How Do Health Insurance Costs Affect Firm Labor Composition and Technology Investment?

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Preliminary. Please do not circulate

Abstract

Employer-sponsored healthcare insurance is a significant component of labor costs. We examine the causal effect of health insurance premiums on firms' employment, both in terms of quantity and composition, and their technology investment decisions. To address endogeneity concerns, we instrument for insurance premiums using idiosyncratic variation in insurers' losses, which is plausibly exogenous to their customers who are employers. Using Census micro data, we show that following an increase in premiums, firms reduce employment. Relative to higher-skilled coworkers, lower-skilled workers are more likely to be laid off and remain unemployed for two years following the shock. Firms also invest more in information technology, potentially to substitute for labor.

Key words: Health insurance premium, insurer losses, low-skill workers, firm employment, technology investment, automation

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1 Introduction

The past few decades have witnessed a persistent decline in the labor share and a weakening demand for low- and middle-skill workers.[1] A growing body of research investigates various determinants of this structural shift, including technological progress, trade exposure, and offshoring pressure, three forces which have made substitutes increasingly competitive.[2] In this paper, we consider an alternative and complementary channel which likely exacerbates the decline in firms' labor demand for these workers, namely the rapid rise in costs of providing employer-sponsored health insurance. As of 2021, U.S. employers contributed $16,253 on average in health insurance premiums per family plan, and employer outlays on health insurance plans accounted for around 10% of wages.[3] Unlike many other labor costs, health-insurance costs do not scale with individual productivity. Thus, higher premiums, which ceteris paribus make it more expensive for firms to retain and attract any worker, create a particularly significant increase in the relative cost of employing low-income, benefits-eligible workers, precisely the types of workers that are increasingly exposed to stronger competition from substitutes.

In many circumstances, an increase in the relative price of a given factor will lead to a decline in its usage; thus, increases in health insurance costs are likely to reduce firms' demand for labor in theory. The answer becomes less clear when one considers labor market frictions. For instance, firms may be able to pass most of the cost increases on to workers if their labor supply is sufficiently inelastic, if workers can easily substitute to alternative health insurance plans, or if workers are inattentive to changes in benefit costs. Even without cost passthrough, labor adjustment costs might prevent firms from responding sufficiently to transitory cost increases. It is thus an empirical question whether changes in health insurance costs affect firm employment.[4] Moreover,

[1]See, e.g., Acemoglu and Autor (2011), Karabarbounis and Neiman (2014), Autor (2014), Autor et al. (2020), Kehrig and Vincent (2021), among many others.

[2]See, e.g., Allen (2001), David et al. (2013), Pierce and Schott (2016), Dorn et al. (2017), Acemoglu and Restrepo (2019), Acemoglu and Restrepo (2020).

[3]Data come from KFF Employer Health Benefits Survey, 2021 `https://www.kff.org/report-section/ehbs-2021-summary-of-findings/` and `https://www.bls.gov/news.release/pdf/ecec.pdf`.

[4]To this end, using non-administrative data, prior literature provides mixed evidence on the effect of health insurance premiums on firm employment. While Baicker and Chandra (2006) document negative employment effects, Almeida et al. (2021) find that increased healthcare premiums induced by the ACA

aggregate employment effects may mask important heterogeneity across worker types, as there may be distributional implications of changes in health insurance costs. If firms do adjust employment in response to higher insurance premiums, one might expect such adjustments to be stronger for low-income workers since 1) as noted above, the same dollar increase in premiums leads to a larger proportional increase in costs for lower-paid workers and 2) many of these workers' tasks can be more easily performed by technology and/or benefits-ineligible (part-time or offshore) workers.

To address these questions, we construct a unique employer-employee matched dataset spanning the period of 2012–2019. We combine Census administrative microdata on the universe of U.S. firms and their workers with information on firms' health insurance costs and their insurers' losses from regulatory filings.[5] We find that, following a plausibly exogenous increase in health insurance premiums, firms reduce employment. This effect is primarily driven by a reduction in the retention of incumbent workers; our estimates for the impact on new hires are smaller in magnitude and imprecisely estimated. The decline in retention is particularly large among low-income workers, who are also more likely to experience years without labor income. In conjunction with these patterns, the nature of firms' input usage changes. Specifically, we document a shift in the composition of new hires towards higher skilled workers and an increase in investments in information technology following the shock.

When studying how health insurance premiums affect firms and their workers, one must address potential endogeneity concerns. For example, firms that want to retain and attract workers may choose to offer more generous health insurance plans. This suggests a correlation between premiums and other unobservable drivers of employment growth. We overcome this challenge by designing a novel identification strategy to isolate changes in healthcare insurance premium that are plausibly exogenous to firm-level conditions. Our strategy is motivated by existing evidence that negative financial shocks often create incentives for firms to prioritize immediate cash flows over more distant ones.[6] Specif-

reduced the number of workers covered by healthcare insurance, but not the total number of employees.

[5]Specifically, we collect this information from Form 5500, which is required to be filed for firms (both publicly and privately-held) with benefit plans which have more than 100 participants.

[6]See, e.g., Chevalier (1995), Chevalier and Scharfstein (1996), Gilchrist et al. (2017), Khanna and

ically, we use idiosyncratic variation in insurers' losses as an instrumental variable for premiums faced by their customers, i.e., employers. We find that insurers suffering more severe past losses charge higher premiums, even in markets outside of those in which these losses were incurred. We further discuss several potential rationales for insurers to engage in such behavior in Section 2 below. Regardless of the specific mechanism, we argue that an insurer's decision to increase premiums in response to its prior losses reflects its own internal objectives and constraints, rather than individual firms' labor and technology investment policies. This is our key exclusion restriction.

