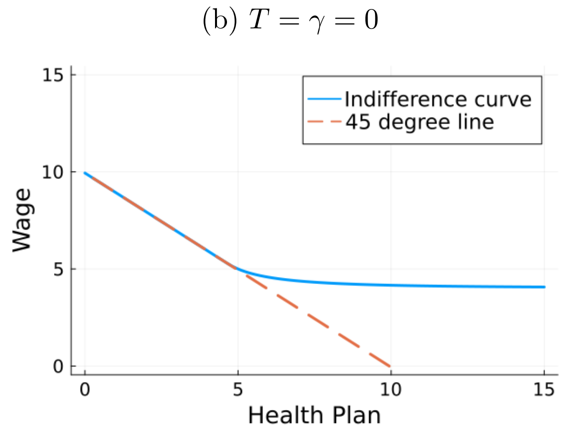
Consider a firm that is minimizing the cost of a worker while offering them their reservation utility level. The cheapest compensation package $\{a_s^*, w_s^*\}$ solves

$$\{a_s^*, w_s^*\} = \underset{\{a,w\}\in R_+^2}{\operatorname{argmin}} \left\{ a + w \mid v(a, w; p_m) \geq \tilde{v}_s \right\}.$$

In an economy with the tax-advantage on employer health plans $T > 0$ or the medical care price wedge $\gamma > 0$, the cheapest compensation package is unique and its health

Figure 4: Indifference Curves between Wages and Health Plans





Notes: The blue lines are indifference curves between wages and health plans; all compensation packages on an indifference curve yield the same utility level. The dashed orange line is a 45-degree line that passes through the cheapest compensation package that is on the indifference curve.

plan is positive, $a_s^* > 0$. This can be see in panel a of figure 4. For intuition, consider a firm offering only wages, and suppose one of their employees is spending \$X on medical care. This can purchase $\frac{X(1-T)}{(1+\gamma)p_m}$ units of medical care. Conversely, if the \$X was in the form of employer health plan, then it could purchase $\frac{X}{p_m}$ units of medical care, which is a $\frac{\gamma+T}{1-T}$% increase. Thus, by shifting the \$X of compensation from wages to employer health plans, the firm keeps its costs the same while increasing the utility it offers.

This example also illustrates why their is not a single cheapest compensation package in an economy without the tax advantage T or price wedge γ. As seen in panel b of figure 4, in such an economy, there are multiple cheapest compensation package, including the package composed of only wages.

When choosing a compensation package, traditional firms can choose from the set of compensation packages that satisfy the reservation utility constraints (3). However, the anti-discrimination constraint (2) and the fact they demand multiple skill levels of labor prevents traditional firms from offering each skill their cheapest compensation package. Following optimality conditions and a Taylor approximation, traditional firms intuitively choose a health plan between the high- and low-skill workers' cost-minimizing health plans.

Lemma 1. *The cost-minimizing health plan of a traditional firm, a_j, is approximately* *equal to a weighted average of each skill's cost-minimizing health plan a_s^*:*

$$\hat{a}_j \approx \sum_s \frac{\omega_{js}}{\sum_{s'} \omega_{js'}} a_s^*, \tag{4}$$

$$\omega_{js} = \underbrace{\varphi_{js}}_{\substack{\text{skill} \\ \text{weight}}} \times \underbrace{\frac{(w_{js}+a_j)n_{js}}{(w_{js}+a_j)n_{js}+p_{os}l_{js}}}_{\substack{\text{share of } s\text{-expenditure} \\ \text{on in-house labor}}} \times \underbrace{\frac{\partial^2}{\partial a^2}\Big(\log\big(a+w(a;\tilde{v}_s,p_m)\big)\Big)\Big|_{a=a_s^*}}_{\substack{\text{curvature of the cost of the} \\ \text{in-house compensation package}}},$$

where $w(a;\tilde{v}_s,p_m) = min_{w\in R_+}\big(w \mid v(w,a;p_m) \geq \tilde{v}_s\big)$.

Proof. See Appendix A.4 □

For any traditional firm j, the weight on the cost-minimizing health plan for s-skill employees, a_s^*, is increasing with (a) the s-skill weight, φ_{js}, (b) its share of s-skill labor expenditure that is on employees, and (c) the curvature of the price of s-skill employees at a_s^*. The intuition for (a) and (b) is that as the quantity of s-skill employees increases, the firm moves its health plan towards the health plan that minimizes the cost of s-skill employees. The intuition for (c) is that as the cost of deviating from a_s^* increases, the firm moves its health plan closer to a_s^*.

In the baseline economy outsourcing firms offer the cheapest compensation packages. Because they demand only a single skill type, the outsourcing firm is unaffected by the anti-discrimination laws. Hence, outsourcing firms have lower labor costs than traditional firms. This provides intuition for how outsourcing firms can exist in a competitive equilibrium; they purchase labor at a lower cost than the traditional firms, then sell that labor to the traditional firms. Further, because of their constant returns to scale technology, their labor costs pin the price of outsourced labor,

$$p_{os} = w_{os} + a_{os} = w_s^* + a_s^*. \tag{5}$$

4.2 Outsourcing Dynamics

The traditional firm's optimality conditions imply that the relative quantity of outsourced labor is proportional to the inverse of its relative price:

$$\underbrace{\frac{l_{js}}{n_{js}}}_{\substack{\text{outsourced over} \\ \text{in-house labor}}} = \alpha_s \underbrace{\left(\frac{w_{js} + a_{js}}{p_{os}}\right)^{\theta_s}}_{\substack{\text{compensation costs relative} \\ \text{to the price of outsourced labor}}}. \tag{6}$$

This expression is intuitive: an increase in the relative price of outsourced labor decreases the relative quantity, with the amount depending on the elasticity of substitution between in-house and outsourced labor θ_s. Plugging equation (5) into (6) yields

$$\underbrace{\frac{l_{js}}{n_{js}}}_{\substack{\text{outsourced over} \\ \text{in-house labor}}} = \alpha_s \underbrace{\left(\frac{w_{js} + a_{js}}{w_{os} + a_{os}}\right)^{\theta_s}}_{\substack{\text{compensation costs relative} \\ \text{to the outsourcing firm's}}}. \tag{7}$$

Hence, the relative quantity of outsourced labor at firm j depends on firm j's compensation costs relative to the outsourcing firm's. Equation (7) shows that traditional firms outsource for two reasons. First is the exogenous weight on outsourced labor α_{js}. Second is the fact the traditional firm has higher compensation costs than the outsourcing firm.

