Domestic Outsourcing and Employer-Sponsored Health Plans*

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Abstract

The cause of the increase in low-skill domestic outsourcing in the United States in recent decades is unknown. I argue that it is a combination of two factors: skill-biased technical change and laws that effectively force firms to offer all employees the same health plans. I create a general equilibrium model in which firms choose the level of health plan to offer and how much labor to outsource. The key force, motivated by laws in the US, is a constraint that requires firms to compensate all employees with the same health plan. The model has three main implications. First, labor-service firms, which supply labor to other firms, pay the lowest prices for employees. Second, goods-producing firms that require a relatively high quantity of high-skill labor outsource a relatively high quantity of low-skill labor. Third, skill-biased technical change, modeled as a change to production technology primitives that increase the demand for high-skill workers, increases the quantity of outsourced low-skill labor. Using cross-sectional industry data, I find qualitative support for the second implication, and I calibrate the model to match key moments that characterize workers' preferences over wages and health plans and firm labor force composition. In my main quantitative exercise, I find that skill-biased technical change, together with the employer health plan laws, explains a significant share of the observed increase in low-skill outsourcing.

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1 Introduction

Many researchers analyze the welfare effects of domestic outsourcing. Dube and Kaplan (2010) and other empirical papers find that outsourcing causes low-skill workers' wages to decrease across several different countries. On the other hand, Felix and Wong (2021) finds that legislation in Brazil that legalized outsourcing caused the wages and employment of security guards to both increase. Bilal and Lhuillier (2021) structurally estimates that the increase in domestic outsourcing decreased low-skill service workers' welfare by over a percentage point.

While many researchers analyze the welfare effects of domestic outsourcing, little existing literature explores the potential causes of the increase. I argue that a large share of the increase in low-skill domestic outsourcing can be explained by two factors: skill-biased technical change and laws that constrain firms' ability to offer varying health plans to in-house employees.[1]

I begin by documenting background information on domestic outsourcing and employer health plans. First, I document several facts about domestic outsourcing in the US using Input-Output data and County Business Patterns data.[2] To analyze outsourcing from the supply side, I classify every worker in the labor-service industries — all industries within the 3-digit NAICS codes 561 and 541 — as domestically outsourced. I document that employment in these industries has grown rapidly since 1980. Employment growth occurs within almost every sub-industry, meaning that many types of occupations, from lawyers to security guards, are increasingly outsourced. To analyze domestic outsourcing from the demand side, I define the outsourced labor share as the share of total output paid to output from the labor-service industries. I document that the outsourced labor share also grew rapidly since 1980, and the growth is due to within-industry changes. Hence, the increase in domestic outsourcing is due to the rise of both low- and high-skill outsourced labor, and almost

[1] Skill-biased technical change is the technological change that increased the demand (and thus compensation) for workers that were relatively highly compensated before the technology change. The increase in income inequality (measured by the variance of wages) in the US in recent decades is often attributed to it. See Card and DiNardo (2002).

[2] Because the raw County Business Patterns data has several industry classification changes over time, I use the harmonized and imputed County Business Patterns data from Eckert et al. (2021).

every sector of the economy increased their consumption of outsourced labor.

Second, I summarize several facts about the price of medical care and employer health plan expenditures in the US. The price of medical care, relative to the price of all non-medical care consumption, has increased dramatically since 1980, more than doubling between 1980 and 2020. As expected given this price increase, employer health plan expenditure as a share of total employee compensation also increased over this time period. Across firms, a large majority of the variance in employer health plan premiums — the prices paid by employers for health plans — is due to between-firm variance, not within-firm variance. This is expected because of legislation that effectively forces employers to offer all their employees the same menu of health plans. This legislation motivates a constraint in my model that requires firms to offer all employees the same health plan.

Next, I develop a general equilibrium theory that features outsourcing and employer health plans. In the model, workers vary in skill level. Firms' production technology uses insourced and outsourced labor of different skill levels. For clarity, I separate the technology into two steps. First, both insourced and outsourced labor of the same skill level enter a CES function. Second, the outputs from the CES functions enter a Cobb-Douglas function. The demand for each skill level is governed by the type weights in the Cobb-Douglas production function.

Workers' preferences turn quantities of goods and medical care into utility. In equilibrium, firms compensate workers with a bundle of wages and health plans, which I call a compensation package. I make the strong assumption that wages can only purchase goods, while health plans can only purchase medical care.[3] In my model, health plans are essentially just a wage that can only be used to purchase medical care.[4] The price of an in-house worker is simply their wages plus their health plan.

Workers have free movement of labor and perfect information, so they choose to supply labor to whichever firm offers the compensation package that yields the highest utility. In equilibrium, firms must offer compensation packages that yield at least as

[3]The assumption that wages cannot be used to purchase medical care is strong. It can be weakened by introducing a tax on wages or some other ingredient that causes workers to prefer to purchase medical care with health plans instead of wages.

[4]I do not model a concept of health or health insurance.

much utility as each skill level's best-outside option. Hence, in equilibrium, the best-outside option for each skill level is the endogenous utility level that equates labor supply to labor demand. When choosing a skill level's compensation package, firms can choose any compensation package that yields as much utility as its best-outside option.

Due to standard assumptions on the utility function, compensation packages that yield the best-outside option form a typical downward-sloping, convex indifference curve. Thus, for any given utility level, there exists a price-minimizing health plan, which I call the optimal health plan. From the firm's perspective, the optimal health plan corresponds to the cheapest compensation package that yields a utility level equal to the best-outside option and is thus the lowest price possible for the worker. As a worker's utility level increases, so does its optimal health plan. In equilibrium high-skill workers have higher demand and, thus, higher utility and higher optimal health plans than low-skill workers. The key driving force is that firms face a constraint, motivated by the US's tax laws, that forces firms to offer all insourced workers the same health plan. Thus, firms must offer low-skill employees the same health plans they offer their high-skill employees, and firms cannot offer every worker their optimal health plan.

The model has three main theoretical implications. First, labor-service firms pay the lowest price for insourced labor in the economy. This implication stems from the fact that labor-service firms demand a relatively high quantity of a single skill level of labor and thus set their health plan close to that skill level's optimal health plan. This result gives some intuition for how labor-service firms can operate in an economy: they input labor at a lower price than other firms, then sell that labor to other firms. Second, firms with a relatively high demand for a single skill level outsource a relatively low quantity of that skill level. For any skill level, if the price of insourced labor decreases relative to the price of outsourced labor, then the relative quantity of insourced labor increases. Firms with relatively high demand for a single skill level set their health plan close to that skill level's optimal health plan. As a result, the price of insourced labor is relatively low, so the firm outsources a relatively low amount of that skill. Hence, variation in firms' labor demand, driven by heterogeneity in the skill weight parameters, determines variation in outsourcing behavior across firms.

Third, in a comparative statics exercise, I find that skill-biased technical change causes the share of low-skill workers that are outsourced to increase. I model skill-biased technical change as an increase in the high-skill weight in each firm's production technology. Intuitively, skill-biased technical change increases the utility level and, thus, the optimal health plan of high-skill workers. As a result, firms increase their health plans, which increases the relative price of insourced low-skill labor.

I conclude the theory section with two additional comparative statics exercises. First, I exogenously change a parameter in the medical care firm's production technology, which causes the price of medical care relative to the price of goods to increase. I find that an increase in the price of medical care, surprisingly, does not necessarily lead to an increase in the domestic outsourcing of low-skill workers. In general equilibrium, an increase in the price of medical care causes the prices of both insourced and outsourced labor to increase, as both goods and labor-service firms adjust their compensation packages. Hence, the change in the relative price of insourced labor is ambiguous, and the change in the relative quantity of insourced labor is also ambiguous. Second, I eliminate the health-plan constraint, which decreases the price of insourced labor of all skill levels at all goods firms and thus decreases outsourcing.

Next, I use data from multiple sources to create a data set that I use to validate and calibrate my model. The main data sources are wage and employment data at the industry-occupation level from the Occupational Employment and Wage Statistics (OEWS) and input-output data from the BEA. In the model, workers vary by skill level, so I map occupations to skill levels by simply grouping occupations by mean wage quintiles, creating five skill levels. I weight intermediate use expenditure by skill level employment shares to map input-output data to skill levels. The resulting cross-sectional data has prices for insourced labor, quantities of insourced labor, and expenditures on outsourced labor by skill for over 100 industries.[5][6]

I test two main cross-sectional implications of the model using this data. First,

[5] In addition to using wage data from the OEWS, I use health plan data from the Annual Survey of Manufacturers and the Services Annual Survey (SAS) to get the price of insourced workers.

[6] In my data set, industry classification is at the 4-, 3-, or 2-digit NAICS level, and my sample is made up of private industries that account for a majority of the private sector's economic activity. The reason industry classification is not consistently at the 4-digit level is because the SAS only offers data at the 3-digit or 2-digit level for some industries. The reason my data set does not account for all of the private sector's economic activity is because the SAS is missing several industries.

firms with a relatively high expenditure on high-skill workers have high health plans and outsource a relatively high quantity of low-skill labor. Second, firms with a relatively high expenditure on low-skill workers have low health plans and outsource a relatively high quantity of high-skill labor. I find that the first implication holds in the data. The second implication does not hold; while relative expenditure on low-skill workers has a negative relationship with health plan expenditure per employee, it has no correlation with high-skill outsourcing expenditure. I take this as evidence that my model can rationalize low-skill outsourcing while some other factors must explain high-skill outsourcing.

Next, I calibrate the model to the year 2012 with the cross-sectional data. A key assumption in the model is that, for each skill level, labor and labor-services enter into the goods firms' production functions in a CES fashion. In theory, I allow for insourced and outsourced labor to be perfect substitutes, gross substitutes, or even complements, depending on the elasticity of substitution. To estimate this key elasticity, I derive a structural equation that relates expenditure on outsourced labor to the price paid for insourced labor. This equation allows me to estimate the elasticities using a regression on cross-sectional data. The elasticity is identified by how much cross-industry variation in outsourcing expenditure is explained by cross-industry variation in the price of insourced labor. For the bottom four quintiles, I find positive, statistically significant relationships between the price of insourced labor and outsourcing expenditures. For the top quintile, I do not find a positive or statistically significant relationship between these two variables. To check that my estimated elasticities are reasonable, I calculate them again with a more specific mapping of labor-service industry output to occupations. I assume the output from a labor-service industry and the labor from the most employed occupations within that industry enters into the CES technology. For example, I assume that output from the accounting services industry is substitutable with labor produced by insourced accountants, auditors, accounting clerks, etc. Then I estimate the elasticity of substitution for each 4-digit labor-service industry. I find that the substitution elasticities are mostly positive and statistically significant.

To finish calibrating the firm production technology parameters, I target: 1) size and labor composition at the firm level, using structural equations that map data on labor expenditure directly to parameters; and 2) outsourcing rates by skill at the economy level, using simulated methods of moments. I assume the utility function is Stone-Geary, and I use simulated methods of moments to target two moments and calibrate all of its parameters. The first moment is health plan expenditure as a share of total compensation. Second is the positive relationship between mean wage level and health plan expenditure per employee across industries.

With the fully calibrated model in hand, I conduct my main quantitative exercise. I calculate the percent of the increase in outsourcing that can be explained by the following: the increase in the price of medical care since 1980; skill-biased technical change that increased the demand for high-skill labor; and the enactment of the legislation that requires firms to offer all insourced employees the same health plan. Specifically, I solve for the equilibrium of the model, which was calibrated to 2012, change a primitive or remove a constraint to emulate the 1980s, then solve for the new equilibrium and compare it to the original. I find that all three factors explain a significant amount of the increase in the bottom three quintiles and little of the increase in the top two quintiles. The increase in the relative price of medical care accounts for 17% of the increase in domestic outsourcing for the lowest-skilled workers (the workers in the bottom quintile). Skill-biased technical change explains 56%, and removing the health plan constraint — allowing firms to offer insourced workers varying health plans — explains 71%.

Next, I emulate the year 1980 by lowering the price of medical care to its respective level, removing the health plan constraint, and removing the effect of skill-biased technical change. I then change each factor to its 2012 counterpart, one by one and in combination, and compare outsourcing rates across the economies. I find that the health plan constraint, together with skill-biased technical change, explains a significant amount of the increase in low-skill outsourcing. Without skill-biased technical change, the health plan constraint has little effect because the low- and high-skill optimal health plans are relatively close together.

Finally, in a policy counterfactual, I find that removing the health plan constraint increases the mean utility level of workers by just over half a percentage point. In a robustness exercise, I find that my main accounting exercise results are not sensitive to the high-skill levels' elasticities of substitution between insourced and outsourced labor.

1.1 Related Literature

Few papers attempt to explain why domestic outsourcing increased in the past several decades. Autor (2003) uses a difference-in-difference approach and finds that the enactment of policies that make firing workers more difficult explains 20% of the growth of temporary help services between 1973 and 1995 in the US. Bartel et al. (2014) develops a theoretical model in which the information technology revolution (the increased rate of computer technology improvement) can qualitatively explain the rise of domestic outsourcing, but they do not use data to quantify their results. To the best of my knowledge, I am the first to qualitatively explain how the following three factors can increase domestic outsourcing: the increase in the price of medical care; skill-biased technical change; and the enactment of tax laws that constrain firms' ability to offer insourced employees varying levels of health insurance. Further, I am the first to quantify each one of these factors.

Another literature theorizes why expenditure on outsourced labor varies across firms. In Bilal and Lhuillier (2021), propensity to outsource increases with firm size. Firms face upward-sloping labor supply curves but can purchase outsourced labor at a constant price. Hence, big firms outsource. In Holmes and Snider (2011) labor has monopoly power and exercises it over both labor-intensive tasks and capital-intensive tasks. Domestic outsourcing is used by firms to separate labor- and capital-intensive tasks in order to weaken this monopoly power. Houseman (2001) surveys establishments and concludes that firms mainly outsource to smooth production fluctuation and screen potential full-time hires. To the best of my knowledge, my paper is the first to create a theory in which variation in outsourcing behavior across firms is determined by variation in demand for skilled labor. Further, I find cross-sectional support for my main mechanism: industries with relatively high expenditures on high-skill labor have relatively high expenditures on low-skill outsourced labor.

A large literature estimates the welfare and efficiency effects of domestic outsourcing. An empirical literature (Goldschmidt and Schmieder (2017) ; Bilal and Lhuillier (2021); Dube and Kaplan (2010); and Drenik et al. (2023)) focuses on the outsourcing of low-wage occupations, like janitors, and finds that, keeping all else equal, contract service firms pay these workers less than normal firms. In addition to considering firm-level variation in wages, Felix and Wong (2021) looks at potential efficiency gains due to outsourcing and finds that following policy changes that allowed more security guards to be outsourced, security guard wages increased due to efficiency effects. Another strand of literature tackles these questions using structural models, like Bilal and Lhuillier (2021) and Chan and Xu (2017). I contribute to this literature by creating a new, micro-founded general equilibrium theory of outsourcing in which domestic outsourcing is an efficient response to legislation that constrains firms' ability to set compensation. Domestic outsourcing, in part, exists due to policy rather than only market frictions.

Another literature discusses within-firm wage setting, and how domestic outsourcing is a tool used to avoid paying low-skill workers relatively high wages. Breza et al. (2018) finds empirical evidence that pay inequality within a firm lowers worker productivity. Such findings could motivate managers to compress wages on their own volition. Weil (2019) suggests that firms outsource low-wage workers, instead of offering them higher wages, to decrease within-firm pay inequality. Holmes and Snider (2011) develops a theory in which labor has monopoly power and exercises it over both labor-intensive tasks and capital-intensive tasks; firms use domestic outsourcing to lessen labor's power over the capital intensive tasks. Other factors that can compress wages within a firm are unions or rent sharing. My contribution to this literature is that I explicitly model legislation that compresses compensation within a firm, and I show that, theoretically and quantitatively, this legislation causes firms to domestically outsource low-skill workers.