Using a two-stage-least-squares (2SLS) design, we study the link between idiosyncratic shocks to firms' health insurance costs and subsequent labor demand and worker-level outcomes. Our instrument is highly relevant: the first-stage results suggest that a one-standard-deviation increase in insurers' losses predicts a 1.4% to 2% increase in premiums. Further, we provide direct evidence that past insurer losses do not predict firms having larger claims in the future but do predict a proxy for higher insurer markups (the ratio of premiums to claims). This is consistent with loss-driven premium changes reflecting insurers' objectives rather than omitted firm or worker characteristics.

We find that an increase in the instrumented insurance premiums leads to a significant decline in firms' overall employment. Our estimates suggest that a 10% increase in premiums is associated with a 2–3% decline firm-level in employment. This is primarily driven by a reduction in the rate of retention of existing workers, with magnitudes similar to the overall effect. We estimate slightly smaller reductions in the number of new hires, though the effect is statistically insignificant. These findings suggest that firms are responsive to these idiosyncratic shocks to health insurance costs.

These employment responses are robust across a wide battery of additional tests. Our benchmark specification includes firm fixed effects and year fixed effects to absorb average differences across firms and macroeconomic conditions. We find similar estimates in a more saturated specification with commuting zone-industry-year interactive fixed ef-

Tice (2005), and Campello (2003). For insurance markets, see, e.g., Froot and O'Connell (1999), Koijen and Yogo (2022), Ge (2022), and Oh et al. (2022). As we discuss in section 2.2, demand from existing customers is likely to be quite inelastic in our setting, creating scope for insurers to generate short run cash flows by raising markups.

fects, which help to rule out confounding effects arising from local conditions or industry dynamics. To address the concern that some firms may be sufficiently large to impact insurers' reported losses, we show that results hold when we include only employers whose premium payment accounts for less than 1% of their insurers' total premium revenue. We further reduce the impact of firm-specific and local conditions by constructing a "leave-one-out" instrument, where insurer losses are computed using only losses and premiums incurred in states outside of the firm's location. Our results remain unchanged to the alternative instrument design.

Next, we leverage the richness of our administrative microdata to better understand the nature of firms' adjustments to higher health insurance costs. We begin by testing for a fairly intuitive mechanism: employment responses should be concentrated in cases where health insurance premiums account for a large fraction of a firm's total labor costs. Indeed, following instrumented increases in health insurance premiums, we only observe employment cuts among firms with high ex-ante premiums-to-total payroll ratios, but not those with low premiums-to-payroll ratios.

More importantly, such a mechanism suggests that rising health insurance costs may generate heterogeneous effects on different types of workers even *within the same firm*. We investigate these distributional implications by leveraging millions of administrative panel earnings records. Holding all else equal, an increase in health insurance premiums requires that a firm pays a higher fixed cost for each benefit-eligible employee. This fixed cost accounts for a higher a proportion of total labor compensation (earnings + employer benefit contributions) for low-income workers. We expect that the same increase in health insurance premiums should reduce firms' demand for lower-income workers more than their more highly remunerated coworkers.

To test this hypothesis, for each worker, we compute her average earnings during the previous five years and then estimate how her retention likelihood is affected differently by health insurance premiums depending on her past earnings. Importantly, we use individual-level data and identify these differential effects by imposing firm-by-year interactive fixed effects in our 2SLS estimation. This specification helps us eliminate concerns related to employer conditions or confounding dynamics related to industry, location, and firm type. We find that an increase in healthcare premiums generates a negative effect on the retention likelihood of low-income, low-skill workers relative to their higher-earning coworkers. A one-standard-deviation (0.42) increase in health premiums leads to a differential job separation likelihood of 2.4 percentage points between low-skill and high-skill workers. This is a substantial magnitude comparing to the sample average of job separation rate of 19 percentage points.[7] We find evidence for a related shift in the composition of new hires: the average skill level (as proxied by average pre-shock earnings) of new hires increases. Our results also suggest that low-income workers are more likely to switch to part-time status following increases in health insurance costs.

Since we do not observe reasons for separation, it is possible that our results are driven by low income workers voluntarily quitting and seeking employment elsewhere. To shed light on this issue, we examine the probability that a worker becomes unemployed for an extended period of time, which is unlikely to be voluntary. We find that, following a one-standard-deviation increase in health insurance premiums, low-income workers are 2.4 percentage points more likely to experience full-year unemployment than high-income workers. Taking stock, our individual-level results are consistent with firms substituting away from low-income workers when facing higher health insurance costs.

Though we do not directly observe the split between employer and employee contributions to health insurance, we find evidence consistent with firms decreasing eligibility and/or increasing employee plan contributions. In particular, our IV estimate for the elasticity of the number of health plan participants to health insurance costs is between -0.75 and -0.83, about 2–3 times higher than our estimated employment elasticity. Note that, if gross earnings and employee contributions were to remain unchanged, a large decline in plan participation would predict lower contributions, and thus increases in earnings net of health insurance deductions. However, we do not find a significant change in incumbent workers' net earnings, pointing to a decline in gross earnings (e.g., due to a

[7] Below, we also consider other potential sources of worker heterogeneity. For instance, firms may be more easily able to substitute away from some workers than others, such as those workers performing routine tasks. We find weak evidence consistent with this mechanism, however magnitudes are smaller and less precisely estimated relative to effects given earnings.

shift to part-time status) or an increase in employee contributions. Taken together, our findings suggest that workers are bearing part of the increase in insurance costs.