When the anti-discrimination constraint is removed, both the traditional and outsourcing firms offer the cheapest compensation packages that yield the reservation utility level. Hence, the compensation cost ratio equals one, and the relative quantity of outsourced labor is pinned by an exogenous parameter,

$$\frac{l_{js}}{n_{js}} = \alpha_{js}.$$

Thus, without the anti-discrimination laws, changes in the price of medical care or other aggregate variables like the reservation utility levels do not increase outsourcing. The intuition for this result is that in an economy without the anti-discrimination laws, changes in the price of medical care or other trends affect traditional and outsourcing firms identically.

Consider the baseline economy with the anti-discrimination laws. Following from equations (7) and (4), the relative quantity of low-skill outsourced labor is approximately equal to

$$\log\left(\frac{\hat{l}_{jl}}{\hat{n}_{jl}}\right) \approx \log\left(\alpha_{jl}\right) + \theta_l \log\left(1 + \underbrace{\left(\left.\frac{\partial^2 w\left(a, \tilde{v}_l\right)}{\partial a^2}\right|_{a=a_l^*}\right)}_{\substack{\text{Sensitivity of wage to} \\ \text{change in health plan}}} \times \underbrace{\left(\frac{\omega_{hj}}{\omega_{lj} + \omega_{hj}}\right)^2}_{\substack{\text{Weight on} \\ \text{high-skill}}} \times \underbrace{\left(a_h^* - a_l^*\right)^2}_{\substack{\text{Distance between cost-} \\ \text{minimizing plans}}} \times \underbrace{\frac{1}{w_l^* + a_l^*}}_{\substack{\text{Cheapest low-skill} \\ \text{compensation cost}}}\right).$$

where $w(a, \tilde{v}_s) = min_{w \in R_+}\big(w \mid v(a, w; p_m) \geq \tilde{v}_s\big)$.

An increase in the price of medical care can increase low-skill domestic outsourcing by increasing the distance between the high- and low-skill cost-minimizing plans. Whether this happens depends on whether the cross derivative $\frac{\partial^2 a_s^*}{\partial p_m \partial \tilde{v}_s} > 0$. If $\frac{\partial^2 a_s^*}{\partial p_m \partial \tilde{v}_s} > 0$, then an increase in the price of medical care increases a_h^* more than it increases a_l^*, spreading out the health plans and increasing $a_h^* - a_l^*$. A CES utility function in which goods and medical care are complements exhibits this property, as discussed in appendix section A.8.

An increase in the demand for high-skill workers can increase low-skill domestic outsourcing through two main channels. First, an increase in demand for high-skill workers also increases their utility, which spreads out the distance between the cost-minimizing plans, $a_h^* - a_l^*$. This channel is similar to that of the rising price of medical care. The second channel is the weight on the high-skill health plan in the firm's optimal health plan equation, $\frac{\omega_{jh}}{\omega_{jh}+\omega_{jl}}$. Suppose that the demand for high-skill labor increases due to an increase in the weight on high-skill labor φ_{jh} for some firm j. Then firm j increases its health plan as seen in equation (6) to decrease the cost of high-skill employees, which consequently increases both the relative cost of low-skill employees and low-skill outsourcing at firm j.

The second channel can be directly tested with data on the cross section of firms. Optimality conditions imply that skill weights equal skill shares of labor expenditure,

$$\varphi_{js} = \frac{\text{Expenditure on } s\text{-skill labor}}{\text{Total expenditure on labor}}. \tag{8}$$

Hence, this mechanism implies that firms with relatively high share of their expenditure on high-skill labor also offer a relatively expensive health plan and outsource a relatively large share of their low-skill labor. I formalize this mechanism in the following proposition.

Proposition 1. *Across firms there is a positive relationship between the share of labor expenditure on high-skill labor* $\frac{(w_{jh}+a_j)n_{jh}+p_{oh}l_{jh}}{\sum_s (w_{js}+a_j)n_{js}+p_{os}l_{js}}$*, health plan expenditure per employee* a_j*, and the share of low-skill labor expenditure on outsourced workers* $\frac{p_{ol}l_{jl}}{(w_{jl}+a_j)n_{jl}+p_{ol}l_{jl}}$.

Proof. See appendix A.5 □

While this proposition is defined at the firm level, it implies the same relationships across industries. Assume that firms within an industry all have identical skill weights. Then, the proposition directly implies the same relationships across industries: skill-intensive industries offer more generous health plans and outsource a relative high share of their low-skill labor.

To sum up, in the presence of the anti-discrimination regulations, an increase in the price of medical care or high-skill demand cause an increase in low-skill domestic outsourcing. While both trends effect outsourcing through a similar mechanism, the former is difficult to test empirically due to data constraints. However, the latter can be tested using publicly available cross-sectional data on industries. The following section 5 does just that and finds empirical support for this mechanism, validating my theory.

5 Data and Validation

5.1 Industry-Level Data

To map the firm-level theory to this data, I assume that firms within an industry all have identical skill weights, allowing them to be represented by a single firm. I then calibrate each representative firm with the most disaggregated industry data available. I focus on the year 2012 due to constraints in the underlying data.[5]

Data on employment and wages is drawn from the 2012 Occupation and Employment Wage Statistics (OEWS) data. This data has employment and wages by NAICS industry and granular 5-digit SOC occupation code.[6] I map occupation codes into three skill groups (low, medium, and high) equally sized in employment based on their average economy-wide earnings. For each industry, in-house s-skill labor n_{js} is the sum of employment in occupations of skill level s and wages w_{js} is the employee-weighted average wage for occupations of skill level s.

Data on health plans is drawn from the Annual Survey of Manufacturers (ASM) and the Services Annual Survey (SAS), which have health plan expenditure by industry. Because of the anti-discrimination laws and how the majority of employer premium variance is between firm as discussed in section 2, I assume that all employees within an industry receive the

[5] Health plan expenditure is only available for a wide range of industries between 2012-2017, while detailed measures of outsourcing expenditure from the Input-Output tables are most detailed in 2012.

[6] Some examples of 5-digit level occupation codes are "Podiatrists," "Traffic Technicians," and "Line Installers and Repairers."

same health plan. For each industry, health plan expenditure per employee a_j is simply total health plan expenditure divided by employees. Employee counts are taken from the ASM and County Business Patterns for the service industries because the SAS does not have employee counts.

Measures of outsourced labor expenditure are drawn from the 2012 BEA's Input-Output (IO) data.[7,8] The IO table has each industry's expenditure on outputs from all other industries. I assume that expenditures on the industries "Professional Services" (NAICS 541) and "Administrative Services" (NAICS 561) are expenditures on outsourced labor. Establishments in NAICS 561 supply firms with low-skill outsourced labor, like janitorial, security guard, and temporary help services, while establishments in NAICS 541 supply firms with high-skill outsourced labor, like legal, accounting, and management consulting services. To calculate outsourcing expenditure by skill by industry, $p_{os}l_{js}$, I map expenditure on each 4-digit sub-industry of 541 and 561 to the single skill levels that has the highest employment share in that sub-industry. (The skill level employment shares are from the OEWS.) For example, the most employed skill level in the janitorial service industry is low-skill, so I consider all expenditure on janitorial services to be expenditure on low-skill outsourced labor. For robustness, I also map each 4-digit sub-industry to multiple skill levels by multiplying expenditure by employment skill shares, and the results are similar.