2 Background information

This section summarizes background information on domestic outsourcing, the price of medical care, employer health plan expenditures, and employer health plan laws.

2.1 Domestic outsourcing in the US since 1980

This section documents the increase in domestic outsourcing since 1980 using industry-level data. For my analysis, I focus on the private sector and the 1980–2020 period.[7]

[7] Including the government sector or extending the time period back to the earliest date possible, 1963, does not notably change my results.

I use two data sources: input-output data from the BEA and harmonized County Business Patterns employment data from Eckert et al. (2021).[8]

As is common in the literature, I use industry classification to identify outsourced labor. I designate all sub-industries with 3-digit NAICS codes 561, "Administrative and Support Services," and 541, "Professional, Scientific, and Technical Services," as *labor-service industries*. These industries, listed in table 1, include janitorial services, security guard services, temp agencies, accounting services, legal services, management consulting services, and other low- and high-skill labor-services. I classify all employment in labor-service industries as domestically outsourced.[9] Table 1 details the growth of the share of total private employment in the labor-service industries, both in percentage points and percents. Employment in all labor-service industries grew by 9.3 percentage points, from 6.4% in 1980 to 15.7% in 2015.

Almost every labor-service industry grew between 1980 and 2015. This implies that the increase in domestic outsourcing in recent decades is due to an increase in the outsourcing of both low-skill and high-skill occupations. Notably, the temporary help services industry, which predominantly employs manual laborers, grew by 2.24 percentage points; professional employer organizations, which essentially sell human resources services, grew by 1.81 percentage points; and computer systems design and related services grew by 1.19 percentage points.

A basic accounting property is that total output equals value added plus payments to intermediate inputs. I define the *outsourced labor share* as the share of total output paid to intermediate inputs from labor-service industries.[10] Figure 1 shows the dramatic increase in the outsourced labor share over time. Between 1980 and 2020, it increased from 3.2% to 8.2%, a 150 percent increase.[11]

[8]County Business Patterns (CBP) data has employment at the industry-year level. Industry classification changed multiple times over the past 50 years, which makes looking at industry level employment across time a challenge. Eckert et al. (2021) uses a crosswalk to harmonize industry classification across all years to NAICS 2012.

[9]Thus, an accountant, a manager, and a security guard in the security guard services industry are all considered outsourced. This captures the following idea: when an industry purchases janitorial services, they are, self evidently, purchasing janitorial labor hours, but they are also purchasing a (smaller) amount of accounting hours, managerial hours, etc.

[10]Several papers also look at food service contractors, which is NAICS 722310. Due to data constraints, I do not include this industry in my analysis. Further, I do not include independent contractors, which is another commonly discussed method of domestic outsourcing.

[11]Meanwhile the share of total output paid to all intermediate services (where services are all private industries not including manufacturing, mining, utilities, construction, and agriculture) increased

I break down the increase in outsourced labor share by industry. Figure 2 shows the change in outsourced labor share between 1980 and 2020 at the industry level. Out of 59 industries, only 10 saw a decrease in their outsourced labor share.[12] I decompose the change in the economy-wide outsourced labor share into a between-industry and within-industry component, and I find that 71.7% of the total increase is due to the within-industry component. The details of this decomposition are in the appendix A.2.

To summarize, the increase in domestic outsourcing in the US is owed to both an increase in the outsourcing of high- and low-skill occupations and the fact that all sectors of the economy increased their consumption of outsourced labor. These observations motivate my model, which has firms that purchase both low- and high-skill outsourced.

2.2 Price of medical care and employer health plan costs

In recent decades the price of medical care also increased dramatically. As seen in figure 4, the price of medical care, relative to the price of all non-medical care consumption, more than doubled between 1980 and 2020. While the price of medical care increased, so did employer-provided health insurance expenditures. Figure 5 shows that in 2021, benefits paid out by employer group health insurance were 9.76% of total employee compensation, while employer contributions to group health insurance were 6.78%. These shares were only 3.85% and 3.76% in 1980.[13]

dramatically. Between 1980 and 2021 it grew by 11.6 percentage points, from 15.6 to 27.2 percent. The share increased in 17 of 18 industries. Output from NAICS 541 and 561 are responsible for roughly half of the entire increase. Over this time period the materials input share (the share of total output paid to intermediate material inputs) fell dramatically, from 29.8% in 1980 to 15.1% in 2021. This decline was driven by the rise of services, as services have a lower materials input share than goods producing sectors. I decomposed the total change into a between and within-industry component, and found that the between-industry component dominated the total decline, accounting for 67% of it. However, even within manufacturing the materials-input share declined by 3.6% between 1980 and 2021.

[12] Manufacturing sub-industries saw relatively small increases in their service input share. Because manufacturing historically had the strongest and highest concentration of unions, this is evidence against the hypothesis that domestic outsourcing is driven by firms using it to prevent workers from unionizing or diminish worker's bargaining power.

[13] This growth is likely due to the drastic increase in the price of medical care, and the fact employer provided health insurance is typically untaxed, unlike wages, and health insurance offered by an employer is cheaper than comparable plans available on the open market.

2.3 Employer health plan laws

This section discusses the types of employer-provided health insurance plans, their prevalence, and the anti-discrimination laws that apply to them. Anti-discrimination laws essentially prohibit companies from providing better health plans to their high-wage employees than to their low-wage employees. I use survey data on employer health plans and find that a majority of the variance in the price employers pay for health plans is due to differences between firms.

In the US, two of the most common types of health insurance plans are self-funded plans and cafeteria plans. Self-funded plans are plans in which the employer assumes direct financial responsibility for the costs of enrollees' medical claims.[14] In 2021, 64% percent of employees with employer provided health plans were covered by self-funded plans.[15] Cafeteria plans are plans in which employees have a choice between receiving their compensation from the plans in cash or as a benefit; if taken as a benefit, the compensation is not taxed.[16] Cafeteria plans are also common; in 2006, 49% percent of all workers had access to some type of cafeteria health plan (Stolzfus (2007)).

Self funded health plans and cafeteria plans are constrained by anti-discrimination tax laws. These tax laws penalize employers that offer high wage and low wage employees different quality health plans. Health plans are compensation that are, generally, not taxed. However, if anti-discrimination laws are violated, then all compensation that is paid in the form of health plans are taxed. Under IRS Code section 105(h), self funded benefit plans cannot discriminate in favor of the highest-paid 25 percent of all employees.[17] Under IRS Code section 125, cafeteria plans cannot discriminate in favor of highly compensated individuals.[18] Section 105(h) and 125 were both enacted in 1978.[19][20]

The anti-discrimination tax laws essentially force firms to offer all employees the

[14]Source: Kaiser Family Foundation Survey 2020. URL: https://www.kff.org/report-section/ehbs-2020-section-10-plan-funding/

[15]Source: Kaiser Family Foundation Survey 2021. URL: https://www.kff.org/report-section/ehbs-2021-section-10-plan-funding/

[16]Source: Society of HR Management. URL: https://www.shrm.org/resourcesandtools/tools-and-samples/toolkits/pages/understanding-section-125-cafeteria-plans.aspx

[17]Source: Cornell Law School. URL: https://www.law.cornell.edu/uscode/text/26/105

[18]Source: Cornell Law School. URL: https://www.law.cornell.edu/uscode/text/26/125

[19]Source: IRS. URL: https://www.irs.gov/pub/irs-tege/lesson4.pdf

[20]Source: Internal Revenue Code. URL: www.govinfo.gov

same menu of health plans, but health plans could, in theory, vary within a firm. Firms could attempt to skirt these laws by offering plans that vary in employee contribution rates to induce low-wage workers to choose cheap health plans with low contribution rates, effectively making the tax laws not bind. I find that this is not the case, as the majority of variation in employer premiums (ie the price the firm faces) is between firms, not within. Using the 1993 Robert Wood Johnson Foundation Employer Health Insurance Survey (Long and Marquis (2006)), I find that 83% (86%) of the total variation of single (family) plan employer premiums is between firms. For details on this decomposition, see A.1.

In conclusion, tax laws encourage firms to offer all their employees the same menu of health plans, and, likely as a result of these laws, a large majority of the variance in employer premiums is between firms. In the next section, I use the key points from this section to motivate a theoretical model in which firms' ability to offer varying health plans to their workers is constrained. In the model, firms must offer a single, identical health plan to all their insourced workers.

3 Model

3.1 Environment, Preferences, and Technology

Time is static. The commodity space is a good and medical care. The economy has four types of agents: workers, labor-service firms, goods firms, and a medical care firm.

Workers: 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. Workers supply labor inelastic, and their utility function u turns goods and medical care into utility. Assume u is strictly increasing in both arguments, strictly concave in both arguments, has weakly positive cross derivatives, is continuous, and satisfies INADA conditions. The worker allocation is, for each worker, quantities of goods and medical care, $\{c_i, m_i\}_{i \in \cup_{s \in \mathcal{S}} N_s}$.

Labor-service firms: There is a single labor-service firm for each skill $s \in \mathcal{S}$. The discrete set of labor-service firms is $\mathcal{O}$. The s-skill labor-service firm's technology inputs s-skill labor n_{ls} and outputs labor-services of the same skill, L_s.[21] The technology is $L_s = z_{ls} n_{ls}$, where $z_{ls} > 0$ is an efficiency term. (Throughout I denote aggregate level variables with capitalized letters, and I denote labor-service firm with a subscript l.) The labor-service firm allocation is, for each labor-service firm, quantities of inputted labor and outputted labor-services, $\{n_{ls}, L_{ls}\}_{s\in\mathcal{S}}$.

Goods firms: The discrete set of goods firms is $\mathcal{J}$. Goods firms' production technology inputs labor and labor-services of each skill and outputs goods. Labor and labor-services of each skill, n_{js} and l_{js} respectively, enter into a CES function that outputs a measure of labor of the same skill, $\mathbf{n}_{js}$. The measures of each skill enter into a decreasing returns to scale production function which outputs goods y_j.[22] Firm j's production technology is

$$y_j = z_j(\Pi_{s\in\mathcal{S}} \mathbf{n}_{js}^{\varphi_{js}})^{\nu}, \quad \mathbf{n}_{js} = (n_{js}^{1-1/\theta_s} + \alpha_s^{1/\theta_s} l_{js}^{1-1/\theta_s})^{\frac{\theta_s}{\theta_s - 1}}$$

where $\nu < 1$ is the returns to scale parameter, $z_j > 0$ is an efficiency term, $\theta_s \geq 0$ is the elasticity of substitution between labor and labor-services of skill s, $\alpha_s > 0$ is an economy-wide weight on labor-services, and $\varphi_{js} > 0$ is the firm-specific s-skill weight. Each firm's skill weights sum to one, $\sum_{s\in\mathcal{S}} \varphi_{js} = 1$. The only exogenous heterogeneity for goods firms is in skill weights and efficiency terms. The goods firms allocation is, for each goods firm, quantities of inputted labor and labor-services of each skill and outputted final good, $\{\{n_{js}, l_{js}\}_{s\in\mathcal{S}}, y_j\}_{j\in\mathcal{J}}$.

The micro-foundation for the fact that labor and labor-services enter the goods firm's production function in a CES fashion is a typical set up in which the firms make many discrete choices. Within each skill, their is a continuum of occupations. Each firm makes a discrete choice to insource or outsource each occupation. Then, given an additional assumption involving extreme value shocks, the model aggregates to a classic CES formulation. See, for example, Anderson et al. (1987).

Medical care firm: The medical care firm operates a constant returns to scale technology that turns goods c_m into medical care M. The production function is

[21] Note that I take an extreme position that the s-skill labor-service firm inputs only s-skill labor, which is akin to stating that janitorial service firms input only janitors. However, my main mechanism holds if I were to write a model in which the labor-service firms demand labor of each skill level, as the goods firms do, but with a more concentrated demand on a single skill.

[22] The production function is decreasing returns to scale to pin firm size.

$M = z_m c_m$, where $z_m > 0$ is an efficiency term. The medical care firm's allocation is quantities of inputted goods and outputted medical care, $\{c_m, M\}$.

Feasibility: An allocation for all four types of agents is feasible if the supply of goods, medical care, labor of each skill, and labor-services of each skill are all greater than their demand:

$$c_m + \sum_{s \in \mathcal{S}} \int_{N_s} c_i di \leq \sum_j y_j, \tag{1}$$

$$\sum_{s \in \mathcal{S}} \int_{N_s} m_i di \leq M, \tag{2}$$

$$n_{ls} + \sum_j n_{js} \leq N_s \quad \forall s \in \mathcal{S}, \tag{3}$$

$$\sum_j l_{js} \leq L_s \quad \forall s \in \mathcal{S}. \tag{4}$$

3.2 Equilibrium

This section explains each agents' maximization problems and states the formal definition of the competitive equilibrium.

3.2.1 Medical Care firm

The medical care firm's profit maximization problem is

$$\max_{c_m \in R^+} p_m z_m c_m - c_m$$

where p_m is the price of medical care, and the price of the good is the numeraire. Looking ahead, in equilibrium the price of medical care is pinned by z_m, an exogenous parameter, essentially making it exogenous, $p_m = \frac{1}{z_m}$. For this reason, I treat the price of medical care as an exogenous parameter.

3.2.2 Workers

Workers, who have perfect information and can move freely between all firms, choose which firm to supply labor to and quantities of goods c and medical care m to consume. Firm j compensates workers with wages w_{js} and health plan a_{js}. Thus when a workers chooses which firm to work at they are choosing a compensation package $\{w_{js}, a_{js}\}$ from a set of packages.

Workers face two (budget) constraints: goods expenditure c must be less than or equal to their wage w_{js}, and medical care expenditure $p_m m$ must be less than or equal to their health plan a_{js}.[23]

$$c \leq w_{js}, \quad p_m m \leq a_{js}. \tag{5}$$

The worker has a two step maximization problem. First, given a compensation package the worker chooses consumption and medical care to maximize utility $u(c, m)$ subject to its budget constraints. (Thus creating a mapping from compensation packages to utility.) Second, given the distribution of compensation packages, the worker chooses the one that yields the highest utility.

3.2.3 Goods Firms

Goods firms choose labor, labor-services, wages, and health plans for each skill level. They face two constraints. First, firms must offer all insourced workers the same health plan. (Later I make this constraint implicit by simply dropping the s subscript from the health plan.)

$$a_{js} = a_{js'} \quad \forall s, s' \in \mathcal{S} \tag{6}$$

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 $\tilde{u}_s$,

$$u(a_{js}, w_{js}) \geq \tilde{u}_s \quad \forall s \in \mathcal{S} \tag{7}$$

Profits are simply revenue minus expenditure on labor and labor-services. The price of skill s labor is wage w_{js} plus health plan a_j, while the price of labor-services is

[23] In this model, health plans are simply compensation that can only be spent on medical care; the model has no notion of health or insurance. I impose that worker's cannot spend their wages on goods because the model mechanically needs a reason for worker's to demand some amount of health plans from the firm, as opposed to receiving all compensation in the form of wages. The assumption that workers can not use wages to purchase medical care can be relaxed by adding an ingredient that makes workers prefer to purchase medical care with health plans instead of wages, for example an income tax on wages.

p_{ls}. Using the standard CES price index we can rewrite labor expenditure as $\sum_s \mathbf{n}_{js} q_{js}$ where q_{js} is the standard CES price index of $\mathbf{n}_{js}$,

$$q_{js} = [(w_{js} + p_m a_j)^{1-\theta_s} + \alpha p_{ls}^{1-\theta_s}]^{\frac{1}{1-\theta_s}}.$$

Thus profits are

$$\pi_j = (\Pi_{s \in \mathcal{S}} \mathbf{n}_{js}^{\varphi_{js}})^{\nu} - \sum_{s \in \mathcal{S}} q_{js} \mathbf{n}_{js} \tag{8}$$

The goods firm's problem follows. Given best-outside options and labor-service prices $\{\tilde{u}_s, p_{ls}\}_{s \in \mathcal{S}}$ the firm chooses CES aggregate labor $\mathbf{n}_{js}$, wages w_{js} and health plan a_j to maximize profits 8 subject to offering all skills a compensation package that yields as much utility as their best-outside option 7.

$$\begin{aligned} V_j(\overrightarrow{\tilde{u}_s}, \overrightarrow{p_{ls}}) = z_j \max_{a_j, \{n_{js}, w_{js}\}_s} (\Pi_s \mathbf{n}_{js}^{\varphi_{js}})^{\nu} - \sum_s q_{js} n_{js} \\ s.t. \qquad \tilde{u}_s \leq u(w_{js}, \frac{a_j}{p_m}) \quad \forall s \in \mathcal{S}. \end{aligned}$$

This section concludes with two remarks. First, firms take the price of labor-services as given, but they have some power to set the price of (insourced) labor. Looking ahead to the equilibrium, when setting the price of insourced labor firms can freely choose from the set of compensation packages that satisfy 7. However, 6 prevents firms from offering all skills the cheapest package that satisfies 7. Second, due to the decreasing returns to scale assumption goods firms have positive profits. To close the model, profits are paid to an entrepreneur who uses profits to purchase as much goods as possible.