The results summarized so far are consistent with the hypothesis that rising healthcare insurance premiums increase labor costs, especially for low-income workers. As a result, employment sharply declines at firms facing positive premium shocks. Our results are consistent with two (not mutually exclusive) mechanisms. First, higher premiums charged by insurers increase employer contributions, which incentivizes firms to lay off workers and/or cut hours for a subset of workers. Second, firms may elect to pass on part or all of the increased cost to workers, by reducing eligibility and/or pushing up employee contributions. This reduces workers' effective earnings and leads them to seek outside options. Regardless of the interpretation, low-skilled workers seem "worse off" as they are more likely to fall into unemployment.

From the firm's perspective, inducing a reduction in worker plan participation likely brings long-run consequences. The fact that, even absent formal mandates, firms reveal a preference for subsidizing workers' health insurance costs implies that they place some value on worker plan participation. As workers stop participating following a rise in premiums, they may be less productive or harder to retain in future years. Thus, it is not straightforward to infer a labor demand elasticity from our estimates absent additional structural assumptions, because shocks to premiums likely induce shifts in both firm labor demand and labor supply curves.

What types of firms are more responsive to shocks to health insurance premiums? We explore several dimensions of heterogeneity. First, firms that have to compete in a tight labor market should be less able to pass the increased premiums to workers and thus, more likely to lose workers to their outside opportunities. Consistently, we find that firm-level employment responds more to changes in insurance premium primarily in areas with lower unemployment rates. Second, firms with better future investment opportunities should be less responsive to a temporary increase in labor costs and may "hoard" labor for future projects (see, e.g., Giroud and Mueller (2017)). Measuring investment options using industry-level Q based on public firms, we find firms in high-Q industries exhibit little sensitivity to premium shocks. Collectively, these results lend additional support to our interpretation of the main results: increased health insurance premiums cause firms to decrease employment due to increased labor costs. Finally, we show that the employment-premium cost relation does not vary across firm size, suggesting that external financial constraints are unlikely to explain our findings. Instead, our findings are consistent with firms optimizing over their production function and responding to changes in labor cost.

We conclude by bringing additional data to test whether firms invest in automation technology in response to health insurance costs, potentially as a replacement for low-income workers. To do so, we leverage on the Aberdeen data that offer information on the budgets set by firms to purchase, install, and maintain information technology. The database covers individual establishments belonging to both public and private firms. We find that a 1% instrumented increase in healthcare insurance premium is associated with around a 1–2% increase in the IT spending per person in a firm. We find a similar estimate for PC budget per person.

Our study contributes to two streams of research. First, we contribute to the growing literature on the effect of health insurance costs. In particular, our paper is related to studies examining the effect of health insurance costs on worker employment and labor force participation. The evidence is mixed. Using non-administrative data, Cutler and Madrian (1998) find that the rising cost of health insurance is associated with increasing work hours. Using similar data source over a different sample period, Baicker and Chandra (2006) document that higher insurance premiums reduce the likelihood that a worker is employed full time and the hours worked. Several other papers study the effect of the Affordable Care Act, which mandated many employers to offer health insurance plans to employees. A concurrent study by Almeida et al. (2021) finds that public firms do not change employment, but cut the number of covered workers. Mulligan (2020) argues that firms cut jobs to stay under 50 employees to avoid triggering the employer mandate. Dillender et al. (2022) finds that part-time employment increases.[8] Our paper is also

[8] Another strand in this literature focuses on the passthrough of health insurance premiums to workers and generally documents a decline in worker wages (Arnould and Nichols 1983, Gruber and Krueger 1991, Olson 2002). Another line of research examines the effect of employer-provided health insurance on worker job-to-job mobility (i.e., the "job lock" effect, see the review in Gruber (2000) and theoretical

particularly related to Tong (2021), who finds that increased health care costs reduces capital expenditures and R&D among public firms, more so for financially constrained firms. We focus on the employment effect of mostly private, smaller firms.

In contrast to prior studies examining sweeping changes in health insurance regulations, our paper exploits idiosyncratic and exogenous shocks that generate variation within markets. With these shocks in hand, we can better tease out the exact mechanism, identify the causal effect of health insurance costs, and highlight the role of firms in responding to premium increases and adjusting their labor and technological inputs. Our instrument also highlights the role of insurers in transmitting shocks across geographical regions and firms. We thus complement existing work showing how financial and nonfinancial firms propagate shocks in the economy (e.g., Gilje et al. 2016, Cortés and Strahan 2017, Giroud and Mueller 2019).

In addition, we use worker-level administrative data to document substantial distributional implications of rising health insurance costs. The implications from these cross-worker analyses are new to the literature and important for policy design. Whereas it is common to finance single payer health insurance schemes via linear payroll taxes outside the U.S., tying health insurance to employers may disproportionately distort labor demand for lower-income workers. To reduce the negative spillovers associated with rising health insurance costs on low-skilled workers' employment and earnings, policymakers could consider subsidizing firms' contribution to these workers' health insurance premiums, especially for firms that are mandated to provide health insurance.