Altogether, the cross-section has data on in-house employment n_{js}, wages w_{js}, and outsourcing expenditure $p_{os}l_{js}$ by skill by industry, and health plan a_j by industry for 128 industries. Industries are defined at the most detailed level possible given the availability in the underlying survey data. Every manufacturing industry is defined at the 4-digit level. Service industries are defined at the 2-, 3-, or 4-digit level.

5.2 Validating the Model's Cross-Sectional Predictions

As stated by proposition 1, across firms, there are positive relationships between high-skill labor expenditure share, health plan expenditure per worker a_j, and the outsourcing share of low-skill labor expenditure. To test these predictions, I regress these variables on each other, as seen in table 1, and I find strong empirical support for this proposition. In column 1, a 1pp increase in the high-skill share is associated with a 0.849 percent increase in health

[7]The BEA has several different Input-Output tables, varying by expenditure definition; I use the "Use Tables/Before Redefinitions/Producer Value". I use Before Redefinitions for consistent classification with the BEA's historical tables.

[8]The year 2012, at its most disaggregate level, has 405 industries, as opposed to 71 in most other years.

Table 1: Cross-Sectional Regressions

	(1) log a_j	(2) $\frac{\text{low-skill outsourcing exp}}{\text{low-skill labor exp}}$	(3) $\frac{\text{low-skill outsourcing exp}}{\text{low-skill labor exp}}$	(4) $\frac{\text{low-skill outsourcing exp}}{\text{low-skill labor exp}}$
$\frac{\text{high-skill exp}}{\text{total labor exp}}$	0.849***		0.973***	0.867***
	(0.262)		(0.118)	(0.122)
log a_j		0.197***		0.124***
		(0.0339)		(0.0276)
Observations	128	128	128	128
R^2	0.071	0.153	0.371	0.427

Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

plan expenditure per employee. Column 2 shows that a 1 percent increase in health plan expenditure per employee a_j is associated with a 0.197pp increase in the low-skill outsourcing share. Column 3 shows that a 1pp increase in the high-skill share is associated with a 0.973pp increase in the low-skill outsourcing share. All coefficients are large, positive, and statistically significant. The size and statistical significance of these coefficients do not change when controlling for covariates associated with an industry's outsourcing ability: communication services expenditure per employee, and medium- and high-skill outsourcing expenditure per employee.

In the model, the reason low-skill outsourcing increases with skill intensity is entirely due to health plans; an increase in φ_{jh} causes the firm to demand more high-skill labor, so they increase a_j to decrease their costs, which consequently increases the relative price of in-house low-skill labor $w_{jl} + a_j$. However, as seen in column 4 of table 1, skill intensity still statistically affects the low-skill outsourcing share even with health plan a_j included in the regression. Hence in the data, skill-intensive industries outsource more low-skill workers for other reasons besides the effect of health plans.

One explanation for this is that benefits other than health plans must also be shared across all in-house workers. The cost of these benefits could be positively associated with the high-skill share in the regression and the low-skill outsourcing share, biasing the estimate on the high-skill share upwards. Another possible explanation is that skill-intensive industries invest in technology that decreases the cost of low-skill labor. This would allow them to outsource a large amount of their low-skill workers and offer expensive health plans. Through the lens of the model, this is interpreted as a positive correlation between the high-skill weight φ_{jh} and the low-skill outsourcing weight α_{jl}.

To sum up, this section uses industry-level data to find empirical support my model's main mechanism. I also find empirical support for this mechanism using state level data from the Quarterly Workforce Indicators, which I detail in Appendix Section A.6. The next section uses the industry-level data to calibrate my model and performs several quantitative exercises.

6 Quantitative Exercises

This section has three parts. First, I calibrate the model to the year 2012 using the cross-sectional industry data from the previous section. The key parameter is the elasticity of substitution between low-skill employees and low-skill outsourced workers. Following from optimality conditions, the parameter is identified by how much variance in outsourcing expenditure is explained by variance in the cost of employees across industries.

Second is an accounting exercise that attributes the growth in outsourcing to the increase in the price of medical care, the increase in demand for high-skill labor, the passage of the anti-discrimination laws, and interactions between these factors. I solve for the equilibrium of the 2012 baseline model, change a facet of the model to match a moment from 1975, then solve for the new equilibrium. I attribute the change in outsourcing between the two equilibriums to the facet I changed.

Lastly, I perform several policy counterfactuals and measure their welfare and inequality implications. First, I remove the anti-discrimination constraint. Second, I remove the tax advantage of employer health plans. Third, I force the traditional firm to offer outsourced workers the same health plans as employees.

6.1 Calibration

I assume there is only one traditional firm, which simplifies calibration. As before, there are three skill levels: low, medium, and high. As this paper is focused on low-skill domestic outsourcing, I shut off high- and medium-skill outsourcing by simplifying the traditional firm's production technology:

$$y = z\left(\left(n_l^{1-1/\theta_l} + \alpha_l^{1/\theta_l} l_l^{1-1/\theta_l}\right)^{\frac{\varphi_l\theta_l}{\theta_l-1}} n_m^{\varphi_m} n_h^{\varphi_h}\right)^{\nu},$$

where the l subscript denotes low skill, m medium skill, and h high skill. I dropped the j subscript because now there is only a single traditional firm. My calibration strategy has three steps. First, I normalize a subset of parameters. Second, I exogenously assign all but one of the remaining parameters. Lastly, I calibrate the remaining parameter using a minimum distance estimator.

First, I normalize three parameters. I normalize the price of medical care to 1 in the baseline model. In a counterfactual, I change this price to measure its effect on outsourcing. I also normalize the efficiency of the traditional firm z and the mass of workers N to 1.

Second, I exogenously assign several parameters. I set the share of each type of worker to be equal, $N_s = \frac{1}{3}N \ \forall s \in \{l, m, h\}$, because I assumed each skill level had the same share of employment when mapping the data on occupations to skills. I set the tax on wages $T = 0.34$ to match the average marginal tax rate from Heathcote et al. (2017). I set the price wedge parameter γ so that workers pay 4.77 percent more for medical care out-of-pocket, which matches the difference between average annual premiums for family plans between large and small firms in 2012 (Kaiser Family Foundation, 2021a). I use the difference between large and small firms because an estimate of the difference between firms and individuals is difficult to find. To calibrate the traditional firm's skill weights, I use the optimality condition (8) to set skill weights equal to skill expenditure shares, which are calculated using the data from section 5. I set the returns to scale of the traditional firm, ν, to 0.95.