3.2.4 Labor-service firms

Each s-skill labor-service firm chooses s-skill labor, a wage, and a health plan. Labor-service firms face the same constraints as goods producing firms; they must offer workers packages that yield as much utility as their best-outside option, and they must offer all workers the same health plan. Because labor-service firms' technology inputs the labor of a single skill, the later constraint has no effect.[24] Profits are equal to revenue minus labor expenses,

$$p_{ls} z_{ls} n_{ls} - n_{ls}(w_{ls} + a_{ls}). \tag{9}$$

The s-skill labor-service firm's profit maximization problem follows. Given the price of labor-services, $\{p_{ls}\}$, the firm picks labor n_{ls}, wages w_{ls} and health plan a_{ls} to maximize profits 9 subject to 7.

3.2.5 Equilibrium Definition

A competitive equilibrium is a worker allocation $\{\{c_i, m_i\}_{i \in \cup_{s\in\mathcal{S}} N_s}\}$, goods firms allocation $\{\{n_{js}, l_{js}\}_{s\in\mathcal{S}}, y_j\}_{j\in\mathcal{J}}$, labor-service firms allocation $\{n_{ls}, L_{ls}\}_{s\in\mathcal{S}}$, a medical care firm allocation $\{c_m, M\}$, firm compensation packages $\{w_{js}, a_{js}\}_{(j,s)\in\mathcal{J}\cup\mathcal{O}\times\mathcal{S}}$, goods firm profits $\{\pi_{js}\}_{j\in\mathcal{J}}$, best-outside options $\{\tilde{u}_s\}_{s\in\mathcal{S}}$, and labor-service prices $\{p_{ls}\}_{s\in\mathcal{S}}$ that satisfy the following.

1. Given the distribution of compensation packages, workers supply labor to the firm with the package that yields the highest amount of utility, the worker allocation solves its maximization problem, and the worker's maximized utility is greater than or equal to that of its type's best-outside option.

2. Given prices and best-outside options, the good firm allocation, profits, and compensation packages satisfy the goods firms' profit maximization problems.

3. Given prices and best-outside options, the labor-service firm allocation and compensation packages satisfy the labor-service firms' profit maximizing problems.

4. Given profits, the entrepreneur purchases as much final goods as possible.

5. The market clearing conditions 1 - 4 hold with equality.

[24]Looking ahead to the data and calibration, this is evidently a simplification of reality. But it rings true to the fact that labor-service firms' employment is highly concentrated in a single skill level. For example, while janitorial service firms do not only employ janitors, janitors make up a huge percentage of their labor force. This simplifying assumption makes the model tractable, and it makes the propositions and logic of the model clear.

3.2.6 Remark on health plans

In the model, what I am calling health plans can theoretically be any form of compensation that cannot vary across workers within a firm. Some examples are office location and some benefits. I specifically use health plans because they are a large part of employee compensation, measurable with publicly-available data.

3.3 Equilibrium Results

This section discusses the equilibrium of the model. I begin by discussing each agent's behavior in equilibrium. Next I discuss two main results. Third, I discuss comparative statics, comparing outsourcing in equilibriums with different primitives or constraints.

3.3.1 Workers

Because the utility function is strictly increasing in both arguments, the budget constraints hold with equality. Thus the worker's problem can simply be formulated as follows: Given the price of medical care p_m and each firm's compensation package, $\{a_j, w_{js}\}_{j \in \mathcal{J} \cup \mathcal{O}}$, the worker chooses the compensation package that yields the highest utility:

$$\max_{j \in \mathcal{J} \cup \mathcal{O}} u\Big(w_{js}, \frac{a_{js}}{p_m}\Big). \tag{10}$$

Because workers have perfect information and can move freely across firms, workers supply labor to whichever offers the compensation package that yields the highest amount of utility. Hence, in equilibrium for any skill s, all compensation packages yield an equal amount of utility, and the amount is equal to the skill's best-outside option $\tilde{u}_s$. (If a firm offers a package that yields less utility than the best-outside option, no labor is supplied to it. If a firm offers a package that yields more utility that the best-outside option, all workers go to it, other firms adjust their compensation, etc.)

All the compensation packages that yield $\tilde{u}_s$ form a typical convex, downward slopping indifference curve, due to the standard assumptions on the utility function. The cheapest compensation package that yields any utility level is unique; the solution to the following problem is a singleton.

$$\{a_s^*, w_s^*\} = \underset{a,w \in R_+^2}{\text{argmin}} \Big\{ a + w \mid u(w, a/p_m) \geq \tilde{u}_s \Big\} \tag{11}$$

For convenience I call a_s^* skill s's *optimal health plan*, and $\{a_s^*, w_s^*\}$ skill s's *optimal compensation package*.

3.3.2 The labor-service firm

The profit maximization problem of a labor-service firm has two steps. First, it chooses a labor compensation package that minimizes labor costs. Because its technology inputs a single skill level of labor, it is unconstrained by the health plan constraint. Thus, they simply offers each skill level their optimal compensation packages.

Second, it chooses the quantity of labor that maximizes profits. Recall its technology is constant returns to scale. Because the labor-service firm cannot have negative profits or infinite profits in equilibrium, the price of labor-services is

$$p_{ls} = \frac{a_s^* + w_s^*}{z_{ls}}. \tag{12}$$

In equilibrium, the quantity of labor-services supplied is set by the relevant market clearing condition so that the quantity supplied equals that demanded by the goods firms.

3.3.3 The goods firms

Because each goods firm must offer all insourced workers the same health plan package, it cannot give each skill level their optimal compensation package. Following from algebra that is left to the appendix, the optimal health plan at firm j, $\hat{a}_j$, is approximately equal to a weighted average of each skill's optimal health plan:

$$\hat{a}_j \approx \sum_s \frac{\omega_{js}}{\sum_{s'} \omega_{js'}} a_s^*, \tag{13}$$

$$\omega_{js} = \varphi_{js} \times \frac{(w_{js} + a_j) n_{js}}{(w_{js} + a_j) n_{js} + p_{ls} l_{js}} \times \frac{\partial^2}{\partial a^2} \Big(log\big(a + w(a, \tilde{u}_s)\big) \Big) \Big|_{a = a_s^*}. \tag{14}$$

where $w(a, \tilde{u}_s) = min_{w \in R_+} \big(w \mid u(w, a/p_m) \geq \tilde{u}_s \big)$. At firm j the weight on a_s^* is ω_{js}.

It is increasing with (1) the skill s weight, φ_{js}, (2) the share of skill s labor expenditure that is on insourced labor (as opposed to labor-services), and (3) the curvature of the price of insourced labor at a_s^*. The intuition for (1) and (2) is that as the quantity of insourced skill s labor increases the firm moves their health plan towards the health plan that minimizes the insourcing price of skill s. The intuition for (3) is that as the cost of deviating from a_s^* increases, the firm moves its health plan closer to a_s^*.

Lemma: Goods firms pay higher prices than labor-service firms for labor supplied directly from workers.

This lemma follows from the health plan constraint that goods firms face, 6. Labor-service firms simply choose the cheapest package that satisfies 7, while goods firms must satisfy this constraint while offering all workers the same level of health plan. This lemma provides intuition for how labor-service firms can exist in a competitive equilibrium; they purchase labor for a price lower than that of the goods firms, then they sell the labor to the goods firms.

3.3.4 Ratio of outsourced to insourced labor

The firm-level ratio of skill-s insourced and outsourced labor is proportional to the inverse ratio of their prices:

$$\frac{\hat{l}_{js}}{\hat{n}_{js}} = \alpha_s \Big(\frac{\hat{w}_{js} + \hat{a}_j}{p_{ls}}\Big)^{\theta_s} \tag{15}$$

where hats denote the goods firm's optimal policies. Equations 15 and 14 together make the following logic clear. If a firm has a relatively high weight for skill $s \in \mathcal{S}$, then they set their health plan relatively close to skill s's optimal health plan. This makes the price ratio on the right hand side of 15 relatively low, and the firm outsources a relatively low amount of skill s labor. I formalize this idea in the following proposition.

Proposition 1: Consider an economy with workers of 2 skill levels $s \in \{1, 2\}$, and at least 2 goods firms. For two arbitrary goods producing firms, labeled A and B, assume that $\varphi_{A2} > \varphi_{B2}$ (and thus $\varphi_{A1} < \varphi_{B1}$). Two cases follow.

1. If in general equilibrium $\tilde{u}_1 \neq \tilde{u}_2$ then firm A outsources relatively more skill 1

labor than firm B, $\frac{l_{A1}}{n_{A1}} > \frac{l_{B1}}{n_{B1}}$, and firm B outsources relatively more skill 2 labor than firm A, $\frac{l_{A2}}{n_{A2}} < \frac{l_{B2}}{n_{B2}}$.

2. If in general equilibrium $\tilde{u}_1 = \tilde{u}_2$ then $\frac{l_{A1}}{n_{A1}} = \frac{l_{B1}}{n_{B1}}$ and $\frac{l_{A2}}{n_{A2}} = \frac{l_{B2}}{n_{B2}}$.

Proof: See appendix.

Plugging 12 into 15 yields

$$\frac{\hat{l}_{js}}{\hat{n}_{js}} = \alpha_s z_{ls}^{\theta_s} \left(\frac{\hat{w}_{js} + \hat{a}_j}{a_s^* + w_s^*} \right)^{\theta_s}. \tag{16}$$

Thus, the quantity of outsourced labor relative to insourced at each firm (and thus the entire economy) is bounded below by $\alpha_s z_{ls}^{\theta_s}$. At each goods firm, due to the health plan constraint, $\left(\frac{\hat{w}_{js} + \hat{a}_j}{a_s^* + w_s^*} \right) > 1$. As the price of insourced labor (relative to the price at the labor-service firm) increases, so does the relative quantity of outsourced labor. The parameter θ_s governs the amount at which an increase in the relative price of insourced labor increases the relative quantity of outsourced labor. If the health constraint is removed, then each goods firm offers each type their optimal compensation package, thus making $\left(\frac{\hat{w}_{js} + \hat{a}_j}{a_s^* + w_s^*} \right) = 1$.

Lemma: At each goods firm, $\frac{\hat{l}_{js}}{\hat{n}_{js}} > \alpha_s z_{ls}^{\theta_s}$ $\forall s \in \mathcal{S}$. If the health plan constraint is removed, $\frac{\hat{l}_{js}}{\hat{n}_{js}} = \alpha_s z_{ls}^{\theta_s}$ $\forall s \in \mathcal{S}$. **Proof**: Follows from 16.

3.3.5 Comparative Statics

This section discusses comparative statistics that explain how changes in primitives or constraints effect outsourcing. For intuition, consider a world with workers of only two skill levels, $1, 2 \in \mathcal{S}$ and, due to differences in supply and demand, skill level 2 has a higher utility level in equilibrium, $\tilde{u}_2 > \tilde{u}_1$.

Manipulating 16 yields

$$\frac{\hat{l}_{j1}}{\hat{n}_{j1}} \approxprop w_{aa}(a_1^*, \tilde{u}_1) \left(\frac{\omega_2}{\omega_1 + \omega_2} \right)^2 (a_2^* - a_1^*)^2 (w_1^* + a_1^*)^{-1} \tag{17}$$

where $\approxprop$ denotes "approximately proportional to" and the equation for $s = 2$ is defined analogously. The relative quantity of outsourced skill-1 labor is proportional to a combination of four terms. How these four term react to changes in primitives will determine the results of the comparative statics.

For intuition, I explain why the relative quantity of outsourced labor has a positive relationship with each term. The first term, $w_{aa}(a_1^*, \tilde{u}_1)$, is the curvature of the insourcing price of skill 1 evaluated at its optimal health plan (as before $w(a, \tilde{u}_s) = min_{w \in R_+}\big(w \mid u(w, a/p_m) \geq \tilde{u}_s\big)$, and the subscripts denote derivatives). Holding all else equal, if this curvature increases then the relative price of insourced skill 1 labor increases because the goods firms health plan is not equal to a_1^*. Thus the relative quantity of outsourced labor increases.

The second term is proportional to the weight on skill 2's optimal health plan in the weighted average that determines the goods firms health plan policy (see equation 13). Holding all else equal, if the weight on a_2^* increases then the weight on a_1^* decreases, which increases the insourced price of skill 1. This leads to a decrease in the quantity of skill 1 labor insourced (relative to that outsourced).

Third is the distance between each skill's optimal health plan. Holding all else equal, if this distance increases, then so does the distance between the firm's health plan policy $\hat{a}_j$ and the optimal health plans. This increases the difference between the price of insourced labor at the goods firms and that at the labor-service firms. The relative price of outsourced labor decreases, and the relative quantity increases.

Last is the inverse of the price of the skill 1's optimal compensation package, which the price of labor-services of skill 1 is proportional to. Holding all else equal, if $w_1^* + a_1^*$ increases, then the price of skill 1 labor-services p_{l1} increases, which decreases the amount of quantity of labor-services purchased.

Using 17 I explain the rational for why skill-biased technical change increases the outsourcing of the low-skill workers. Suppose skill-biased technical change increases the weight on type 2 labor, φ_{j2} at any number of goods firms. Demand for type 2 workers increases, thus increasing $\tilde{u}_2$. Likewise, demand for type 1 decreases, decreasing $\tilde{u}_1$. The change in utility levels causes the third term and last term in 17 to increase. Further, if the goods firm is one in which φ_{j2} increases, then their is a first order increase in the second term. The change in the first term is ambiguous, and depends on the functional form of u. I pick a simple functional form to derive the following proposition.

Proposition 2: Assume $u(w, a/p_m) = w^\alpha (a/p_m)^{1-\alpha}$. Consider an economy with workers of two skill levels, $s \in \{1, 2\}$. Denote whichever worker has higher utility in general equilibrium as skill 2, $s = 2$. (If both skill levels have the same utility level, then either can be labeled as type 2.) Consider a comparative static in which φ_{j2} increases (and φ_{j1} decreases so that $\sum_{s\in\{1,2\}} \varphi_{js} = 1$) at any number of goods firms $j \in \mathcal{J}$. Then the percent of skill 1 workers that are outsourced increases. **Proof:** See appendix.

skill-biased technical change has an ambiguous effect on the outsourcing of high-skill workers. The increase in $\tilde{u}_2$ causes $(w_2^* + a_2^*)^{-1}$ to decrease, while $(a_2^* - a_1^*)^2$ increases. Thus, the effect on $\frac{\hat{l}_{j2}}{\hat{n}_{j2}}$ is ambiguous.

If the price of medical care p_m increases, then the change in outsourcing of all skill levels is also ambiguous. While the fourth term in 17 likely increases, the change in the other three terms is ambiguous, even while assuming a simple functional form for utility. I leave a more detailed conversation about this comparative statistics to the appendix A.7.