Finally, we add to the studies documenting the persistent decline in labor share as well as the demand for low- and middle-skill workers. Prior literature focuses on the impact of import competition (Bilal and Lhuillier 2021, David et al. 2013, Lu and Ng 2013, Pierce and Schott 2016), technological advancement (Doms et al. 1997, Acemoglu and Restrepo 2019, Acemoglu and Restrepo 2020), and distributional implications of policy changes (Tuzel and Zhang 2021, Engbom and Moser 2021). We add to this line of research by focusing on a unique and important part of labor input cost, namely health insurance

arguments in Dey and Flinn (2005)).

premiums. Our study is the first to document its effect on low-income, low-skill workers, potentially shedding light on another source of deteriorating labor demand for those workers. We find that increases in health insurance premiums are particularly costly to low-skill workers, leading to greater job separation and unemployment rates. Relatedly, rising health insurance costs can increase incentives to adopt substitute technologies, consistent with our evidence on technology investments in Section 8.

2 Identification Strategy: Instrument for Premiums

2.1 Instrumenting Premiums with Insurer Losses

We seek to estimate the causal effects of health insurance premiums on firm policies by instrumenting premiums with losses faced by insurers. Our instrument is the idiosyncratic shocks to losses at the insurance company level. We expect that more severe losses should lead insurers to charge higher premiums, which in turn influence firm decisions.

There are several reasons why larger losses should lead insurers to charge higher premiums for employer customers.[9] First, past losses generate greater pressure for firms to increase short-term profits, even if such actions can hurt long-term profits due to various reasons such as decreased customer loyalty. The reason is that losses can tighten financial constraints, making liquidity especially valuable today for insurers' operations. This intuition builds upon findings in the prior corporate finance literature, suggesting that tightened financial constraints motivate firms to increase prices (Chevalier (1995), Chevalier and Scharfstein (1996), and Gilchrist et al. (2017)). Similar effects are documented by studies focusing specifically on the insurance industry (Froot and O'Connell (1999), Koijen and Yogo (2022), and Ge (2022)).[10] Additionally, this response could arise from managerial incentives to manage earnings (see, e.g., Stein 1989 and Edmans et al. 2017).

Second, the ACA mandates that insurers spend at least 85% of premiums on claims

[9] Note that health insurers do not face regulatory restrictions in their pricing in the large group market, in which our sample firms fall.

[10] How firms should change product prices to increase short-term profits will depend on the demand elasticity. In addition, as Ge (2022) argue, for long-term products, such as those sold by life insurance companies, how products affect firms' short-term financial conditions also matter for how firms change product prices.

in every three consecutive years in a state-market or rebate customers. Higher recent losses can thus allow insurers to raise prices, which may move prices closer to the optimal levels, while still being compliant with the 85%-rule.

Third, insurers may update their perception about the "correct" pricing after witnessing past losses. In other words, losses could lead insurers to expect higher costs in the future and raise premiums accordingly. Note that in this argument, losses affect insurers' expectations regarding the future costs of the *entire* operating portfolio, which could arise from firms in many different locations and industries rather than merely the firm of interest.

All the above mechanisms are consistent with the exclusion restriction, i.e., insurer losses should not affect the labor composition and technology investments of individual customer firms through channels other than changes in health insurance premiums. The insurers in our sample are large, national insurance conglomerates that cover many firms. Losses incurred by these insurers reflect the gap between the average premium charged and the claims filed by insured individuals across numerous geographical locations. They are unlikely to be determined by the conditions of the focal firm. With time fixed effects, we essentially remove the time-series variation in aggregate losses and focus on the idiosyncratic component. This addresses the concern that insurer losses could reflect macro-economic conditions or macro trends in healthcare costs. We provide additional evidence to substantiate the exclusion restriction in Section 5.2. For example, we show that insurer losses are not associated with higher future claims, but are positively associated with higher future markups (proxied by premiums divided by claims). Moreover, losses from areas outside the focal firm's state are highly predictive of future premiums charged by the insurer. Using such out-of-the-state losses as instruments, our results stay similar.

Importantly, we note that the first two mechanisms described above depend on the assumption that insurers often possess market power and can raise prices. We discuss this assumption next.

2.2 Insurers' Pricing Power

In this section, we provide arguments and evidence suggesting that insurers in our data have substantial pricing power. To start, the market for health insurance is heavily segmented geographically, and firms are left with limited choices of insurers to work with. More importantly, switching insurers is costly both for the firm and for its workers. Due to the complexity of health insurance plans, the market for employer-sponsored plans presents significant search friction and is intermediated by brokers. As brokers gain higher commissions from booking firms to more expensive plans, they may not have incentives to present cheaper options. Moreover, firms' switching plans imposes large costs to their employees. Employees may lose valuable relationships with existing healthcare providers due to changes to coverage networks, In addition, they have to spend time learning the rules of the new health insurance plan.

Due to these reasons, employers are likely to have relatively inelastic demand towards their current insurers, allowing insurers to gain substantial pricing power in this market (see, e.g., Dafny 2010 and Dafny et al. 2012 for related evidence). Consistent with our argument that employer-insurer relationships are sticky, we find that firm-insurer relationships are relatively persistent in our data: 9.8% of firms switch in a given year. The sticky employer-insurer relation helps support the idea that it is difficult for firms to seek lower-price options when their insurer face losses. As we will discuss in Section 5.2, our instrument is not associated with statistically significant differences in the employers' probability of switching insurers over the next 2 years.

Moreover, we instrument for current premiums using losses incurred by the firm's prior (rather than current) insurer. If when prior insurers' losses are high, firms are able to switch to other insurers and prevent their actual premiums from increasing, it will prevent us from finding a strong relationship between premiums and prior insurers' losses at the first stage. However, as we discuss below, our first stage is sufficiently strong, indicating that firms are not able to completely offset the effect of insurers' losses on premiums.