To calibrate the utility function parameters, the weight ψ and elasticity of substitution η, I target the price elasticity of medical care consumption across time. To do this, I set up a simple representative household problem with a CES utility function,

$$\max_{c,m} \left(\psi c^{1-1/\eta} + (1-\psi)\, m^{1-1/\eta}\right)^{\frac{\eta}{\eta-1}} \ \ s.t.\ p_c c + p_m m \leq y \tag{9}$$

where c is non-medical care consumption, m is medical care consumption, p_x is the price of x, y is income, ψ is a weight and η is the elasticity of substitution. Time subscripts on the quantities and prices are omitted for convenience. Optimality implies

$$\Delta \log\left(\frac{p_m m}{p_c c}\right) = (1-\eta)\,\Delta \log\left(\frac{p_m}{p_c}\right).$$

Data on relative prices $\frac{p_m}{p_c}$ and expenditure ratios $\frac{p_m m}{p_c c}$ are from FRED. The above regression yields an estimate of the elasticity of substitution $\eta = 0.11$. The weight parameter ψ is estimated using the optimality conditions from (9) and data from 2012:

$$\psi = \left(1 + \left(\frac{p_m}{p_c}\right)^{1-1/\eta} \left(\frac{p_m m}{p_c c}\right)^{1/\eta}\right)^{-1}.$$

Note that CES preferences are homoethetic. Generally, this means that as income increases, expenditures shares do not change. In my model this implies that the composition of the cost-minimizing compensation package $\{a_s^*, w_s^*\}$ does not change with respect to changes in utility level. As outsourced workers receive their cost-minimizing compensation packages, this implies that health plan's share of total compensation for outsourced workers $\frac{a_s^*}{a_s^*+w^s}$ does not change across skill levels. I find support for this implication. I compare the compensation packages of outsourced workers — which are workers in "Administrative Services" and "Professional Services". I drop the "Professional Services" sub-industries that are not highly-homogeneous, as the theory suggests outsourced workers receive their cost-minimizing because they are in homogeneous firms. For low-skill outsourced workers, health plans make up 4.9% of their compensation. For medium-skill, its 4.6%. For high-skill, its 4.9%. Hence, I find evidence in support of homothetic preferences.

The last parameter I estimate externally is the elasticity of substitution between in-house and outsourced low-skill labor, θ_l. Manipulating equation (6) yields

$$\underbrace{\log \frac{p_{ol} l_{jl}}{n_{jl}}}_{\substack{\text{outsourcing expenditure} \\ \div \text{ in-house employees}}} = \theta_l \log(\underbrace{w_{jl} + a_j}_{\substack{\text{compensation} \\ \text{costs}}}) + \underbrace{(1-\theta_l)\log p_{ol}}_{\text{constant}} + \underbrace{\log \alpha_{jl}}_{\text{shifter}} + \underbrace{\epsilon_{js}}_{\substack{\text{error} \\ \text{term}}}$$

Hence, the parameter θ_l can be estimated with the cross-sectional industry data. The only complication is the parameter α_{jl}, which acts as an exogenous shifter; in words, some industries are inherently better at outsourcing low-skill workers. Omitting this parameter biases my estimate of θ_l upwards. If an industry has a high α_{jl}, holding all else equal, they outsource a relatively high share of low-skill labor, which increases the dependent variable. This also allows them to increase their health plan a_j to decrease their cost of in-house high-skill labor, which increases the cost of low-skill labor, $w_{jl} + a_j$. Hence, the shifter α_{jl} is positively correlated with both the dependent variable and the key independent variable, so omitting it will bias my estimate of θ_l upwards.

To control for the shifter α_{jl} I include controls for high- and medium-skill outsourcing expenditure per employee and communication services expenditure per employee. Using cross-sectional industry data I run the regression

$$\log \frac{p_{ol} l_{jl}}{n_{jl}} = \theta_l \log(w_{jl} + a_j) + \beta_0 + \beta_1 X_j + \epsilon_j. \tag{10}$$

where X_j includes logged per-employee expenditures for communication services and non-low-skill outsourcing. The variable of interest, θ_l, is identified by how much of the variance in outsourced labor expenditure relative to the quantity of employees can be explained by variance in the cost of employees.

The results of this regression are in table 2. I find that the elasticity of substitution θ_l is large, positive, and statistically significant. The first column of table 2 corresponds to the regression with no controls. I find that a 1 percent increase in the price of in-house low-skill labor increases the low-skill outsourcing expenditure per low-skill employee by 5.509 percent. With all controls in the third column, this estimate decreases to 3.258. All estimates of θ_l are statistically significant. I use the estimate with controls, $\theta_l = 3.258$, in my calibration.

Table 2: Elasticity of Substitution, In-house vs Outsourced Low-Skill Labor

	(1)	(2)	(3)
	Low-skill out expnd per low-skill employee		
Low-skill compensation $w_{jl} + a_j$	5.509***	4.546***	3.258***
	(0.746)	(0.578)	(0.500)
Communication services expnd per employee		1.036***	0.400***
		(0.108)	(0.120)
Non-low-skill out expnd per employee			0.828***
			(0.105)
Observations	127	125	125
R^2	0.304	0.600	0.735

Standard errors in parentheses.

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

Notes: The table shows the regression results from equation (10). All variables are in logs.

I calibrate the final parameter, the weight on low-skill outsourced labor α_l, using a minimum distance estimator (MDE). I set this parameter to match the percent of low-skill workers that are outsourced. The pairing between this moment and this parameter is direct; an increase in α_l directly increases low-skill outsourcing. I estimate the quantity of low-skill outsourced workers in year t as the number of low-skill workers in "Administration and Support Services" (NAICS 561) adjusting by the share of the industry's output that is used as intermediate inputs:

Table 3: Summary of Parameters and Moments

Parameter	Description	Value	Moment	Model	Data
Normalized					
p_m	Price of medical care				
z	Efficiency				
N	Mass of workers				
External					
N_s	Mass of workers of skill s	$\frac{1}{3}N$			
η	Elast. of subs., goods vs medical care	0.11			
ψ	Weight on goods in utility	0.81			
γ	% more workers pay for medical care out of pocket	0.05			
T	Average tax on wages	0.34			
ν	Returns to scale, traditional firms	0.95			
θ_l	Elast. of subs., low-skill, in vs outsourced	3.26			
φ_s	Skill weights		Expenditure shares		
MDE					
α_l	Weight on low-skill outsourced labor in production	0.08	% of low-skill outsourced	0.14	0.14

Notes: The table shows the parameter values and matched moments from the main model specification. The model is calibrated to the year 2012.

$$\text{Low-skill outsourced workers}_t = n_{561,t} \times n^l_{561,2012} \times m_{561,t}$$

where $n_{561,t}$ is employment in administrative services in year t, $m_{561,t}$ is the share of administrative services' output that is used as intermediate inputs, and $n^l_{561,2012}$ is the share of administrative services' employment that is low-skill in the year 2012. I use this share across all years because the underlying data used to calculate these shares, the OEWS data, is not consistently offered before 1997. Table 3 summarizes the targeted moments and parameter estimates. The model successfully matches the share of low-skill outsourced workers.