If the health plan constraint is removed — allowing firms to offer insourced workers varying health plans — then outsourcing decreases. If firms are unconstrained when choosing each worker's health plan, then the goods firms choose the same optimal compensation package as the labor-service firms, and thus by 15,

$$\frac{\hat{l}_{js}}{\hat{n}_{js}} = \alpha_s z_{ls}^{\theta_s}.$$

Thus, qualitatively outsourcing of all skill levels decreases. Quantitatively, the size of the change depends on how much greater the goods firms' insourcing prices are compared to the labor-service firms'.

4 Data

The cross-sectional industry level data I use for the main analysis draws from multiple sources. Health plan expenditure per employee is from the Annual Survey of Manufacturers (ASM) and the Service Annual Survey (SAS).[25] Employment and mean wage at the occupation-industry level is from the Occupational Employment and Wage Statistics (OEWS). Lastly I use the BEA's make-use tables to get each industry's expenditure on output from the labor-service industries . The make-use tables are the most disagreggated in years 2007 and 2012, while the SAS only has health plan data between 2012 and 2017 inclusive. Hence, my main calibration focuses on the cross section of industries in 2012.

From here I map the data to the model as follows. First, I map each goods firm in the model to a single industry.[26] Second I assume that expenditure on output from the labor-service industries is expenditure on domestically outsourced labor. I do not use expenditure on any other industry in my calibration.[27] Third, I map occupations in the OEWS to skills by dividing broad occupation into 5 quintiles by mean wage, and weighting each quintile so that they each have the same number of employees.[28] Fourth, to estimate labor-service expenditure by skill for each industry, I weight industry expenditure by employment shares by skill level:

$$X_{js} = \sum_{k \in \mathcal{J}_l} X_{jk} \frac{n_{ks}}{n_k}$$

where X_{js} is the estimated expenditure by industry j on skill s, X_{jk} is expenditure by industry j on industry k's output, and $\frac{n_{ks}}{n_k}$ is the percent of industry k's employment that is skill s, and J_l is the set of labor-service industries at the 4 digit NAICS code level.

Finally, to estimate the quantity of labor that is domestically outsourced, I weight

[25] While the SAS has a majority of service industries, it is missing several of them. Further, while the ASM has data for every manufacturing industry at the 4 digit NAICS level, the SAS sometimes aggregates industries to the 2 or 3 digit NAICS level. I keep the data as disaggregated as possible, to maximize the number of observations in the cross section. Also, SAS has total health plan expenditure, but does not have total employment. I use the County Business Patterns database to get employment for the service industries, so that I can calculate health plan expenditure per employee.

[26] If I assume that within an industry, their are a continuum of firms with identical skill weights, then all firms within an industry can be represented by one firm.

[27] I am using a conservative definition of domestic outsourcing here. I am not including, for example, expenditure on transportation, warehousing, or retail trade in my main quantitative exercise.

[28] The OEWS's occupation classification scheme has 4 levels of aggregation. Broad level is the 3rd most disaggregate or detailed level. There were 457 broad level occupations in the year 2012. The occupations are granular; some example are "Podiatrists", "Traffic Technicians", and "Line Installers and Repairers".

the level of employment in labor-service industries by the percent of the industry's output that is intermediate input in production,

$$L_s = \sum_{j \in \mathcal{J}_l} \frac{\text{output used as intermediate input}_j}{\text{Total output}_j} n_{js},$$

where L_s is the estimated quantity of outsourced skill s labor and n_{js} is the quantity of skill s employment in industry j.

5 Testing cross-sectional theoretical implications

This section tests the cross-sectional implications of the model described by proposition 1. To recap, firms vary in skill weights. Firms with relatively high weight on high-skill workers pick high health plans to minimize the price of insourced high-skill workers, at the expense of having a relatively high price for insourced low-skill workers. This relatively high prices causes these firms to outsource a relatively high quantity of low-skill worker. Hence, the model predicts a positive relationship between the following variables: high-skill labor expenditure as a share of total labor expenditure; health plan expenditure per employee; and low-skill outsourcing expenditure as a share of total low-skill labor expenditure.[29] I classify skill levels 1 and 2 as 'low' skill, and skill levels 4 and 5 as 'high' skill, then plot these variables against each other. The resulting figures (6, 7, and 9) show that these variables all have positive relationships with each other, as predicted by the model. (For a more concrete measure of low-skill labor, figure 8 shows temp agency expenditure per employee against health plan expenditure per employee; their is a strong positive relationship between the two variables.)

The model also implies that firms with relatively high weight on low-skill workers pick low health plans and outsource a relatively high quantity of high-skill labor. As predicted, figure 10 shows negative relationship between low-skill labor expenditure and health plan expenditure. However, at odds with my theory, I do not find a positive relationship between low-skill expenditure and high-skill outsourcing expenditure, see 12. I also do not find a negative relationship between health plan expenditure per

[29]An implication from the firm profit maximization problem is that the share of labor expenditure on any given type is equal to its type weight parameter. Hence, relatively high expenditure on high-skill labor implies a relatively high weight φ on high-skill labor.

employee and the share of high-skill labor that is outsourced, see 11.

To summarize, the cross-sectional implications of my model agree with the data on low-skill outsourcing, but disagrees on high-skill outsourcing. Later in the quantitative section, I find that my accounting exercises can explain a significant share of the increase in low-skill outsourcing, and little to none of the increase in high-skill outsourcing.

6 Quantitative Analysis

This section discusses the calibration of the model and the main quantitative results. I use detailed industry level data to calibrate the model to the year 2012. The main quantitative exercise is to quantify how the following three factors have contributed to the increase in domestic outsourcing: the rising price of medical care, skill-biased technical change, and laws which constrain firms ability to offer varying levels of health plans. Specifically, I solve the calibrated model's equilibrium, change a primitives or constraint, solve for the new equilibrium, and see how much domestic outsourcing changes. Last, I do a policy counterfactual, and compare welfare and efficiency to the economy with and without the health plan constraint.

6.1 Calibration

The calibration strategy has four steps. First I exogenously set one parameter. Second, I calibrate the goods firms' skill weights and efficiency terms internally, using structural equations to map data directly to the parameters. Third I estimate the elasticities of substitution between insourced and outsourced labor by deriving an equation that allows the elasticity to be estimated by running a regression on cross-sectional data. Finally, I use simulated methods of moments (SMM) to calibrate the remaining parameters.

Before calibrating the parameters I make the following assumptions to the analytical model. First, I assume that the utility function are Stone-Geary,

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

Second, I set the efficiency parameters of the labor-service firms to 1, $z_{ls} = 1$, because the z_{ls} and the α_s terms are not separately identifiable. Third, in the baseline model I normalize the price of medical care to 1.

First, I exogenously set the returns to scale of the goods firm, ν, to 0.95. Second, I use the goods firm's first order conditions to derive equations that map data on labor expenditure directly to the goods firms' skill weights and efficiency terms:

$$\varphi_{js} = \frac{X_{js}}{\sum_s X_{js}}, \qquad z_{js} \approx \frac{\sum_s X_{js}}{\nu(\sum_s X_{js}^{\varphi_{js}})^{\nu}}$$

Next, to estimate θ_s, I manipulate 15 to derive the following regression equation.[30]

$$log\frac{X_{js}}{n_{js}} = (\theta_s - 1)log(w_{js} + a_j) + \beta_0 + \epsilon_j \tag{18}$$

The dependent variable is the expenditure on skill-s *outsourced* labor per *insourced* skill-s employees. The independent variable is the price of *insourced* skill-s employees. I run the regression on cross-sectional industry data. Identification comes from industry level variance in 1) the price of insourced labor and 2) the expenditure on outsourced labor relative to the quantity of insourced labor.

The results of this regression are in table 2. For the lowest 4 wage quintiles, I find positive, statistically significant relationships between the price on insourced labor and expenditure on outsourced labor. For the fifth and highest wage quintile, I do not find a positive or statistically significant relationship, and I cannot reject zero. As a check to make sure these estimates are reasonable, I run the above regression for industries that have a clear occupational mapping. For example, I check if their is a positive relationship between the price of insourced janitors and the expenditure on janitorial services. For a majority of these industries I find positive, statistically significant coefficients. The result of these regressions are in appendix section B.

The remaining parameters are calibrated using simulated methods of moments (SMM). All parameters are calibrated simultaneously, so a perfect 1 to 1 mapping between targeted moments and parameters does not exist. But, I provide a clear, rough mapping. I target the economy wide health plan to wage ratio, which roughly

[30] For this regression, I allow the CES weight term α to vary across industries, to explain the error terms.

maps to the weight on medical care in the worker's utility function. I also target the relationship between mean wage and health plan level in the cross section. That is, across firms as the mean wage level increases, so does the health plan expenditure per worker. I target this moment with the two other utility parameters: the elasticity of substitution between goods and medical care and the non-homotheticity term. Next, I target the expected utility of each type of worker — calculated by inputting health plan and wage data into the calibrated utility function — with the mass (supply) of each type of worker. Lastly, I set the skill-s weight on labor-services in the firm's production function, α_s, to match the percent of skill-s workers that are outsourced. See table 3 for a summary of the calibration strategy and table 4 for targeted moments. My calibration hits the targeted moments almost perfectly.

6.1.1 Discussion

I target the percent of workers outsourced in the economy, which can be expressed as a weighted average of a convolution of firm level prices and α_s,

$$\frac{n_{ls}}{N_s} = \sum_{j \in J} \frac{\alpha_s}{\alpha_s + R_{js}} \times \frac{n_{js} + l_{js}}{N_s}$$

where

$$R_{js} = \left(\frac{w_s^* + a_s^*}{\hat{w}_{js} + \hat{a}_{js}} \right)^{\theta_s} \in (0, 1].$$

Intuitively in the calibration step, first R_{js} is pinned by targeting moments that characterize worker's preferences and firm labor demand. Second, the primitive α_s is set so outsourcing in the model matches that of the data.

Recall the main accounting exercises are attributing the *increase* in domestic outsourcing in the data to primitive or constraint changes in the model. I calibrate the model to 2012, and I change a primitive or constraint to emulate an aspect of the economy in 1980, and see how much domestic outsourcing *decreases*. The level of α_s is important because it sets a floor on the percent of the increase in outsourcing my accounting counterfactuals can explain. In the baseline calibration, $R_{js} < 1\ \forall j, s$. The accounting exercises, which change primitives or constraints, can increase R_{js} and thus decrease the level of outsourcing. However, the maximum value of R_{js}, by construction, is 1, which bounds the level of outsourced workers below by $\frac{\alpha_s}{1+\alpha_s}$. Table 5 shows the estimates for $\frac{\alpha_s}{1+\alpha_s}$, along with outsourcing rates in 2012. The table shows that $\frac{\alpha_s}{1+\alpha_s}$ is close to the outsourcing rate in 2012 for $s \in \{4, 5\}$. This means that little of high-skill outsourcing is explainable by relative price R_{sj} and in equilibrium the compensation package offered to high-skill workers is close to their optimal.

For intuition on why high-skill workers' compensation packages are close to their optimal, figure 14 plots health plans on the x-axis against the distance between the price for insourced labor and the optimal compensation package as a function of health plans, $(w(a, \tilde{u}_s)+a)-(w_s^*+a_s^*)$, on the y-axis. For each skill level, this graph shows the raw change in insourcing price as the health plan moves away from their optimal health plan; the raw change is much greater for high-skill workers than for low-skill. Because of this, firms offer high health plans to minimize the insourcing price of high-skill labor. A ramification is that low-skill workers are far from their optimal compensation package; the price of low-skill workers can be lowered by lowering health plans and increasing wages.

For tractability, the labor-service firms input a single type of labor. This is simplification of the fact that, for example, the workforce at janitorial service firms has a much higher percent of janitors than the workforce at other firms. The model with labor-service firms demanding inputs of all skill types would have higher prices for outsourced labor, lower price ratios in 15, and thus higher estimated α_s. Hence, my simplification biases the estimate for α_s downward and increases the share of the rise in outsourcing that is explainable by my accounting exercises.

6.2 Accounting for the increase in domestic outsourcing

After calibrating the model to 2012 and solving for the equilibrium, I conduct three counterfactual analyses and compare the level of domestically-outsourced workers to the baseline economy. First, I restrict the price of medical care to its 1980s level.[31] Second, I study a scenario where skill-biased technical change has not occurred, i.e., the demand for high-skill workers has not changed. I do this by adjusting each firm's

[31] The 1980's level of the price of medical care (over the price of all other goods) is calculated using CPIs. The price of medical care (relative to the price of all non medical care consumption) grew by 108% between 1980 and 2012. Hence, in the model, if the relative price of medical care is normalized to one in 2012, then the price of medical care in 1980 is $1/(1+1.08) = 0.48$.

estimated weights on skill-types in production, decreasing the weight on high-skill (and high-utility) workers.[32] Third, I remove the constraint requiring firms to offer the same health plans to all workers within their firm.

Table 6 contains the results. The table has the percentage point change in outsourcing rate by skill between 1980 and 2012 (estimated from the data) and the percent of that change explained by each counterfactual. I find that each counterfactual explains little of the increase in domestic outsourcing in the top two quintiles (the highest-paid occupations), but a significant amount of that in the bottom three quintiles. The increase in the price of medical care explains 17%, 8%, and 4% of the change in outsourcing in the bottom three quintiles, from lowest to highest, respectively. Skill-biased technical change explains 56%, 37%, and 14%. The health plan constraint explains 72%, 40%, and 22%.

Next, I calculate the percent of workers outsourced by skill for an economy representing 1977. There is no health plan constraint, the price of medical care is lowered to its respective level, and I adjust the firm skill weights to lower the demand for high-skill labor. I then add back each factor one-by-one and in combination, and compare the outsourcing rates for each counterfactual economy. Table ref:tab:mainResults2 contains the results. The table shows that the increase in low-skill domestic outsourcing was caused by the health plan constraint together with skill-biased technical change. In a world where the optimal health plans of low- and high-skill workers are close together, the health plan constraint has little effect and does not greatly change the price of insourced low-skill workers. Skill-biased technical change spread out the utility levels and optimal health plans of low- and high-skill workers and, due to the health plan constraint, greatly increased the relative price of insourced low-skill workers.

In conclusion, the health plan constraint together with skill-biased technical change had a significant effect on the outsourcing of low-skill workers. My counterfactuals show that skill-biased technical change, the increase in the price of medical care, and the enactment of the health plan constraint all have a small or nonexistent effect on the outsourcing of high-skill workers.

[32] This counterfactual is ad-hoc at this point in time. I uniformly shift the skill weights toward the lowest skill at each firm.

6.3 Policy counterfactual: Removing the health plan constraint

I compare the benchmark equilibrium to that without the health plan constraint along various welfare, distribution, and efficiency metrics. The results are in table 8. Notably, the mean utility level of the workers increases by 0.6%. Both goods per capita and profits per capita have increased by 0.01 percent.

6.4 Robustness

Next, I repeat the main quantitative exercise to show that my main results are robust to how substitutable outsourced and insourced labor are for the top three quintiles. I re-calibrate the model, setting the elasticity of substitution for the top three quintiles to one, $\theta_s = 1 \ \forall s \in \{3, 4, 5\}$. For the top three quintiles a change in the relative price of outsourced labor does not change the relative expenditure on outsourced labor. See table 9 for my results. Compared to my main specification, the share of low-skill outsourcing explained by my three counterfactuals does not significantly change.

7 Conclusion

I create a new theory of domestic outsourcing. The model has several interesting implications. First, labor-service firms face lower prices for labor than goods firms, giving an intuition for how labor-service firms can operate in a competitive equilibrium. Second, firms with a relatively high demand for high-skilled labor choose high health plans and outsource a relatively high quantity of low-skilled labor. Third, in the presence of the health plan constraints motivated by US legislation, skill-biased technical change causes low-skill domestic outsourcing to increase.

I use multiple data sources to create a cross-sectional data set to validate and calibrate my model. I find that, qualitatively, the second implication of the model is supported by the data. I then calibrate the model to the year 2012.