3 Data

3.1 Employers' Health Insurance Data

We obtain information on employer-sponsored health insurance plans from the Annual Reports of Employee Benefit Plan required by the Department of Labor. The data come from the "Insurance Information" section of Schedule A of Form 5500. All employer-sponsored plans with more than 100 participants need to file Form 5500. Part III of Schedule A reports the premium and number of participants associated with various types of contracts. We classify the following types as health plans: health (other than dental or vision), HMO (health maintenance organization) contract, PPO (preferred provider organization) contract, and stop-loss contract. Form 5500 provides rich information regarding the filer, including its name, employer identification number (EIN), location, phone number. More importantly, the data include total premium paid, the number of participants, and the insurer for each plan-year. We exclude firms that are self-insured or have a unionized workforce (i.e., firms that report any collective-bargaining welfare plans).

We define premiums per participant as the ratio of total premiums divided by the number of participants for a given plan-year. Both the premiums and the number of participants include those of covered family members of employees. When an employer reports health insurance contracts with multiple insurers, the premium per participant is the sum of all the premiums divided by the sum of the number of participants across all the insurers. Our main explanatory variable, which we instrument for, is the natural log of premiums per participant.

One caveat is that plan premiums reported on Form 5500 include premiums paid by employers as well as those paid by employees. Premiums paid by employers account for around 73% of total premium payments for family plans according to a 2021 Kaiser Family Foundation Survey.[11] This portion reflects a direct labor cost faced by firms and is likely to be the main mechanism driving the employment effect. However, we note that the premium paid by employees is still relevant. Suppose employees need to contribute

[11] https://www.kff.org/health-costs/report/2021-employer-health-benefits-survey/.

more to healthcare insurance plans when insurers charge higher premiums. Workers now receive lower net compensation after deducting such benefit payments from their salaries. To the extent that the shocks we exploit are idiosyncratic and thus firm-specific, we expect premium shocks to affect firm employment by increasing the costs faced by employers and/or employees.

3.2 Construction of Instrumental Variable

Insurers' financial data come from Centers for Medicare & Medicaid Services (CMS). Under the Affordable Care Act, health insurers need to report their different components of their underwriting performance to the CMS by state and market. A market can be individual, small group, or large group, where group is synonymous to employer. Most states classify plans with at least 51 participants as large groups, while some states use 101 as the cutoff. Because only plans with at least 100 participants need to file Form 5500, the majority of the plans in our sample belong to the large group market. In computing insurers' losses, we use claims and premiums in their large group market because, within an insurer, the pricing choices of large group clients (firms) are likely to be more connected with gains and losses in the large group market than with other markets.

The ACA regulates insurers' medical loss ratio, requiring insurers to reach a minimum loss ratio of 0.85 based on the performance of three consecutive years. Otherwise, insurers need send rebates to customers. The numerator for the ratio calculation is claims plus allowable expenses and other adjustments over three years. The denominator is premiums plus adjustment over three years. We directly use these numerators and denominators that insurers report to the CMS.

Many insurers operate as regional subsidiaries of insurance conglomerates. We compute the medical loss ratio at the conglomerate level using the group code reported in the CMS data, supplemented by data from the National Association of Insurance Commissioners. Specifically, we sum up the aforementioned numerators (denominators) across all individual divisions within a group. The aggregation at the conglomerate level is motivated by two reasons. First, with the active internal capital market within insurer groups (see Ge (2022) and Niehause (2021)), losses from other divisions could spillover and influence the financial constraints of the focal division. Moreover, other divisions' performance can change insurers' expectations about future claims. Insurers may expect future claims to be higher if recent losses are high in other divisions.

Because of the ACA 0.85 rule, we impose a floor value of 0.85 on the loss ratio computed at the conglomerate level.[12] If an employer contracts with multiple insurers in a year, we take the premium-weighted average of all these insurers' medical loss ratios, using the premiums between the focal employer and each of the insurers in that year as the weights.

Formally, our measure of insurer losses for firm i in year t is defined as:

$$Insurer\ Loss_{i,t-3\ to\ t-1} = \sum_{j\in 1}^{N_i} w_{i,j,t-1} max\{LossRatio_{j,t-3,t-1}, 0.85\} \tag{1}$$

where $LossRatio_{j,t-3,t-1}$ is the loss ratio of insurer j originating from its large group market aggregated across all divisions over the past three years. N_i is the total number of insurers that work with firm i. $w_{i,j,t-1}$ is the insurer j's share of employer i's premiums in year $t-1$.

3.3 Worker Data from the U.S. Census and IRS

We obtain micro-level employer-employee matched data from the SOI Individual Tax Returns (W2) data provided by the Internal Revenue Service (IRS). This database provides information on the job affiliation (identified by EIN) and annual wage income for all U.S. taxpayers from 2005 onward. We exclude workers who are younger than 18 or older than 70.

Our analysis relies primarily on two samples. The first sample is a firm-year panel, where we track the changes in a firm's total employment around shocks to healthcare insurance premium. The key variable of interest is *Log(Employees)*, the log of total

[12]This procedure is slightly different from ACA regulation, which requires that individual insurers' medical loss ratio at the state level to be at least 0.85 in the large group market. However, this should work against us from finding a strong first-stage result.

number of workers employed by a firm in a year. When calculating employment at the firm level in year t, we exclude employees whose annual wages are less than minimum wages at 20 hours per week, as these workers may be separated within year t.[13]

We exclude firms whose number of participants is less than 50% of their number of employees. This helps us focus on firms for whom health insurance is a meaningful portion of labor costs. It also alleviates the concern that our results may be influenced by firms trying to avoid health insurance obligations and reducing benefit-eligible workers. Specifically, ACA mandates firms to offer workers health insurance if at least 50% percent of their employees work over 30 hours a week. Firms may avoid triggering the mandate by maintaining fewer than 50 employees or employing workers at fewer than 30 hours a week.