6.2 Accounting for the Rise of Low-Skill Domestic Outsourcing

To account for the rise of low-skill domestic outsourcing between 1975 and 2012, I model the year 1975 by changing three factors. First, I decreasing the price of medical care to its 1975 level. Second, I decrease the high-skill weight φ_5 so that the change in high- to low- wage ratio $\frac{E[w_h]}{E[w_l]}$ matches that in the data between 1975 and 2012. Construction of the high- to low-wage ratio uses American Community Survey data and is detailed in appendix section A.7. Third, I remove the anti-discrimination constraints. Then one-by-one and in combination I add back each feature, comparing outsourcing rates in the different equilibriums.

Table 4 shows the results. As expected from the discussion in section 4, the two trends have no effect on outsourcing in an economy without the anti-discrimination laws. Adding the laws alone explains 23 percent of the increase in low-skill domestic outsourcing seen in

Table 4: Accounting for the Increase in Low-Skill Domestic Outsourcing

	Δ p.p.	% explained
Data:	10.72	
Model:		
High-skill demand $\varphi_h \uparrow$ alone	0	0
Price of medical care $p_m \uparrow$ alone	0	0
Anti-discrimination laws alone	2.49	23.2
Laws + $\varphi_h \uparrow$	2.49	23.2
Laws + $p_m \uparrow$	5.79	54.0
Laws + $\varphi_h \uparrow + p_m \uparrow$	5.79	54.1

Notes: The table shows the percentage point change in low-skill domestic outsourcing between 1975-2012 and the amount of this change explained by the model counterfactual.

the data. The laws plus the increase in the price of medical care explain 53 percent of the increase seen in the data. I conclude that the rising price of medical care interacting with the laws was a major driver of the increase in low-skill domestic outsourcing.

The table also shows that the increase in the demand for high-skill labor has a minimal effect on low-skill domestic outsourcing. Given an increase in utility for high-skill workers, the traditional firm finds it optimal to increase wages as opposed to increasing health plans. Because the firm does not increase its health plan, the cost of low-skill employees does not increase so low-skill domestic outsourcing does not increase. This result follows from the fact that the increase in high-skill demand is concentrated at the top of the skill distribution; if the increase effected both high- and medium-skill workers, then it causes low-skill domestic outsourcing to increase. However, since it only effect high-skill, firms find it optimal to increase wages for just the high-skill workers, as opposed to increasing the health plans for all of their workers.

6.3 Policy Counterfactuals

The first policy counterfactual is the removal of the anti-discrimination laws. The goal of these laws is to improve the quality of health plans that low-skill workers receive. However, by increasing the health plan paid to low-wage workers, it increases the cost of low-skill workers, decreasing their demand and utility. So, while the goal of the anti-discrimination laws is to increase the health plans and, thus, utilities of low-skill workers, it could have the opposite effect.

Panel a of table 5 displays changes in utility, mean wages, and mean health plans for

Table 5: Policy Counterfactuals: Changes in Welfare Relative to Baseline Economy

	Skill		
	Low	Medium	High
a. Remove Anti-Discrimination Laws			
%Δ Utility v_s	18.3	0.2	9.8
%Δ Wage $E[w_{js}]$	24.4	-0.9	-23.0
%Δ Health Plan $E[a_{js}]$	-25.0	1.9	104.5
b. Remove Tax Advantage of Employer Health Plan			
%Δ Utility v_s	14.5	-3.7	4.8
%Δ Wage $E[w_{js}]$	6.3	6.6	2.6
%Δ Health Plan $E[a_{js}]$	-6.3	-11.3	-11.3
c. Outsourced and Employees get Same Health Plan			
%Δ Utility v_s	-3.9	0.0	0.0
%Δ Wage $E[w_{js}]$	-4.7	0.5	0.3
%Δ Health Plan $E[a_{js}]$	5.1	-0.6	-0.6

Notes: The table shows the change in metrics for the policy counterfactual economies relative to the baseline economy.

each skill level upon removing the anti-discrimination laws from the baseline 2012 model. Removing the anti-discrimination laws increases welfare for all workers. The traditional firm can offer each skill level its cost-minimizing compensation package. This decreases the cost of all types of workers, which increases the demand for and, thus, the utility of each type. The low- and high-skill workers' utility increases by 18.3% and 9.8%. The low-skill worker gets a large decrease in their health plan and a large wage increase. Symmetrically, the high-skill workers get a large wage decrease and a large increase in their health plans.

The second policy counterfactual is removing the tax exemption of employer health plans. The tax exemption on employer-provided health plans is costly; according to Congressional Budget Office (2019), the tax exclusion of employer health plans cost the government $300 billion dollars in 2020. This exemption acts as a substantial subsidy on employer health plans Finkelstein et al. (2023), and a large literature documents the distortionary effects of this subsidy on health insurance coverage, wages, and labor supply decisions (e.g. Gruber and Madrian (2002)). Finkelstein et al. (2023) finds that removing this tax subsidy would decrease the college wage premium by 11 percent and increase non-college employment by half a million.

Panel b of table 5 displays changes in welfare metrics upon removing the tax advantage of employer health plans. Specifically, I add a tax to health plans that is equal to that on wages while keeping tax revenue neutral by decreasing the tax rate. Removing the tax advantage increases the utility of low-skill workers by 14.5 percent. The cost-minimizing health plans for each skill level all decrease and move closer together, which makes the anti-discrimination law less costly. The cost of the low-skill worker decreases, increasing their demand and utility. High-skill workers experience a 4.8 percent increase in utility, while medium-skill workers see a 3.7 percent decrease.

The third policy counterfactual forces traditional firms to offer outsourced workers the same health plans as employees. This policy is similar to Assembly Bill 5 in California (California Legislative Information, 2019), that suggested by the Labor Secretary in 2021 (Bose, Nandita, 2021) or other policies that classify outsourced workers as employees. The idea behind these policies is to give outsourced workers access to employe benefits and increase their compensation. However, they could have adverse effect as they increase the cost of low-skill workers, decreasing their demand and utility. In the model, the policy moves the low-skill outsourced worker along its indifference curve, increasing its health plan, decreasing its wages, and increasing their compensation package costs. This increase in cost decreases the demand and utility of low-skill outsourced workers.