My main quantitative result is that the employer health laws, together with skill-biased technical change, explain a significant amount of the increase in domestic outsourcing of low-skill workers over the past 40 years. To the best of my knowledge, this is the first paper to quantitatively measure the effect of either of these two factors or the increase in the price of medical care on domestic outsourcing. Further, compared to the literature, the model can explain a relatively high amount of the increase in low-skill domestic outsourcing. Autor (2003) finds that the erosion of the employment at will doctrine explains 20% of the growth of employment in the temporary help services industry between 1973 and 1995. I find that the passage of laws that constrain firms' ability to offer varying levels of health insurance to their employees and skill-biased technical change can together explain roughly half of the increase in low-skill outsourcing.

While I find empirical and quantitative evidence that my theory can explain the rise of low-skill outsourcing, I find little evidence that it can explain the rise of high-skill outsourcing. Future work is necessary to understand why high-skill outsourcing is growing and the welfare, efficiency, and distributional effects of the growth.

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A Appendix

A.1 Employer health plan expenditure variance decomposition

I use the Robert Wood Johnson Foundation Employer Health Insurance Survey. Data is from the year 1993. Each observation is a employer health plan. Most plans have an option between single or family coverage. For each observation has employer identification. Each observation and coverage type has employer premiums and employee participation. The data set has roughly 22,000 plans, and 15,000 employers.

I decompose the variance in the dispersion of employer premiums (the price the firm faces for employer health plans) into a between firm and within firm component.[33] The total dispersion of employer premiums 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 is plan, j is employer, x is employer premium, and the overbar denotes mean. I run the above decomposition seperately for single and family coverage, under the assumption that they operate in distinct markets. I find that 83% (86%) of the total variation of single (family) plan employer premiums is between firms. The results are not sensitive to weighting by employee participation.

The size of the between firm component is not surprising because many firms in the sample offer only a single health plan. If I use the subset of firms that offer two or more health plans, the between and within components are both responsible for roughly half of the total dispersion.

A.2 Outsourced labor share: between vs within decomposition

I decomposed the change in the outsourced labor share into a within industry and between industry component, and find that the outsourced labor share increase is due to many sectors of the economy increasing their outsourced labor expenditure. The

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

change in outsourced labor share between time t and τ is

$$\Delta s_{t,\tau} = \sum_{j \in J} \underbrace{\bar{\omega}_{j,t,\tau} \Delta l_{j,t,\tau}}_{\text{Within-industry}} + \underbrace{\Delta \omega_{j,t,\tau} \bar{s}_{j,t,\tau}}_{\text{between-industry}}$$

where J is the set of all industries, $\omega_{j,t}$ and $s_{j,t}$ are industry j's share of total output and outsourced labor share at time t respectively, the over bar denotes the mean of the value at time t and τ, and Δ denotes the percentage point change between two time periods. Figure 3 plots the total change in the outsourced labor share on the x-axis against the within industry component on the y-axis. Each point is a five year period between 1965 and 2020. Most points are near the 45 degree line, meaning that the within-industry component was mostly responsible for the increase in the change in service input share. Between 1980 and 2021, the within component was responsible for 71.7% of the total increase in the outsourced labor share. Further, a similar pattern holds if expenditure on 541 or 561 is looked at individual.

A.3 Worker problem with taxes

All together, the worker's problem is to choose the compensation package that yields the highest utility. That is, the type s workers view the entire distribution of compensation packages, $\{a_j, w_{js}\}_{j \in \mathcal{J}}$, and chooses the compensation package that yields the highest utility,

$$\max_{j \in \mathcal{J}} u(a_j, w_{js}). \tag{19}$$

where

$$u(a_j, w_{js}) = \max_{(a,c) \in R_2^+} \{u(a + a_j, c) \mid c + p_a a \xi \leq T(w_{js})\}. \tag{20}$$

p_a is the (exogenous) price of medical care, $\xi \geq 1$ captures the idea that medical care could be cheaper when purchased by the firm through a health plan rather than being purchased directly by the worker If $\xi > 1$, then medical care is cheaper when purchased through the firm's health plan. If $\xi = 1$, then the price of medical care purchased by the firm and that purchased by the worker are equivalent. $T : R^+ \to R^+$ is the tax function.

A.4 Derivation of the goods firm optimal health plan

The goods firm first order conditions (dropping the j subscript) are

$$\nu\varphi_s y = q_s \mathbf{n}_s \quad \forall s \tag{21}$$

$$\tilde{u}_s = u(w_s, a) \quad \forall s \tag{22}$$

$$\frac{\partial q_s}{\partial w_s}\mathbf{n}_s = \lambda_s \frac{\partial u_s}{\partial w_s} \quad \forall s \tag{23}$$

$$\sum_s \frac{\partial q_s}{\partial a}\mathbf{n}_s = \sum_s \lambda_s \frac{\partial u_s}{\partial a} \tag{24}$$

where $u_s \equiv u(w_s, a)$. Combine 24 and 23 to get

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

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

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

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

By the chain rule

$$\frac{du_s}{da} = \frac{\partial u_s}{\partial a} + \frac{\partial u_s}{\partial w}\frac{\partial w}{\partial a} \tag{25}$$

By 22, $\frac{du_s}{da} = \frac{d\tilde{u}_s}{da} = 0$ since $\tilde{u}_s$ 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 25 and rearrange to get

$$-\frac{\partial w_s}{\partial a} = \frac{\partial w}{\partial u_s}\frac{\partial u_s}{\partial a} \tag{26}$$

Now continue with the algebra

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

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

Use 21 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 15, I get

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

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

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

(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

$$a \approx \sum_s \frac{\varphi_s \times \frac{\partial^2 log(a+w(a,\tilde{u}_s))}{\partial a^2}\Big|_{a=a_s^*} \times \frac{(w_s+a)n_s}{(w_s+a)n_s+p_{ls}l_s}}{\sum_{s'} \varphi_{s'} \times \frac{\partial^2 log(a+w(a,\tilde{u}_{s'}))}{\partial a^2}\Big|_{a=a_{s'}^*} \times \frac{(w_{s'}+a)n_{s'}}{(w_{s'}+a)n_{s'}+p_{ls'}l_{s'}}} a_s^*. \tag{27}$$

A.5 Proof of proposition 1

By the assumptions on the utility function, $\{a_s^*, w_s^*\}$ is unique for each skill level, the price of insourced labor $a + w$ strictly increases as a moves away from a_s^*, and $\frac{\partial a_s^*}{\partial \tilde{u}_s} > 0$.

Case 2 is trivia. Because $\tilde{u}_1 = \tilde{u}_2$, then $a_1^* = a_2^*$. Hence, goods firm set a equal to the optimal health plans of both skills. The result follows from 15.

Case 1: Because $\tilde{u}_1 \neq \tilde{u}_2$, then $a_1^* \neq a_2^*$. Combine every firm first order condition to get:

$$\sum_s \frac{\partial log(a + w_s)}{\partial a} \varphi_{js} \frac{(w_s + a) n_s}{(w_s + a) n_s + p_{ls} l_s} = 0$$

Rearrange to get

$$\frac{\varphi_{j2}}{\varphi_{j1}} = -\frac{\frac{\partial log(a+w_1)}{\partial a}}{\frac{\partial log(a+w_2)}{\partial a}} \frac{\frac{(w_1+a)n_1}{(w_1+a)n_1+p_{l1}l_1}}{\frac{(w_2+a)n_2}{(w_2+a)n_2+p_{l2}l_2}} \equiv f(a) \tag{28}$$

Observe that this equation is a function of only primitives and a. Thus we get that

$$\frac{\partial\varphi_{j2}/\varphi_{j1}}{\partial a} = \frac{\partial f(a)}{\partial a}$$

Now I approximate $\frac{\partial f(a)}{\partial a}$,

$$\frac{\partial f(a)}{\partial a} \approx \frac{\frac{(w_1+a)n_1}{(w_1+a)n_1+p_{l1}l_1}}{\frac{(w_2+a)n_2}{(w_2+a)n_2+p_{l2}l_2}} \times \frac{\partial}{\partial a}\left(-\frac{\frac{\partial log(a+w_1)}{\partial a}}{\frac{\partial log(a+w_2)}{\partial a}}\right) \tag{29}$$

My justification for this approximation is that the partial derivative of $\frac{\frac{(w_1+a)n_1}{(w_1+a)n_1+p_{l1}l_1}}{\frac{(w_2+a)n_2}{(w_2+a)n_2+p_{l2}l_2}}$ with respect to a is a much smaller magnitude than the partial derivative of the other term, which is sensitive to changes in a. Recall that a is be between a_1^* and a_2^*, and observe that the limit of this term as it approaches either optimal health plan is extreme:

$$\lim_{a \to a_1^*} \frac{\partial log(a+w_1)/\partial a}{\partial log(a+w_2)/\partial a} = 0$$

$$\lim_{a \to a_2^*+} \frac{\partial log(a+w_1)/\partial a}{\partial log(a+w_2)/\partial a} = \infty$$

$$\lim_{a \to a_2^*-} \frac{\partial log(a+w_1)/\partial a}{\partial log(a+w_2)/\partial a} = -\infty$$

Thus we get

$$\frac{\partial\varphi_{j2}/\varphi_{j1}}{\partial a} \underset{\sim}{\propto} \frac{\partial}{\partial a}\left(-\frac{\frac{\partial log(a+w_1)}{\partial a}}{\frac{\partial log(a+w_2)}{\partial a}}\right)$$

Now there are two sub-cases.

1. If $\tilde{u}_2 > \tilde{u}_1$, then $\frac{\partial}{\partial a}\left(-\frac{\frac{\partial log(a+w_1)}{\partial a}}{\frac{\partial log(a+w_2)}{\partial a}}\right) > 0$. Thus, $\frac{\partial\varphi_{j2}/\varphi_{j1}}{\partial a} > 0$. Because $\frac{\varphi_{A2}}{\varphi_{A1}} > \frac{\varphi_{B2}}{\varphi_{B1}}$, I get $a_A > a_B$. Thus a_A is closer to a_2^* and farther from a_1^* then a_B is.
2. If $\tilde{u}_2 < \tilde{u}_1$, then $\frac{\partial}{\partial a}\left(-\frac{\frac{\partial log(a+w_1)}{\partial a}}{\frac{\partial log(a+w_2)}{\partial a}}\right) < 0$. Thus, $\frac{\partial\varphi_{j2}/\varphi_{j1}}{\partial a} < 0$. Because $\frac{\varphi_{A2}}{\varphi_{A1}} > \frac{\varphi_{B2}}{\varphi_{B1}}$,

I get $a_A < a_B$. Thus a_A is closer to a_2^* and farther from a_1^* then a_B is.

Because a_A is farther from a_1^* than a_B is, $w_{B1}+a_B < \hat{w}_{A1}+a_A$ and firm A outsources relatively more skill 1 workers than firm B. Analogously, firm B outsources relatively more skill 2 workers than firm A.

□

A.6 Proof of proposition 2

The increase (decrease) in demand for skill 2 (1) labor increases $\tilde{u}_2$ (decreases $\tilde{u}_1$) in equilibrium. The total derivative of 15 yields

$$\frac{d\frac{\hat{n}_{out,js}}{\hat{n}_{in,js}}}{d\varphi_{j2}} \propto \frac{\partial log(\hat{a}_j - a_s^*)}{\partial \varphi_{j2}} + \frac{\partial log(\hat{a}_j - a_s^*)}{\partial \tilde{u}_1}\frac{\partial \tilde{u}_1}{\partial \varphi_{j2}} + \frac{\partial log(\hat{a}_j - a_s^*)}{\partial \tilde{u}_2}\frac{\partial \tilde{u}_2}{\partial \varphi_{j2}} + \left(- \frac{\partial log(\tilde{u}_s)}{\partial \varphi_{j2}} \right) \tag{30}$$

Thus the ratio of outsourced to insourced workers of skill s at firm j is proportional to the sum of four terms. In an abuse of notation, $\frac{\partial \tilde{u}_s}{\partial \varphi_{j2}}$ denotes how $\tilde{u}_s$ changes in equilibrium with respect to an increase in $\partial\varphi_{j2}$. The magnitude of these terms are unknown, but the sign is obvious. Further note that $\frac{\partial x}{\partial \varphi_{j2}} = \frac{\partial x}{\partial \varphi_{j2}} + \frac{\partial x}{\partial \varphi_{j1}}\frac{\partial \varphi_{j1}}{\partial \varphi_{j2}}$. Also $\frac{\partial log(x)}{\partial \varphi_{j2}} = \frac{1}{x}\frac{\partial x}{\partial \varphi_{j2}}$.

The proof concludes with cases.

1. If $s = 1$ then all four terms are positive. Thus $\frac{d\frac{\hat{n}_{out,j1}}{\hat{n}_{in,j1}}}{d\varphi_{j2}} > 0$.

2. If $s = 2$ then the first three terms are positive, and the last term is negative. Thus the sign of $\frac{d\frac{\hat{n}_{out,j1}}{\hat{n}_{in,j1}}}{d\varphi_{j2}}$ is ambiguous

A.7 What happens to outsourcing when p_m increases?

Consider an economy identical to that in proposition 2. The total derivative of 15 with respect to the price of medical care yields

$$\frac{d\frac{\hat{n}_{out,js}}{\hat{n}_{in,js}}}{dp_m} \propto \frac{\partial log(\hat{a}_j - a_s^*)}{\partial p_m} + \frac{\partial log(\hat{a}_j - a_s^*)}{\partial \tilde{u}_1}\frac{\partial \tilde{u}_1}{\partial p_m} + \frac{\partial log(\hat{a}_j - a_s^*)}{\partial \tilde{u}_2}\frac{\partial \tilde{u}_2}{\partial p_m} + 2(1-\alpha)p_m^{-1} + \left(- \frac{\partial log(\tilde{u}_s)}{\partial p_m} \right)$$

In the case of $s = 1$, the first term is positive because $\frac{\partial^2 a_s^*}{\partial p_m \partial u_s^*} > 0$, hence an increase in p_m causes the optimal health plans to spread out. The second term is positive, the third term is negative, the fourth term is positive, and the last term is positive. Hence ambiguous.

In the case of $s = 2$, the first term is positive times a negative (simplify the log), the second term is positive times negative times negative, the third term is negative times negative times negative, the fourth term is positive, and the final term is positive. Hence ambiguous.

B Alternative estimates for the elasticity of substitution between insourced and outsourced labor

This section documents an alternative estimation strategy for the elasticities of substitution between insourced and outsourced workers. In the main section, the estimation used a generalist strategy. In this section, I take a more exacting approach. I create a mapping from labor-service industries to a specific set occupations, for example janitorial services to janitors, then I estimate the elasticity of substitution using labor-service expenditure and wage and employment for the set of occupations.

First, for each 4 digit labor-service industry l, I rank each occupation by employment, and I take the minimum number of occupations that are responsible for at least half of total industry employment. Denote this set of occupations o_l. For example, in "services to businesses and dwellings", "building cleaning workers" and "ground maintenance workers" alone are responsible for over half of employment in this labor-service industry, and are the only two occupations in the industry's set of occupations. For accounting services, the following occupations make up its set: Accountants and Auditors; Bookkeeping, Accounting, and Auditing Clerks; Tax Examiners, Collectors and Preparers, and Revenue Agents.

Second, for each industry j and each labor-service industry l, I find the mean wage level and total employment of occupations in o_l. Denote the mean wage level of occupations in o_l for industry j as w_{jl}, and employment n_{jl}. Next, from the make use tables I get each industry's expenditure on each labor-service industry. Denote industry j's expenditure on labor-service industry l as X_{jl}. Finally, I take health plan expenditure per employee a_j from the ASM, SAS, and CBP combination, as in the main analysis. Now, for each labor-service industry l, I run the following regression:

$$log\frac{X_{jl}}{n_{jl}} = (\theta_l - 1)log(w_{jl} + a_j) + \beta_0 + \epsilon_j \tag{31}$$

The results are in table 11 and 10. Each column is a 4-digit industry with 3-digit naics code 541 or 561. The naics

For 6 out of 8 sub-industries of 561, I get positive, statistically significant estimates of the elasticity of substitution. However, they are smaller than my estimate in the main section. For 6 out of 9 four-digit sub-industries with NAICS code 541, I get positive, statistically significant estimates of the elasticity of substitution. For 2 of the 9, I cannot reject 0. For the last one, naics 5415, travel agencies, I get a large, negative elasticity.