We link the employers of taxpayers in the W2 data to their insurance plan information from F5500 based on employer identification number (EIN). Some noises may arise from this mapping. When multiple EINs belong to the same parent company, it is possible the parent company shifts the reporting of workers and/or health insurance plan participants from one EIN to another over time. To correct for potential data biases, we compute the year-on-year growth rate of the total number of workers as well as plan participants, and exclude firms where the two differ by over 30 percentage points. We also present robustness tests where we aggregate employment, premiums, and the instrument all the EIN at the parent company level, where we match EINs to parent company using the LBD database and a matching algorithm based on phone number, address, company name, and EIN.

Our second sample is an individual-year panel, tracking workers' employment outcomes over time. In this sample, we examine the differential impact of insurance premium changes on high-skill and low-skill workers. We define two variables of interest. *Retained* is an indicator variable for whether a worker continues to report wage income from the existing employer that exceeds minimum wage at 20 hours a week. *Unemployed* is an indicator that turns to one if a worker earns less than minimum wage at 20 hours a week

[13] One caveat is that these workers could be part-time. Another caveat is that we potentially include in the employment count workers who are separated during year t but earn more than minimum wages at 20 hours per week.

and do not file any 1099 with the IRS (which are filed by contractors and ad hoc service workers).

We supplement the W2 data with the American Community Survey (ACS) data. From the ACS data, we extract individual characteristics, in particular, their occupation. We use data provided by Auto and Dorn (2013) to assign each occupation scores describing the extent to which it requires manual and routine work, respectively. One in 40 workers are sampled every year and a worker is at most sampled once. These occupation scores are assigned to a worker throughout the sample period.

3.4 IT Investment Data

Information on firms' investment in technology comes from the Aberdeen Group under the Computer Intelligence Technology Database. This database compiles information on the quantities and types of technology investment at the establishment level through telephone surveys. Our initial sample covers over 3 million establishments per year over the period of 2011 through 2018.

The Aberdeen database provides detailed information that helps us identify each establishment, including the name of the firm, location, and phone number associated with each establishment. We match the establishments in Aberdeen to the Employer Identification Number (EIN) of firms that file Form 5500 to the U.S. Department of Labor. The matching follows several steps. First, we match establishments to an EIN by phone number. For the remaining Aberdeen establishments that cannot be matched through phone number, we match them by standardized names and 5-digit zipcode. Finally, we consider the possibility that some establishments may belong to a subsidiary of a firm that carries a different name from the parent. Relying on the corporate hierarchy structure data from Dun and Bradstreet, we match establishments to subsidiaries based on their DUNS ID and assign the EIN of the parent to all subsidiaries.

With the matched sample, we aggregate the investment budget at the establishment-level to the firm-level (uniquely identified by EINs). Our main measures of technology investments are the overall IT budget (*IT Budget*) and the budget allocated to personal computers (*PC Budget*). Both variables are computed on a per-employee dollar basis and converted into log terms. Their values are winsorized at the 1st and 99th percentiles. We combine the technology investment data with the data on healthcare premium.

3.5 Summary Statistics

Table 1 presents the summary statistics for our key variables of interest, including premium per participant, firm and worker employment, and technology investment variables. In the firm-year sample, the average and median values of insurer loss ratio are both 0.89. On average, firms in our sample employ 270 workers and contribute $6,763 to each worker's healthcare plan. In the individual-level panel, workers have an average likelihood of 81% of continuing working in the same firm and 3% of being unemployed. They also have an average 5-year nominal wage growth rate of around 20%. The average firm in our sample spends around $393 on personal computers for each employee on an annual basis. The total IT spending amounts to over $7000 for each employee.

TABLE 1 ABOUT HERE

4 Empirical Specification

We rely on an instrumental-variable approach to estimate the effect of health insurance costs on firm and worker outcomes. The instrument for insurance premium is the medical loss ratio of a firm's insurer during the previous year, which is the portion of premiums being spent on medical claims.

Using the firm-level sample, we estimate the following regressions in a two-stage-least-square framework:

$$Premium_{i,t} = \alpha_i + \tau_t + \beta Insurer\ Loss_{i,t-3\ to\ t-1} + \epsilon_{i,t} \tag{2}$$

$$Y_{i,t} = \lambda_i + \kappa_t + \gamma \widehat{Premium}_{i,t} + \nu_{i,t}, \tag{3}$$

where i represents a firm, t represents a year, $Premium_{i,t}$ stands for the log of premium per participant paid by firm i during year t; and $Insurer\ Loss_{i,t}$ is the weighted average of medical loss ratio across all firm i's insurers over the previous three years, as defined in Section 3.2. $Y_{i,t}$ represents various firm-level outcomes, including the log of employees, log of plan participants, technology investment, etc. Note that a firm's premiums in year t is usually determined before the start of year t.

Our initial specification controls for firm fixed effects and year fixed effects to remove the confounding effects of cross-firm differences and macro-level conditions. We later include more saturated fixed effects on top of firm fixed effects to address concerns related to local and industry-level dynamics. These additional controls include industry-by-year fixed effects, state-by-year fixed effects, commuting zone-by-year fixed effects, and commuting zone-industry-year interactive fixed effects. Standard errors are clustered by firm.