Panel c of table 5 displays changes in welfare metrics upon forcing the traditional firm to offer outsourced workers the same health plans as employees. The cost of outsourced low-skill labor increases, decreasing their demand and utility. Their utility decreases by 3.9 percent. The fact that low-skill outsourced workers get the same health plans as employees raises the cost of offering a generous health plan, so the traditional firm decreases its health plans. To offset the decrease in health plans, the firm raises the wages of medium- and high-skill workers, keeping their utility unchanged.

Table 6 displays measures of inequality for the baseline and policy counterfactual economies. In the baseline economy, the high-skill worker makes 4.6 times the wage of the low-skill worker. Without the anti-discrimination laws, the traditional firm increases (decreases) the health plan and decreases (increases) the wage paid to high-skill (low-skill) workers, and the wage ratio drops to 2.9. However, the utility ratio does not change much compared to the baseline economy. Hence, while wages change a lot, health plans compensate so that the utility ratio only slightly changes. The other two counterfactuals have smaller effects on inequality.

Table 6: Inequality in the Baseline and Counterfactual Economies

	Ratio, high- to low-skill	
Economy	Wage $E[\frac{w_{jh}}{w_{jl}}]$	Utility $\frac{v_h}{v_l}$
Baseline	4.7	3.1
Remove Anti-Discrimination Laws	2.9	2.9
Remove Tax Advantage of Employer Health Plan	4.5	2.8
Outsourced and Employees get Same Health Plan	4.9	3.2

Notes: The table shows the change in the wages and utility of the high-skill workers relative to that of the low-skill, for the baseline and policy counterfactual economies.

7 Conclusion

I create a new theory that features domestic outsourcing and employer health plans. Qualitatively, I find that a rising price of medical care or rising high-skill labor demand can increase low-skill domestic outsourcing by interacting with anti-discrimination laws. By a similar mechanism, more skill-intensive firms are more likely to outsource low-skill positions. I find empirical support for this prediction. Using the calibrated model, I find that the price of medical care interacting with the health plan laws was responsible for over 50 percent of the increase in low-skill outsourcing seen in the data. Conversely, rising high-skill labor demand had a minimal impact on the trend. This is the first theory of domestic outsourcing that is centered on health plans. Further, this is the first paper to quantitatively measure the effect of the rising price of medical care on domestic outsourcing.

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A Appendix

A.1 The Rise of Low-Skill Domestic Outsourcing

As is common in the literature, I use industry classification to identify outsourced labor.[9] I define employment in "Administrative and Support Services" (NAICS 561) as low-skill domestically outsourced labor and measure this using County Business Patterns data from Eckert et al. (2021), who use crosswalks to harmonize industry classification across time. I classify expenditure on output from this industry as expenditure on low-skill domestically outsourced labor, and I measure this expenditure using input-output tables from the BEA.

Since 1980 firms increased their usage of low-skill domestically outsourced labor of many occupations. This can be seen in table 7, which documents the growth of 5-digit sub-industries of "Administrative and Support Services". The table shows the growth of the industry is due to the growth of multiple sub-industries. As sub-industries specialize in different occupations, this implies that the overall growth of the industry is due to growth across multiple occupations. "Temporary Help Services" by nature employs many different occupations. "Janitorial Services" mainly employs janitors, while "Security Services" mainly employs security guards."Professional Employer Organizations" supply firms with Human Resources services. (Arguably, this industry fits better in medium- or high-skill domestic outsourcing. This is the only major sub-industry of Administrative Services that qualitatively does not fit under the low-skill outsourcing label.)

If service industries, on average, use more outsourced labor than manufacturing, then the shift of economic activity towards services would mechanically increase domestic outsourcing. I find that this is not the case using a variance decomposition. Let s denote expenditure on low-skill domestically outsourced labor divided by value added. The change in this ratio over a period is

$$\Delta s = \sum_{j \in J} \underbrace{\bar{\omega}_j \Delta s_j}_{\text{within-industry}} + \underbrace{\Delta \omega_j \bar{s}_j}_{\text{between-industry}}$$

where J is the set of all industries and ω_j is industry j's share of total economy-wide output. The over bar denotes the mean of the variable over the period, and Δ denotes the percentage point change over the period. The within-industry component measures how much of the overall change was due to changes that occured within each industry. Between 1970 and 2021, the within component was responsible for 86% of the total increase, while the between component was responsible for only 14%. Hence, the increase in expenditure on low-skill

[9] See Dube and Kaplan (2010), Dorn et al. (2018), or Bostanci (2021)

Table 7: Employment Growth by Low-Skill Outsourcing Industry, 1980-2015

	Employment Share, %		
Admin Services 5-digit Sub-Industry	1980	2015	Change, pp
Temporary Help Services	0.4	2.7	2.2
Professional Employer Organizations	0.1	2	1.8
Janitorial Services	0.3	0.8	0.5
Security Services	0.2	0.6	0.4
Office Administrative Services	0.1	0.4	0.3
Telephone Call Centers	0.1	0.4	0.2
Facilities Support Services	0	0.2	0.2
Other	1.4	1.6	0.2

Notes: The table displays employment shares for the 5-digit sub-industries of Administrative and Support Services (NAICS 561). An industry's employment share is its share of total private employment. Data is from Eckert et al. (2021).

domestic outsourcing is due to many industries increasing their use of outsourced labor, not the shift from manufacturing to services.

How does the growth of low-skill domestic outsourcing compare to that of other intermediate inputs? Table 8 shows the share of the economy's total output paid to intermediate inputs from every sector. The share of the economy's output paid to intermediates from the low-skill outsourcing industry increased by 1.7 percentage points between 1980 and 2015. Over this same period, only two sectors experienced higher growth: Finance, Insurance, and Real Estate (NAICS 53 and 55); and Professional, Scientific, and Technical Services (NAICS 541). The latter is associated with high-skill outsourcing, comprising accounting, legal, managerial consulting, and other high-skill services. All other service industries combined had less growth along this dimension, while goods-producing industries saw a significant decline.

A.2 Employer health plans

A.3 Microfoundation for the CES Aggregator

This section follows Eaton and Kortum (2002). For each skill level $s \in \mathcal{S}$ there is a unit measure of tasks $j \in [0, 1]$. These unit measures do not overlap; each task can be completed by only one skill level. I drop firm and skill subscripts from here on out for convenience.