C Figures and Tables

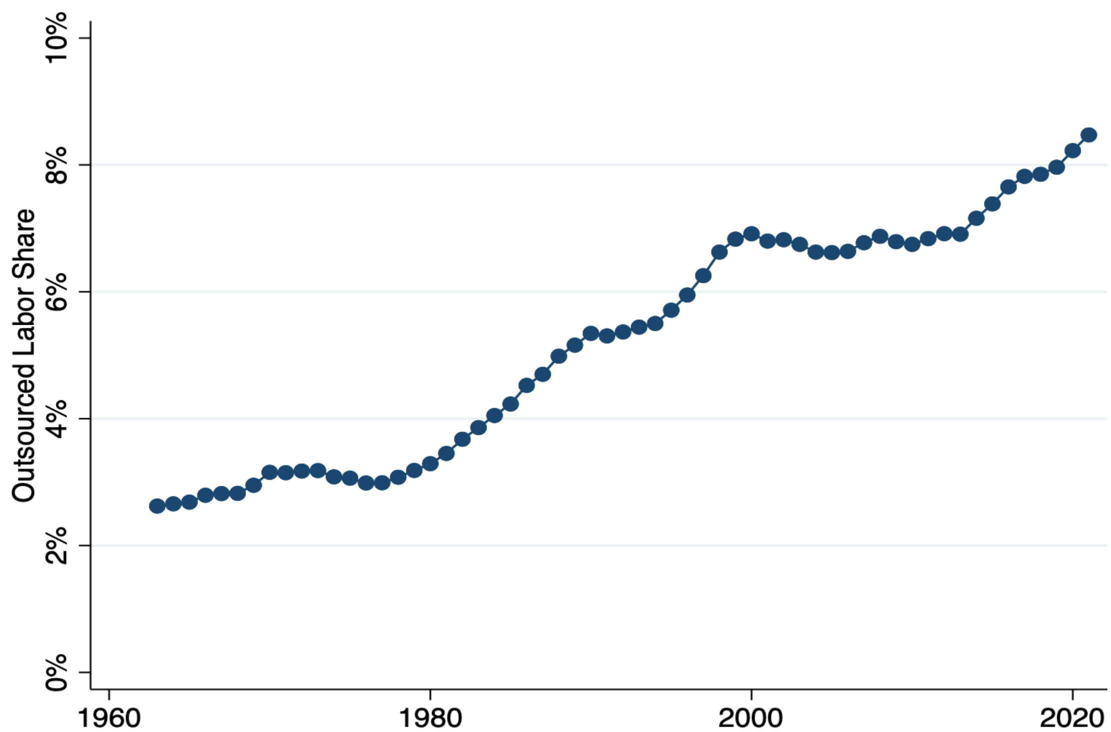

Figure 1: The figure plots the share of total output paid to intermediate inputs from the labor-service industries across time.

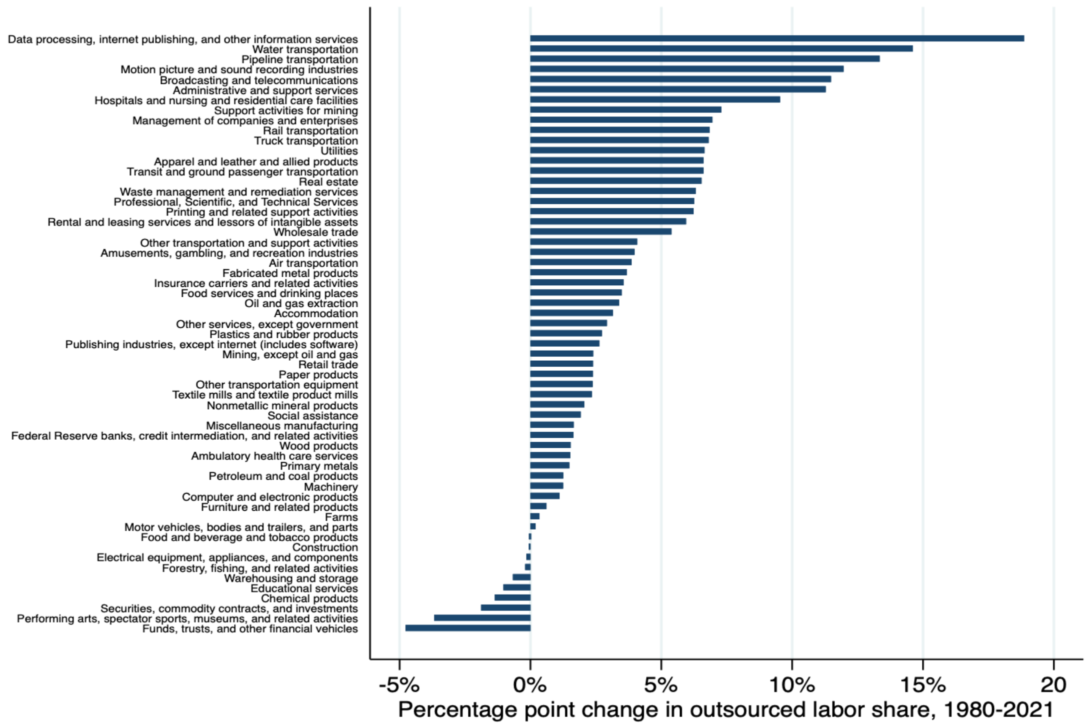

Figure 2: The figure plots the percentage point change, by industry, in the share of total output paid to intermediate inputs from the labor-service industries between 1980 and 2020.

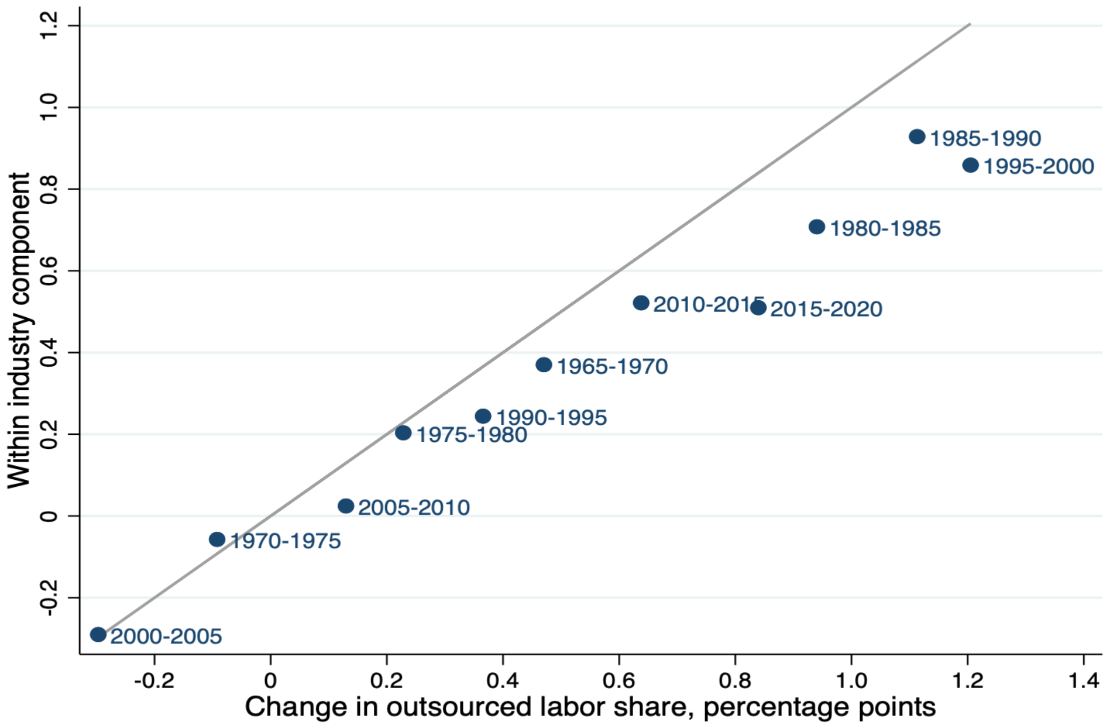

Figure 3: The figure plots the total change in outsourced labor share on the x-axis against the within industry component on the y-axis. Each point is a 5 year period between 1965 and 2020. The line is a 45-degree line; if a point is on the line then the entirety of the change in outsourced labor share in that period is within-industry.

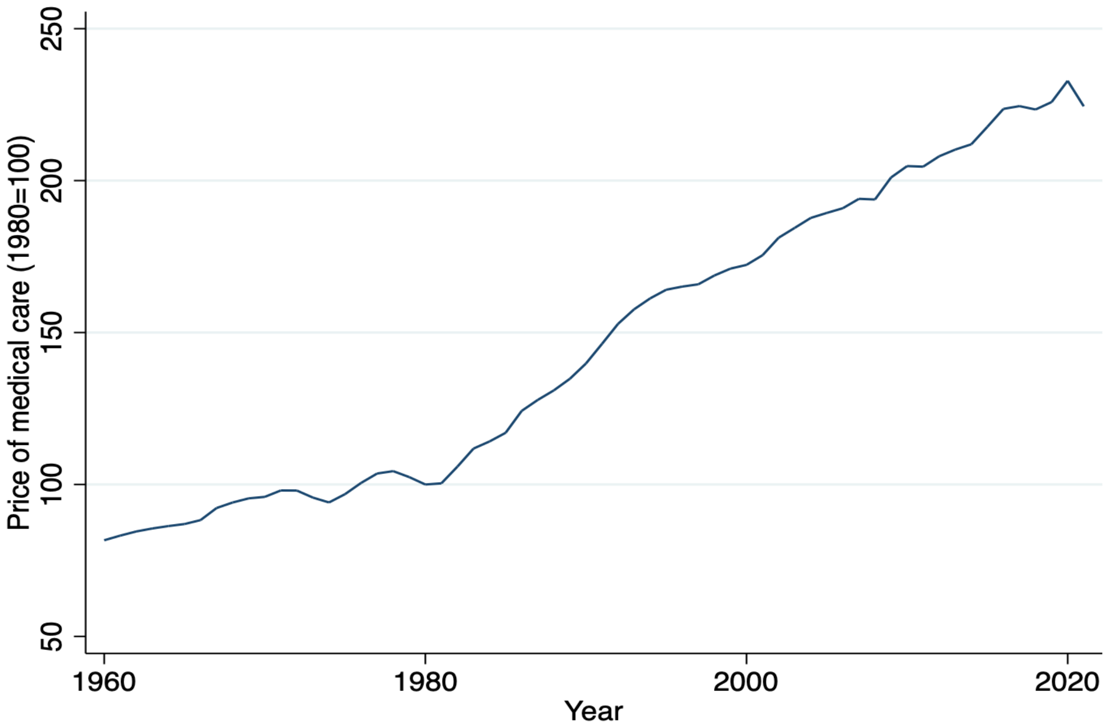

Figure 4: The figure plots the price index of medical care, relative to the price index of consumption excluding medical care. The index is normalized to 100 in the year 1980.

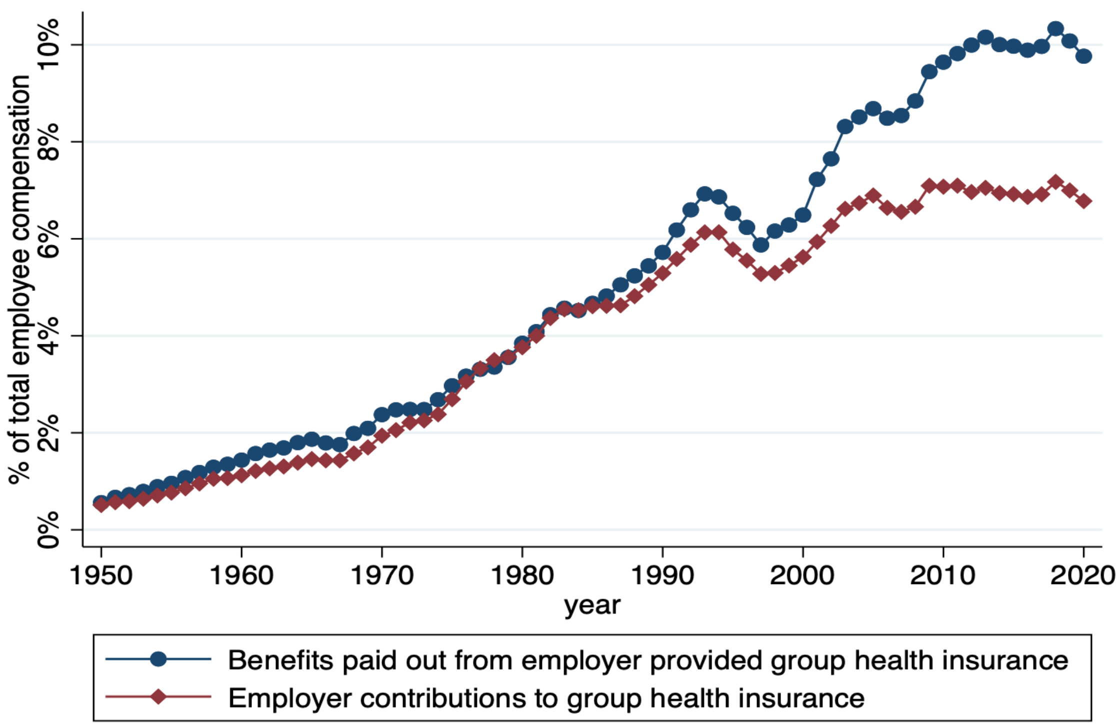

Figure 5: The figure plots the share of worker's total compensation that is in the form of employer provided health insurance.