For the individual-level panel analysis, we focus on the heterogeneous effect of insurance costs on high-skill and low-skill workers employed by the same firm at the same time. To fix ideas, in a hypothetical scenario in which a firm keeps an employee's compensation, plan quality, and health insurance deductions unchanged, a fixed increase in health insurance premiums is isomorphic to levying a fixed tax for each benefits eligible employee.[14] Recast as a proportion of total labor compensation (earnings + employer benefit contributions), such a tax is highly regressive. Thus, in such a scenario, the same percentage increase in health insurance premiums likely reduces firms' demand for workers with lower earnings levels relative to their more highly remunerated coworkers. We test this hypothesis via a within-firm analysis that includes firm-year interactive fixed effects. Formally, we estimate the instrumental-variable regression below:

$$Premium_{i,t} \times Skill_{j,t} = \mu_{i,t} + \phi Insurer\ Loss_{i,t-3\ to\ t-1} \times Skill_{j,t} + \epsilon_{i,j,t} \tag{4}$$

$$Y_{i,j,t} = \delta_{i,t} + \theta \widehat{Premium_{i,t}} \times Skill_{j,t} + \psi Skill_{j,t} + \nu_{i,j,t}, \tag{5}$$

where j represents an individual. $Skill_{j,t}$ is a vector of individual skill measures, including the average wages earned in the past five years as well as manual and routine scores. To ease the interpretation, we standardize these three variables so that they have a mean

[14] We will discuss evidence for and potential implications of endogenous take up in Section 7.

of zero and a standard deviation of one. $Y_{i,j,t}$ includes individual employment outcomes, such as *Retained*, the dummy variable for whether person j remains employed in firm i during year t, and *Unemployed*, the indicator for whether person j becomes unemployed as defined in Section 3.3. Importantly, the estimation includes firm-by-year fixed effects, which absorb the effect of changes in insurance premiums on the average worker. The coefficient of interest is θ, which reflects the differential effect of health insurance costs on workers across skill levels.

5 Health Insurance Premium and Firm Employment

5.1 Main Results

We examine the effect of health insurance premiums on firm-level employment using the two-stage-least-square approach. To start, we present results from the first stage (Equation 2) in Panel A of Table 2. The dependent variable is the natural logarithm of premium per plan participant ($Log(Premium\ per\ Person)_t$) and the independent variable is the insurers' loss ratio over the past three years ($InsurerLoss_{t-3\ to\ t-1}$). In column (1), we test our main specification, controlling for firm fixed effects and year fixed effects. We then add more stringent fixed effects. In column (2), we add state-by-year fixed effects, in column (3), we include industry-by-year fixed effects, and in column (4), state-by-industry-by-year fixed effects. These fixed effect structures remove confounding effects arising from local or industry-level dynamics, and allow us to only compare firms whose insurers face idiosyncratic shocks to their peers in the same state or/and industry. Across these specifications, coefficients on $Insurer\ Loss_{i,t-3\ to\ t-1}$ are statistically significant and generate stable economic magnitudes. A one-standard-deviation increase in insurer losses (0.022) is associated with 1.4% to 2% increase in premium per person, depending on the specification.

TABLE 2 ABOUT HERE

Results from the second stage are presented in Panel B. Our main dependent variable is the log of employees in a firm (*Log(Employees)*$_t$). The fixed effect specifications in column (1) through (4) follow those of Panel A. We find that the predicted increase in insurance premiums is associated with a substantial decline in employee counts. The estimate in our main specification, column (1), suggests an employment-premium elasticity of around 0.3. This means that a 10% increase in premium per person is associated with a 3% reduction in employees, or that a one-standard-deviation increase in premium (0.42) leads to a 12% employment decline. Combined with the estimates from the first stage, a one-standard-deviation increase in insurer losses is associated with 0.4% decline in firm employment, although the coefficient is also negative.

We next examine whether the decline in employment is driven by the increase in the separation rates of existing workers or the reduction in the number of newly hired ones. We investigate these two sources in columns (5) and (6), respectively. Results suggest that higher health insurance premiums are associated with significant reduction in the number of retained workers, and the effect has a similar magnitude as the drop in employment. In contrast, there is no statistical significant link between predicted changes in health insurance premium and the number of new hires.

In Table 9, we repeat our IV estimation for plan participants and plan take-up rate. In Panel A, we find that the number of participants decline sharply with increases in health insurance premiums. The magnitude is larger than the effect on employee counts, suggesting that a fraction of employees stop participating in the employer-sponsored plans, either because firms no longer offer the plan to them or they voluntarily switch away due to a higher required worker contribution amount. Consistent with this result, Panel B shows that plan take-up rate, measured by the participants/employee ratio, declines significantly with premiums. The effect is robust to all fixed effect specifications as well as controlling for past employment size of the firm. We provide a more detailed discussion of this result in Section 7.1.

5.2 Addressing Concerns Related to the IV

In this section, we discuss various concerns related to our instrumental variable approach. We also test its sensitivity to alternative empirical choices.

We start by controlling for the effect of firms' lagged employment. Given that the instrument is constructed using data from $t-3$ to $t-1$, we control for the log of employee counts during year $t-4$. We next consider the possibility that our results could be influenced by local economic conditions that vary at a finer area than states. Accordingly, we impose commuting zone-by-industry-by-year interactive fixed effects. In addition, we account for the possibility that firms with multiple EINs may have discretion in filing F5500 and workers' W2's, and could change their filing through different subsidiaries over time. We address this concern by aggregating the premium and employee information at the parent level. Results are reported in columns (1) through (3) of Table 3. Our results remain largely unchanged across these tests.