Workers are either in-house or outsourced. I call a worker's employment status its type. The efficiency of type i workers in producing a unit of task j is $z_i(j)$. Hence $Q_i(j) =$

Table 8: Change in Economy-Wide Intermediate Input Intensity, 1980-2015

	Share of Economy's Output, %		
Intermediates Supplied by Sector	1980	2015	Change, pp
Finance, Insurance, and Real Estate	4.7	9.4	4.6
Professional, Scientific, and Technical Services	2.9	5.5	2.6
Administrative and Support Services	0.9	2.5	1.7
All Other Service Industries	10.6	12.2	1.5
Goods-Producing Industries	31.4	17.1	−14.2

Notes: The table shows the share of economy-wide output spent on intermediate inputs from each sector. Data is from Input-Output tables from the BEA.

$n_i(j) * z_i(j)$.

With CRS, the price of a unit of task j from workers of type i is $p_i(j) = \left(\frac{c_i}{z_i(j)}\right)$, where c_i is the input cost for workers of type i. For in-house workers, $c_{in} = (w+a)$, and for outsourced workers $c_{out} = p_o$. Firm chooses to outsource task j if the price is lower.

Assume that task-level labor $Q(j)$ is aggregated in a CES fashion to yield total labor,

$$\mathbf{n} = \left(\int_0^1 Q(j)^{\frac{\sigma-1}{\sigma}} dj\right)^{\frac{\sigma}{\sigma-1}}.$$

where $Q(j) = \sum_i n_i(j) * z_i(j)$.

Assume efficiency of type i workers for task j $z_i(j)$ is the realization of a random variable z_i drawn independently for each j from a type specific discribution $F_i(z)$. Assume that this distribution is a Frechet distribution,

$$F_i(z) = e^{-T_i z^{-\psi}}$$

where $T_i > 0$ and $\psi > 1$. Following Eaton and Kortum (2002), assuming that the efficiencies are pulled from a Frechet distribution yields that the price index for labor $\mathbf{n}$ is

$$q_n = \gamma[\sum_i T_i c_i^{-\psi}]^{-1/\psi},$$

where $\gamma = \left[\Gamma\left(\frac{\psi+1-\sigma}{\psi}\right)\right]^{1/(1-\sigma)}$ is a constant (Γ is the Gamma function). The share of expenditure on type i workers is

$$\frac{X_i}{X} = \frac{T_i c_i^{-\psi}}{\sum_{i'} T_{i'} c_{i'}^{-\psi}}.$$

Thus, the expenditure shares and price index from the task-based set up match the model's main CES specification. To clearly see this, set parameters $\psi = \theta - 1$, $T_{in} = \gamma^{\psi}$, and $T_{out} = \alpha\gamma^{\psi}$.

A.4 Proof of Lemma 1

The traditional firm first order conditions (dropping the j subscript for convenience) are

$$\nu\varphi_s y = q_s \mathbf{n}_s \quad \forall s \tag{11}$$

$$\tilde{v}_s = u(w_s, a) \quad \forall s \tag{12}$$

$$\frac{\partial q_s}{\partial w_s}\mathbf{n}_s = \lambda_s \frac{\partial u_s}{\partial w_s} \quad \forall s \tag{13}$$

$$\sum_s \frac{\partial q_s}{\partial a}\mathbf{n}_s = \sum_s \lambda_s \frac{\partial u_s}{\partial a} \tag{14}$$

where $q_s = [(w_{js}+a_j)^{1-\theta_s} + \alpha p_{os}^{1-\theta_s}]^{\frac{1}{1-\theta_s}}$ is the price index of $\mathbf{n}_s$, and $u_s \equiv u(w_s, a)$. Combine (14) and (13) to get

$$\sum_s (\frac{\partial q_s}{\partial a} - \frac{\partial u_s}{\partial a}\frac{\partial w_s}{\partial u_s}\frac{\partial q_s}{\partial w_s})\mathbf{n}_s = 0$$

$$\sum_s (\frac{\partial q_s}{\partial a}\frac{\partial w_s}{\partial q_s} - \frac{\partial u_s}{\partial a}\frac{\partial w_s}{\partial u_s})\mathbf{n}_s \frac{\partial q_s}{\partial w_s} = 0$$

$$\sum_s (\frac{\partial q_s}{\partial a}\frac{\partial w_s}{\partial q_s} - \frac{\partial u_s}{\partial a}\frac{\partial w_s}{\partial u_s})\mathbf{n}_s \frac{\partial q_s}{\partial w_s} = 0$$

$$\sum_s (1 - \frac{\partial u_s}{\partial a}\frac{\partial w_s}{\partial u_s})\mathbf{n}_s \frac{\partial q_s}{\partial w_s} = 0$$

By the chain rule

$$\frac{du_s}{da} = \frac{\partial u_s}{\partial a} + \frac{\partial u_s}{\partial w}\frac{\partial w}{\partial a} \tag{15}$$

By (12), $\frac{du_s}{da} = \frac{d\tilde{v}_s}{da} = 0$ since $\tilde{v}_s$ is a constant (an change in a (w) causes w (a) to change so that the utility level remains the same). Use this fact in (15) and rearrange to get

$$-\frac{\partial w_s}{\partial a} = \frac{\partial w}{\partial u_s}\frac{\partial u_s}{\partial a} \tag{16}$$

Now continue with the algebra

$$\sum_s (1 + \frac{\partial w_s}{\partial a})\mathbf{n}_s \frac{\partial q_s}{\partial w_s} = 0$$

$$\sum_s \frac{\partial a + w_s}{\partial a}\mathbf{n}_s \frac{\partial q_s}{\partial w_s} = 0$$

Use (11) to get

$$\sum_s \frac{\partial a + w_s}{\partial a}\varphi_s q_s^{-1} \frac{\partial q_s}{\partial w_s} = 0$$

$$\sum_s \frac{\partial a + w_s}{\partial a}\varphi_s \frac{(w_s + a)^{-\theta}}{(w_s + a)^{1-\theta} + \alpha p_s^{1-\theta}} = 0$$

$$\sum_s \frac{\partial \log(a + w_s)}{\partial a}\varphi_s \frac{(w_s + a)^{1-\theta}}{(w_s + a)^{1-\theta} + \alpha p_s^{1-\theta}} = 0$$

Following from (**??**), I get

$$\sum_s \frac{\partial \log(a + w_s)}{\partial a}\varphi_s \frac{(w_s + a)n_s}{(w_s + a)n_s + p_{Os} l_s} = 0$$

Take a second order Taylor approximation of $\frac{\partial \log(a+w_s)}{\partial a}$ around a_s^* to get

$$\frac{\partial \log(a + w_s)}{\partial a} \approx \frac{\partial \log(a + w_s)}{\partial a}|_{a=a_s^*} + \frac{\partial^2 \log(a + w_s^*)}{\partial a^2}\Big|_{a=a_s^*}(a - a_s^*).$$