		Employment share		Change	
naics		1980	2015	pp	Percent
541, 561	All labor-services	6.43	15.74	9.31	145
541	Professional, Scientific, & Technical	4.01	7.09	3.08	77
5411	Legal	.72	.92	.2	28
5412	Accounting, Tax Preparation, Bookkeeping, & Payroll	.55	1.17	.62	114
5413	Architectural, Engineering, & Related	.83	1.16	.33	39
5414	Specialized Design	.06	.09	.03	60
5415	Computer Systems Design & Related	.17	1.36	1.19	705
5416	Management, Scientific, & Technical Consulting	.23	.95	.72	307
54161	Management Consulting	.15	.79	.64	423
5417	Scientific Research & Development	.75	.57	-.18	-24
5418	Advertising, Public Relations, & Related	.4	.37	-.03	-7
5419	Other Professional, Scientific, & Technical	.3	.49	.19	66
561	Administrative & Support	2.42	8.65	6.23	258
5611	Office Administrative	.07	.36	.29	439
5612	Facilities Support	.03	.21	.18	609
5613	Employment Services	.75	4.86	4.11	550
56131	Employment Placement Agencies & Executive Search	.13	.22	.09	66
56132	Temporary Help	.44	2.68	2.24	514
56133	Professional Employer Organizations	.15	1.96	1.81	1215
5614	Business Support	.27	.63	.36	134
5615	Travel Arrangement & Reservation	.18	.19	0	1
5616	Investigation & Security	.47	.73	.27	57
56161	Investigation, Guard, & Armored Car	.23	.63	.4	175
56162	Security Systems	.24	.11	-.13	-55
5617	Services to Buildings & Dwellings	.49	1.46	.97	199
56172	Janitorial	.3	.82	.52	172
5619	Other Support Services	.15	.22	.07	43

Table 1: The table shows the change in each labor-service industry's share of all private employment between 1980 and 2015. The underlying data is harmonized and imputed CBP data from Eckert et al. (2021)
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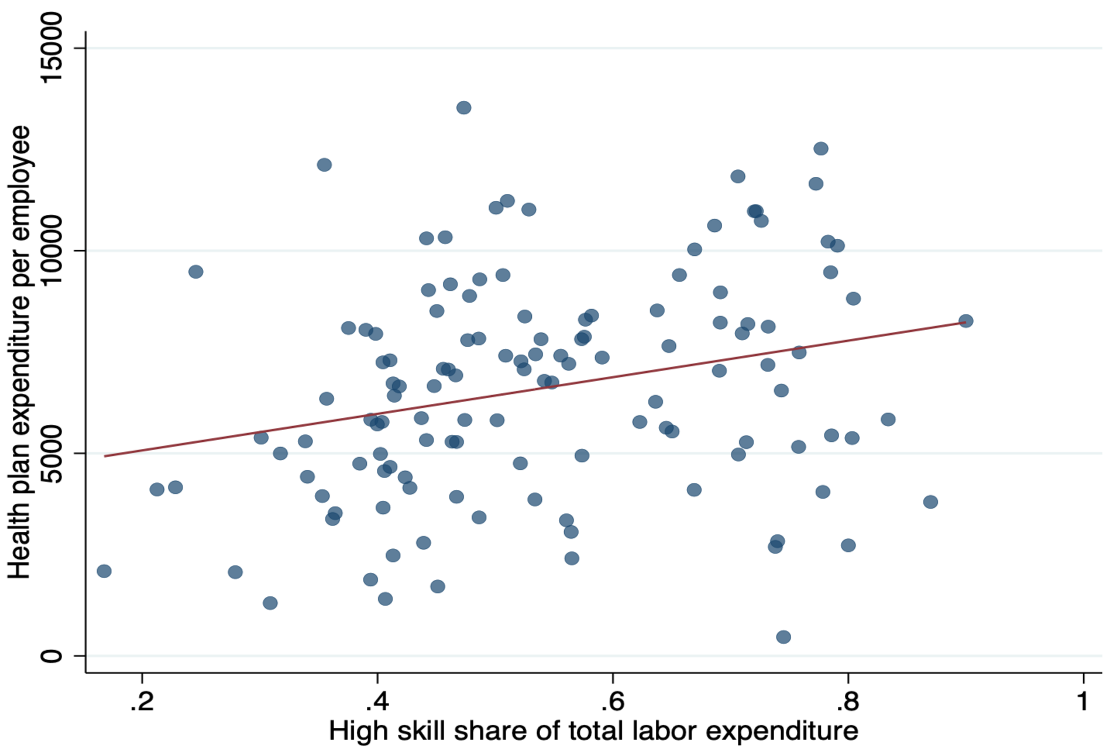

Figure 6: The figure plots high-skill labor expenditure to total labor expenditure the x-axis, against health plan expenditure per employee y-axis. high-skill is labor in wage quintiles 4 and 5.

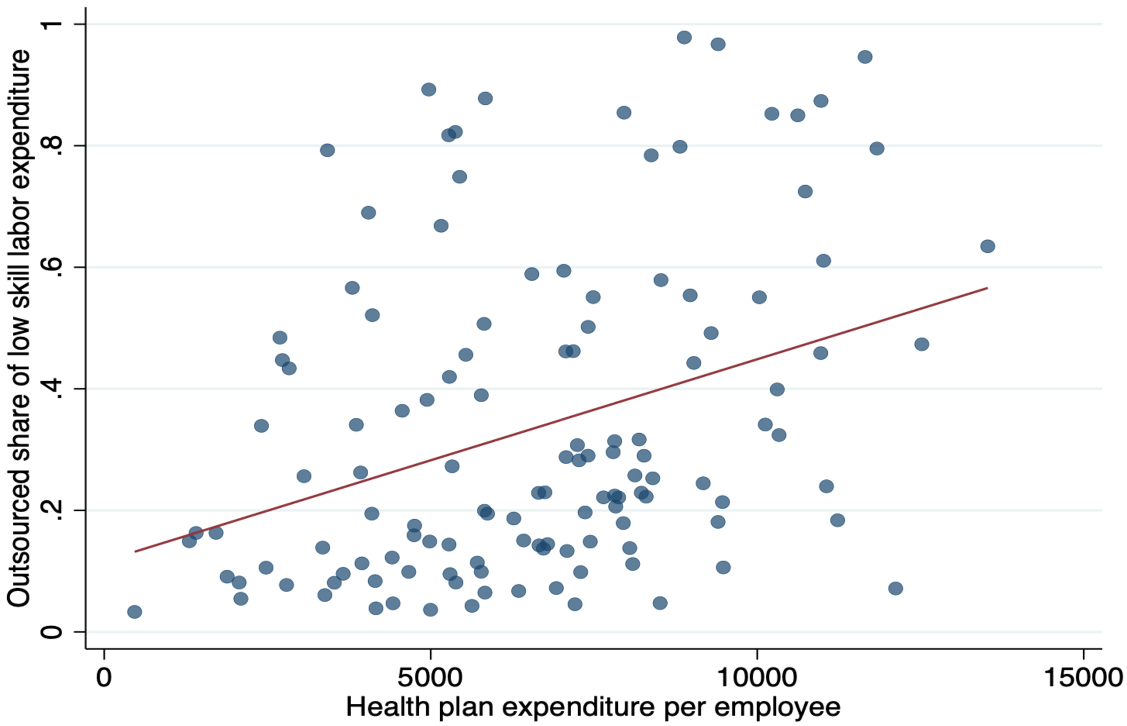

Figure 7: The figure plots health plan expenditure per employee the x-axis, against expenditure on low-skill outsourced labor as a share of total low-skill labor expenditure on the y-axis. low-skill is labor in wage quintiles 1 and 2.

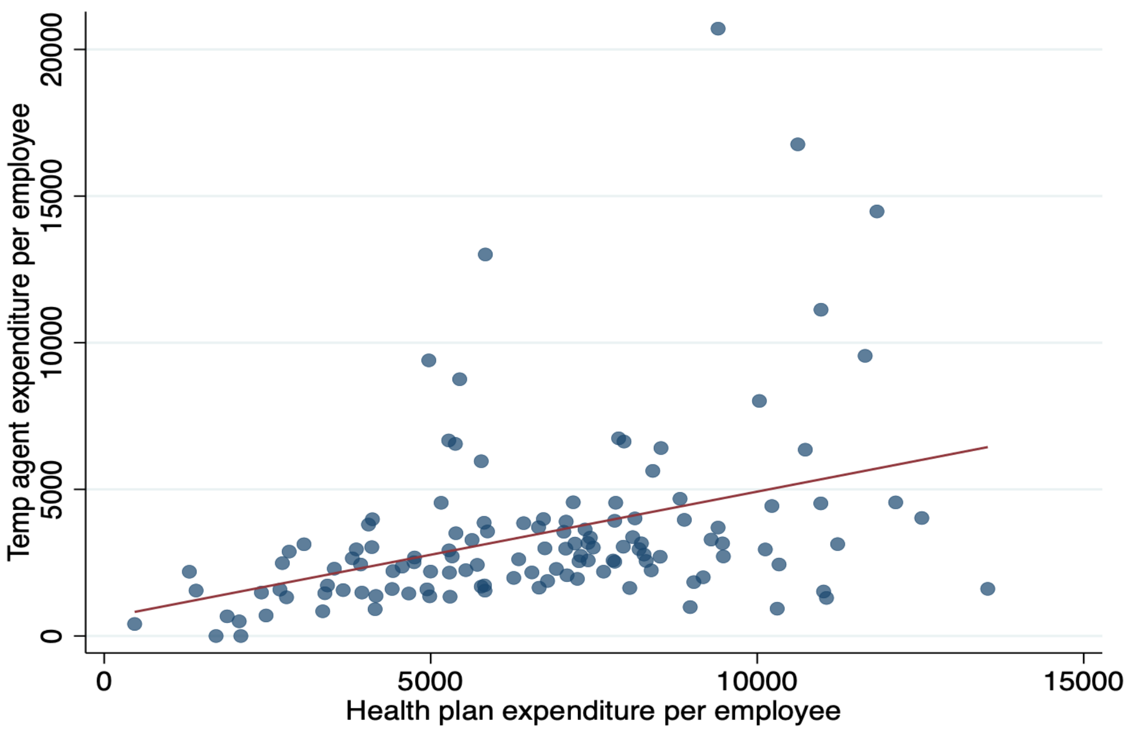

Figure 8: The figure plots health plan expenditure per employee the x-axis, against temo agency expenditure per employee on the y-axis.

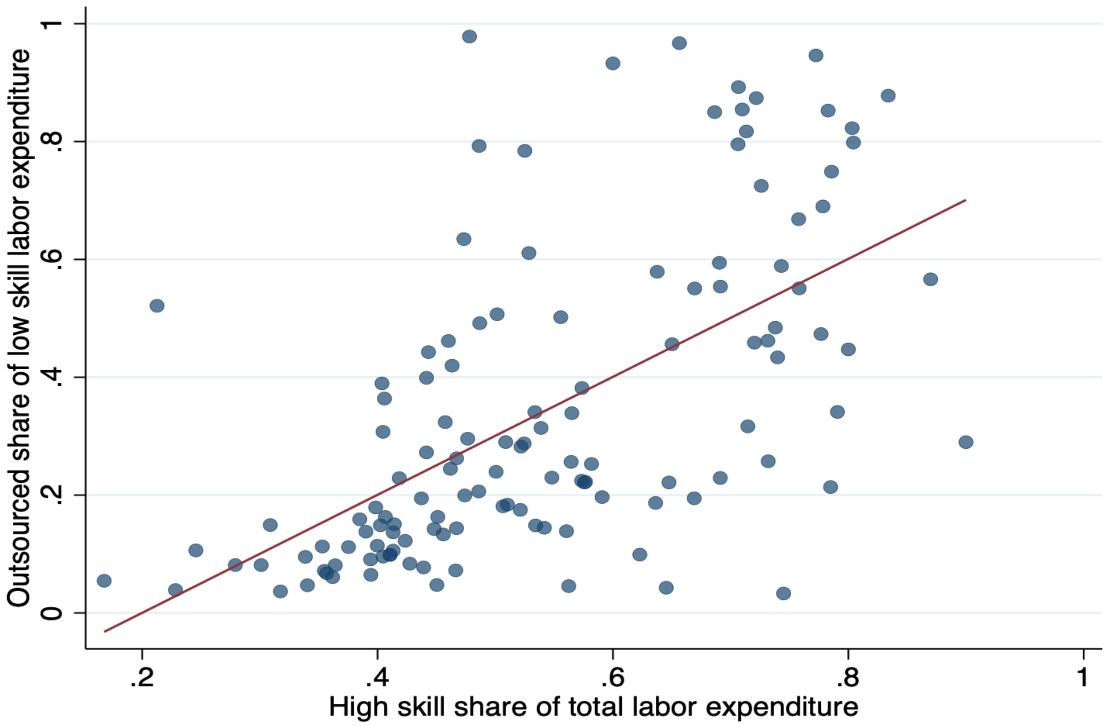

Figure 9: The figure plots total expenditure on high-skill labor (insourced and outsourced) as a share of total labor expenditure on the x-axis, against expenditure on low-skill outsourced labor as a share of total low-skill labor expenditure on the y-axis. low-skill is labor in wage quintiles 1 and 2. high-skill are wage quintiles 4 and 5.

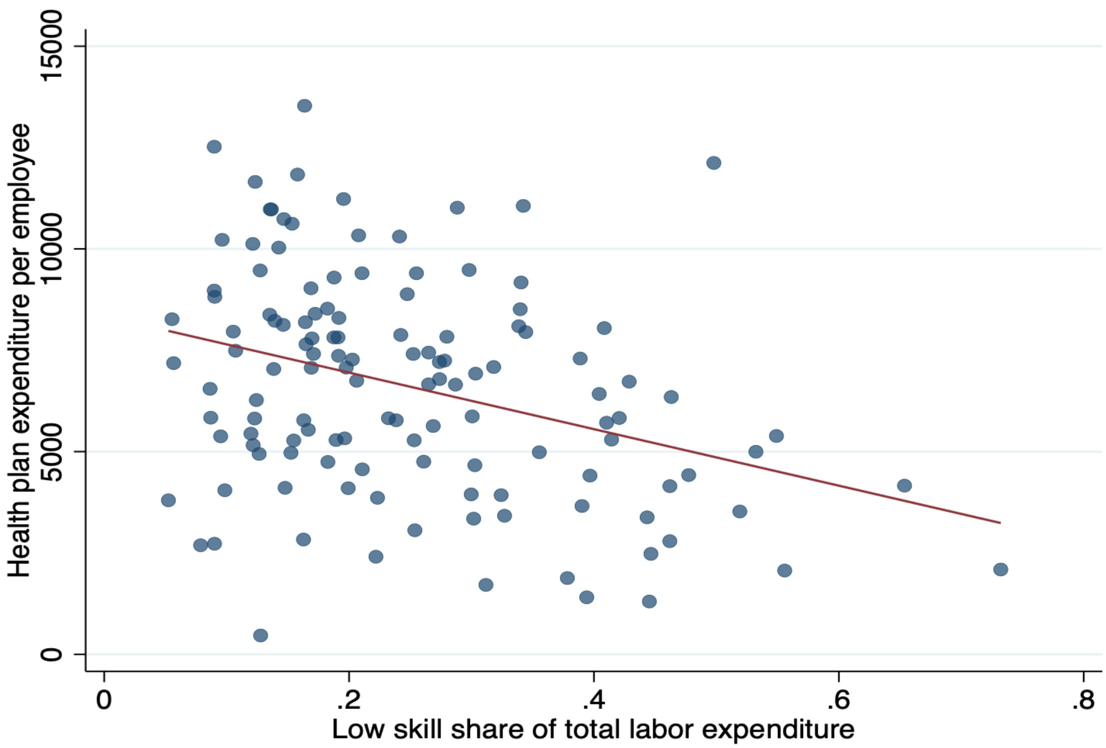

Figure 10: The figure plots low-skill labor expenditure to total labor expenditure the x-axis, against health plan expenditure per employee y-axis. low-skill is classified as labor in wage quintiles 1 and 2.

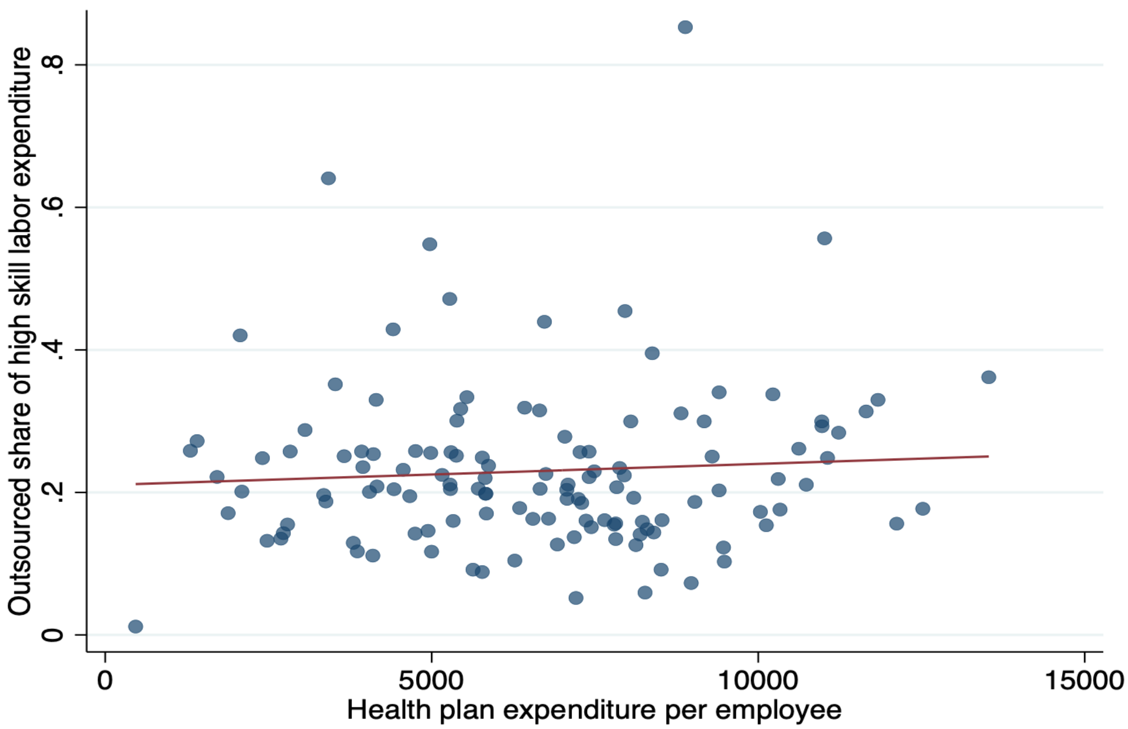

Figure 11: The figure plots health plan expenditure per employee the x-axis, against expenditure on high-skill outsourced labor as a share of total high-skill labor expenditure on the y-axis. high-skill is labor in wage quintiles 4 and 5.