(I take the second order approximation as opposed to the first because $\frac{\partial \log(a+w_s)}{\partial a}|_{a=a_s^*} = 0$ by the fact a_s^* minimizes labor costs)

Plug in the taylor approximations and rearrange to get

$$a \approx \sum_s \frac{\varphi_s \times \frac{\partial^2 \log(a+w(a,\tilde{v}_s))}{\partial a^2}\Big|_{a=a_s^*} \times \frac{(w_s+a)n_s}{(w_s+a)n_s+p_{Os} l_s}}{\sum_{s'} \varphi_{s'} \times \frac{\partial^2 \log(a+w(a,\tilde{v}_{s'}))}{\partial a^2}\Big|_{a=a_{s'}^*} \times \frac{(w_{s'}+a)n_{s'}}{(w_{s'}+a)n_{s'}+p_{ls'} l_{s'}}} a_s^*. \tag{17}$$

□

A.5 Proof of Proposition 1

By optimality condition (8), the share of expenditure on high-skill labor is equal to the high-skill weight. Recall $\varphi_{jh} + \varphi_{jl} = 1$. Hence an increase in φ_{jh} decreases φ_{jl}.

Holding all else equal, by equation (4), an increase in φ_{jh} and a decrease in φ_{jl} increases a_j (assuming the effect of changes in φ_{js} on the in-house expenditure shares is second order to the effect on φ_{js} itself).

An increase in a_j increases the cost of the low-skill in-house worker $w_{jl} + a_j$ because it moves the firm farther away from the low-skill cost-minimizing package $\{w_l^*, a_l^*\}$. By 6, the share of low-skill labor expenditure on outsourced labor $\frac{p_{ol}l_{jl}}{(w_{jl}+a_j)n_{jl}+p_{ol}l_{jl}}$ increases.

Hence, as the share of labor expenditure on high-skill labor increases, so does φ_{jh}, which increases a_j, which increases $w_{jl} + a_j$, which increases the share of low-skill expenditure on outsourced labor, $\frac{p_{ol}l_{jl}}{(w_{jl}+a_j)n_{jl}+p_{ol}l_{jl}}$. □

A.6 State-level analysis

While section 5 is focused on industry level data, proposition 1 also implies that skill-intensive states also outsource more low-skill workers. I test this implication using data from the Quarterly Workforce Indicators (QWI). The QWI draws on the Longitudinal Employer-Household Dynamics, and thus represents almost the universe of employees. I measure the low-skill outsourcing rate as the share of non-college educated workers in "Administrative Services". I regress the low-skill outsourcing rate on the share of employees with a college education, while controlling for state and year trends:

$$\frac{n_{hs,561}}{n_{hs}}_{st} = \beta_0 + \beta_1 \frac{n_{college}}{n}_{st} + \Theta_s + \Theta_t + \epsilon_{st}$$

where n denotes employees, hs denotes non-college, $college$ denotes college, 561 denotes "Administrative Services", s denotes state, t denotes year, and Θ denotes fixed effects. The key coefficient is β_1. It is identified by how a change in the share of workers with a college degree effects the share of non-college workers employed in "Administrative Services", while controlling for state-level and annual trends. Hence, it is identified by changes within each state. Standard errors are clustered by state by year. I find that $\beta_1 = 0.17$ and statistically significant at the 5 percent level. In words, a 1 percentage point increase in the share of workers with a college degree is associated with a 0.17 percentage poitn increase in the share of non-college workers in "Administrative Services." I conclude that the model's relationship between skill-intensity and low-skill oustourcing has empirical support at the state level.

A.7 Calculating the high- to low-skill wage ratio

This section details the construction of the high- to low-skill wage ratio for 1980 and 2012. I use these moments to target the increase in the high-skill weight φ_h between 1980 and 2012. Because I use the OEWS data to calibrate φ_h for the year 2012, ideally I would use this

Table 9: Mean Wage by Skill for the year 2012

Skill	ACS	OEWS
1	26,900	26,200
2	42,200	42,800
3	74,400	83,300

same data to also calibrate its change between 1980 and 2012. However, the OEWS does not extend back to 1980, so I use ACS data, while treating it in the same way that I treated the cross-sectional industry data in my baseline calibration. Then, I compare mean wages in the ACS sample to the OEWS, to make sure they are similar.

To calculate mean wages by skill level in the ACS, first I filter the data to privately employed people. Next, I drop people who work less than 10 hours a week or make less that minimum wage at part time. Then, I collapse to get mean wage by year and occupation. Then I group occupations into terciles by their mean wage, and calculate each terciles mean wage. Finally, I calculate the mean wage in each skill level in the OEWS data in the year 2012, then I compare these moments to those from the ACS sample. I find that they are fairly close.

Using the ACS sample, I find that the high- to low- mean wage ratio increased from 2.11 in 1980 to 3.2 in 2012, a 50.4 percent increase. The baseline model is calibrated to the year 2012. So for the high-skill demand counterfactual, I decrease φ_h while holding every other parameter constant so that the wage ratio decreases by 50.4 percent.

A.8 The cost-minimizing health plan with CES preferences

The cheapest compensation package $\{a_s^*, w_s^*\}$ solves

$$\{a_s^*, w_s^*\} = \underset{\{a,w\}\in R_+^2}{\operatorname{argmin}} \left\{a + w \mid v(a, w; p_m) \geq \tilde{v}_s\right\}.$$

In an economy with a tax on wages or a health plan wedge, the cheapest compensation is one where the worker spends the entirety of their wages on consumption. Thus, the cheapest compensation package solves:

$$\{a_s^*, w_s^*\} = \underset{\{a,w\}\in R_+^2}{\operatorname{argmin}} \left\{a + w \,\middle|\, \left(\psi\left(w(1-T)\right)^{1-1/\eta} + (1-\psi)\left(a/p_m\right)^{1-1/\eta}\right)^{\eta/(\eta-1)} \geq \tilde{v}_s\right\}.$$

The analytical solution for the cost-minimizing health plan a_s^* is

$$a_s^* = \tilde{v}_s \left(1-\psi\right)^{\eta} p_m^{1-\eta} \left(\psi^{\eta}(1-T)^{\eta-1} + (1-\psi)^{\eta} p_m^{1-\eta}\right)^{\frac{\eta}{1-\eta}} .$$

Hence, the cross derivative with respect to reservation utility level and the price of medical care is positive, $\frac{\partial^2 a_s^*}{\partial p_m \partial \tilde{v}_s} > 0$, if goods and medical care are complements, $\eta < 1$.