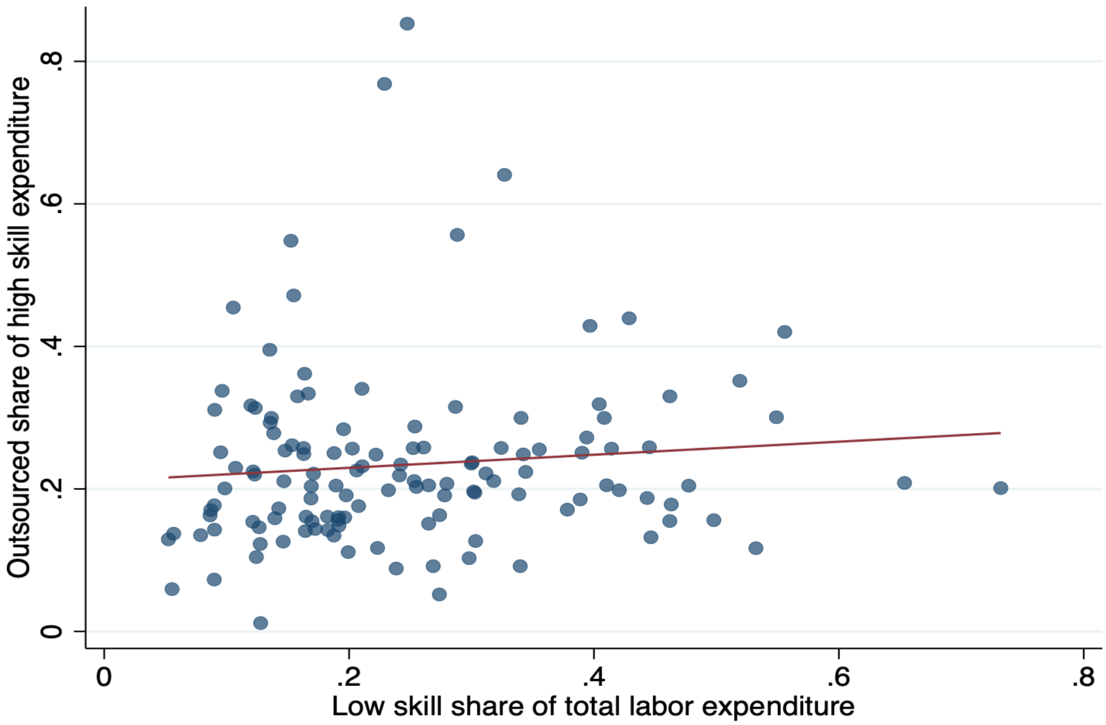

Figure 12: The figure plots total expenditure on low-skill labor (insourced and outsourced) as a share of total labor expenditure on the x-axis, against expenditure on high-skill outsourced labor as a share of total high-skill labor expenditure on the y-axis. low-skill is labor in wage quintiles 1 and 2. high-skill are wage quintiles 4 and 5.

skill:	1	2	3	4	5
	$log(w_{js}+a_j)$	$log(w_{js}+a_j)$	$log(w_{js}+a_j)$	$log(w_{js}+a_j)$	$log(w_{js}+a_j)$
$log\frac{X_{js}}{n_{js}}$	6.932***	4.648***	4.030***	3.629***	0.622
	[5.719,8.145]	[2.708,6.589]	[2.490,5.569]	[2.204,5.054]	[-0.726,1.970]
N	127	127	127	127	127
R^2	0.514	0.210	0.239	0.234	0.010

95% confidence intervals in brackets

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

Table 2: The table contains the results from the main regression, 18. Each column is a separate regression; one for each skill level.

External Calibration		
$\nu = 0.95$	Returns to scale	
Internal Calibration		**Moment matched**
φ_{js}	Skill intensity by industry j	From FOCs, $\varphi_{js} = \frac{X_{js}^{data}}{\sum_s X_{js}^{data}}$
z_j	Efficiency by industry j	From FOCs, $z_{js} \approx \frac{\sum_s X_{js}^{data}}{\nu(\sum_s (X_{js}^{data})^{\varphi_{js}})^{\nu}}$
θ_s	elasticity of subs., in vs outsourced	Estimated from regression
SMM		**Moment matched**
$\eta = 0.59$	Worker utility, elasticity of subs.	$elasticity(\bar{w}_j, a_j)$
$\psi = 0.78$	Worker utility, weight	$E(\frac{a_j}{\bar{w}_j})$
$\underline{\mathrm{m}} = 0.57$	Worker utility, non-homotheticity	
N_s	Mass of skill s workers	$E(\tilde{u}_s)/E(\tilde{u}_1)$
α	Weight on insourced labor in CES	% of each skill level that are outsourced.

Table 3: The table summarizes the calibration strategy of the main model specification.

Targeted Moment	Data	Model
$elasticity(\bar{w}_j, a_j)$	0.251	0.249
$E(a_j/\bar{w}_j)$	0.120	0.121
$E(\tilde{u}_s)/E(\tilde{u}_1)$	[1. ; 1.06 ; 1.18 ; 1.36 ; 1.65]	[1. ; 1.06 ; 1.18 ; 1.36 ; 1.65]
% of skill s workers outsourced.	[0.06 ; 0.18 ; 0.11 ; 0.09 ; 0.14]	[0.06 ; 0.18 ; 0.11 ; 0.09 ; 0.14]

Table 4: The table shows targetted moments, their value in the data, and their value in the model.

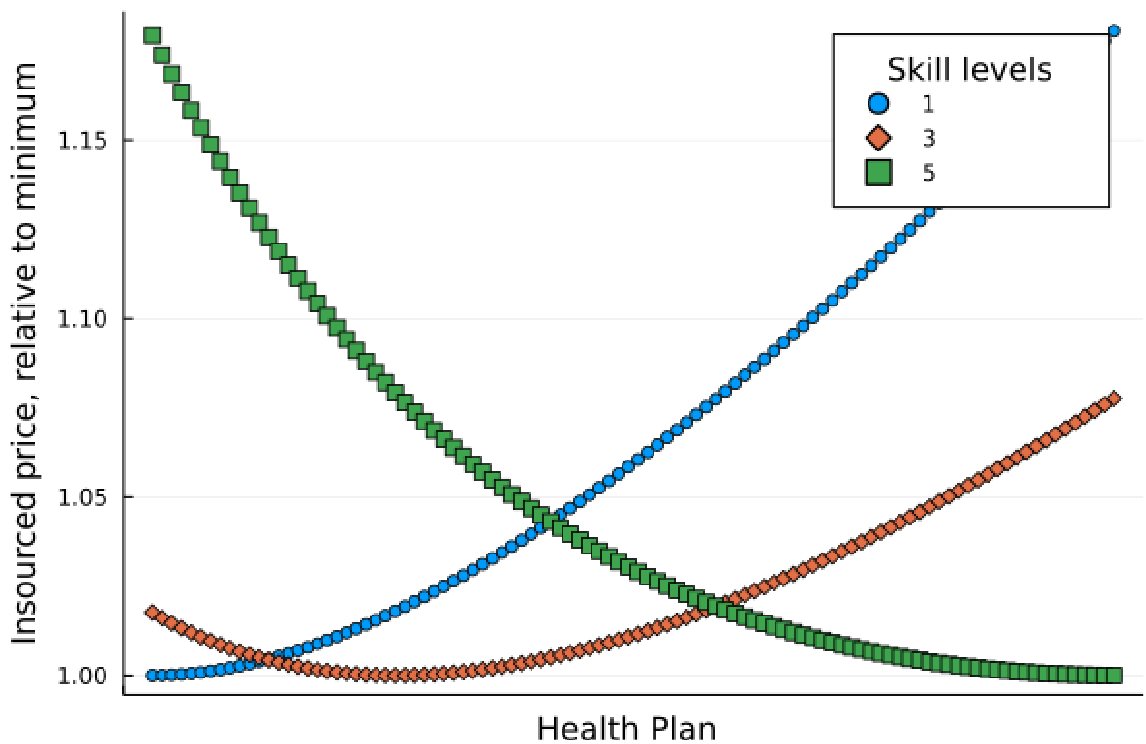

Figure 13: The figure plots health plan on the x-axis, and price for insourced labor relative to the price of the optimal compensation package, $\frac{w(a,\tilde{u}_s)+a}{w_s^*+a_s^*}$, on the y-axis. Each line is the relative price for a different skill level. The x-axis ranges from the optimal compensation package of the lowest skill labor to that of the highest skill labor.

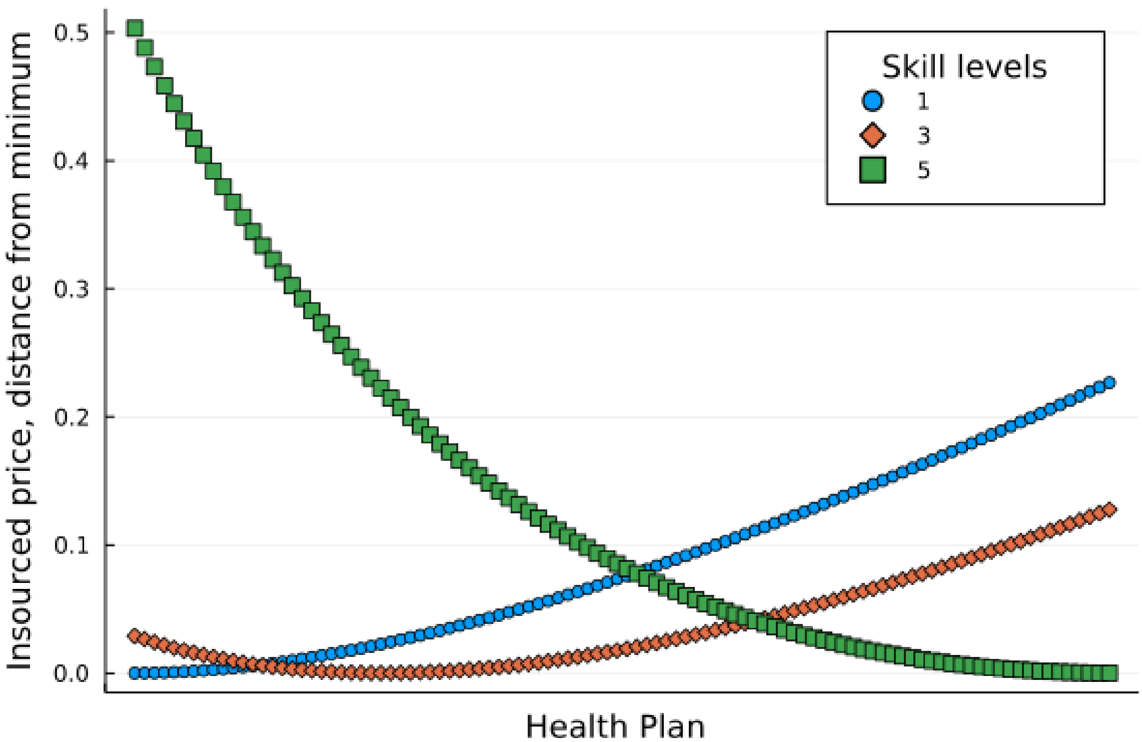

Figure 14: The figure plots health plan on the x-axis, and the distance between the price for insourced labor and the optimal compensation package, $(w(a, \tilde{u}_s) + a) - (w_s^* + a_s^*)$, on the y-axis. Each line is a different skill level. The x-axis ranges from the optimal compensation package of the lowest skill labor to that of the highest skill labor.

Skill level	$\frac{\alpha_s}{1+\alpha_s}$	% outsourced, 2012
1	0.024	0.064
2	0.114	0.179
3	0.091	0.114
4	0.085	0.090
5	0.142	0.142

Table 5: The table shows the estimated $\frac{\alpha_s}{1+\alpha_s}$ for each skill level, along with outsourcing rates in 2012.

Skill:	1	2	3	4	5
Percentage point change in outsourcing rate, 1980-2012	4.59	12.48	7.35	5.42	7.61
Percent explained by:					
Change in medical care price	17.3	8.1	4.3	1.0	0.1
Skill-biased technical change	56.0	36.7	13.8	4.3	0.3
Removing health plan constraint	71.5	40.4	22.3	5.3	0.4

Table 6: The table shows the percent of the change in outsourcing rate in the data explained by each model counterfactual, for the main accounting exercise.

Counterfactual economy			% of each skill level outsourced				
Health plan constraint	SBTC	p_m increase	1	2	3	4	5
No	No	No	2.45	11.42	9.08	8.56	14.21
Yes	No	No	2.52	11.91	9.34	8.65	14.22
Yes	Yes	No	5.70	16.93	11.03	8.94	14.25
Yes	No	Yes	2.53	11.97	9.37	8.66	14.22

Table 7: The table shows the percent of workers outsourced by skill level for four counterfactual economies.

Metric	Percent change
Mean utility level	0.62%
Utility, skill 1	6.22%
Utility, skill 2	4.12%
Utility, skill 3	2.26%
Utility, skill 4	0.54%
Utility, skill 5	0.18%
Goods per capita	0.01%
Profits per capita	0.01%

Table 8: The table shows the percent change in various welfare and efficiency metrics caused by removing the health plan constraint.

Skill:	1	2	3	4	5
Percentage point change in outsourcing rate, 1980-2012	4.59	12.48	7.35	5.42	7.61
Percent explained by:					
Change in medical care price	14.8	6.59	0.6	0.1	0.2
Skill-biased technical change	56.0	36.7	13.8	4.3	0.3
Removing health plan constraint	64.4	34.4	3.6	0.6	1.0

Table 9: The table shows the percent of the change in outsourcing rate in the data explained by each model counterfactual, for the robust calibration model specification.

	5611	5612	5613	5614	5615	5616	5617	5618
	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$
$log\frac{X_{jl}}{n_{jl}}$	-0.0806	2.740***	5.604***	2.358***	-0.752	1.880**	6.031***	2.564***
	(0.874)	(0.892)	(0.962)	(0.707)	(1.703)	(0.874)	(0.896)	(0.674)
N	108	112	127	123	57	93	121	117
R^2	0.000	0.086	0.275	0.069	0.004	0.058	0.367	0.117

Standard errors in parentheses

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

Table 10: The table shows the results from regression specification 31 for the 4 digit sub-industries of 561. Each column is the regression results for one 4 digit sub-industry.

	5411	5412	5413	5414	5415	5416	5417	5418	5419
	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$	$log(w_{jl} + a_j)$
$log\frac{X_{jl}}{n_{jl}}$	2.257**	0.824*	2.559***	2.882***	-3.996***	1.811***	0.146	1.369***	1.319
	(0.887)	(0.447)	(0.732)	(0.651)	(0.999)	(0.545)	(2.357)	(0.359)	(2.127)
N	127	127	127	122	123	127	80	127	121
R^2	0.239	0.033	0.100	0.189	0.188	0.098	0.000	0.089	0.020

Standard errors in parentheses

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

Table 11: The table shows the results from regression specification 31 for the 4 digit sub-industries of 541. Each column is the regression results for one 4 digit sub-industry.