TABLE 3 ABOUT HERE

We next discuss a concern related to the exclusion restriction of our instrument, which suggests that insurers' losses could be correlated with an employer's underlying conditions. This is a possibility when the employer is large and account for a meaningful fraction of the insurer's revenue. We alleviate this concern in two ways. First, we restrict the sample to firms that account for less than 1% of their insurers' total premiums. Doing so requires that we construct a firm-insurer pair sample and measure the importance of an employer for each of the insurer it subscribes to. Column (4) shows that our results persist in this restricted sample. Second, we reconstruct our instrument by constructing losses using only premiums and claims that originated from areas outside of the focal employer's state. *Insurer Loss (Other States)* thus captures insurers' incentives to change premiums induced by losses unrelated to the focal firms' operations. Column (5) presents the first-stage results from this analysis and column (6) presents results from the second stage. We continue to find that out-of-state losses are associated with increased premiums charged by insurers, which in turn leads to a decline in employment by the firm of interest.

Another concern is that our results could capture an anticipation of the decline in worker health. In other words, firms with declining worker health may struggle to keep their workers, and also face increasing premiums from insurers. This argument suggests that insurers charge higher prices because they witnessed past losses and anticipate a deterioration of worker health condition in the future.

We directly evaluate this argument by testing the correlation between insurer losses and future claims per person being filed from the firm. Note that only a subset of firm-year observations report claims data in Form 5500. This leads to some sample attrition. Column (1) of Table 4 reports the results. We do not observe any positive correlation between insurer losses and future claims being filed. If anything, there is a weak, negative association. In column (2), we show that insurer losses positively predict future markup, measured by the premium-to-claims ratio at the firm-year level. Taken together, our results do not support the argument that insurers' losses are related to declining worker health. Instead, they are consistent with the argument that losses lead insurers to charge higher markups.

TABLE 4 ABOUT HERE

Finally, we consider the argument that, as insurers suffer from losses, firms may switch to other insurers that could provide lower quotes. In Section 2.2, we argue this is unlikely because insurers often have substantial pricing power in a market. Nevertheless, we explicitly examine the likelihood of a firm switching insurers when its current insurers face losses.[15] We construct an indicator $1(\mathit{Switch\ Insurer})_{t-1\ to\ t+1}$, which equals one if a firm changes their insurer from year $t-1$ to year $t+1$, and zero otherwise. This indicator is then regressed on our instrument, *Insurer Loss*. Column (3) shows that firms are not more likely to switch away from insurers that carry losses. This supports the idea that insurers have substantial market power and the dynamic matching between firms and insurers are unlikely to explain our results.

[15] We only consider the largest insurer in terms the firm's premium when there are multiple insurers.

5.3 Heterogeneous Effects Across Firms

We look into the heterogeneous effects of health insurance premiums on employment across firms to shed light on potential mechanisms driving our results. We explore several dimensions of heterogeneity. Results are presented in Table 5.

<u>TABLE 5 ABOUT HERE</u>

First, we examine the relevance of health insurance premiums as a portion of total labor costs for employers. If a large fraction of labor compensation paid by a firm is attributed to insurance premiums, shocks to premiums generate substantial changes to labor costs. We thus compute ratios of premiums-to-total payroll for firms during $t-1$ and partition firms into two groups based on whether this ratio exceeds its sample median value. We then compare the employment responses between firms with high vs. low ratios following an instrumented shock to health insurance premiums. Results are shown in columns (1) and (2). Consistent with our conjecture, the employment effect is concentrated on firms with high premium-to-payroll ratios, with a coefficient (-0.34) that is slightly larger in absolute magnitude than the baseline coefficient. Effects for firms with low premium-to-payroll ratios are much smaller in magnitude (-0.07) and not statistically significant.

Next, we consider the role of labor market tightness and measure it using the unemployment rate at the county level. We expect that in areas where workers are more likely to find another job, the labor supply curve will shift more and the effect on firms employment should be larger. We use county-level unemployment rates to gauge local labor market tightness (looseness). To test our conjecture, we split the sample by county-level unemployment rates at the median, and report the result in each subsample in columns (3) and (4), respectively. Consistently, we find that firm-level employment only changes following an instrumented increase in premiums in areas with lower unemployment rates, i.e., a tight labor market. In ares with high unemployment rates, we document a much smaller employment effect and the effect is not statistically significant at conventional levels.

Finally, we examine the role of investment opportunities in moderating our results.

Firms with better future investment opportunities should anticipate a greater need for workers and may "hoard" labor for future projects (see, e.g., Giroud and Mueller (2017)). Consequently, they should be less responsive to a temporary increase in labor costs. We measure investment options with industry-level Q using data from public firms, and assign industry Q to all firms (public and private) in our sample. Columns (5) and (6) present results from high-Q and low-Q industries, also defined based on sample median. Results verify our conjecture: firms in high-Q industries exhibit a smaller employment-to-premium sensitivity. In contrast, employment falls sharply following premium shocks for firms in low-Q industries. The coefficient of *Log(Premium per Person)* for low-Q industries is nearly double the size of our baseline coefficient.

Taken together, results from these cross-sectional investigations help substantiate our interpretation of the main results: increased health insurance premiums cause firms to decrease employment due to increased labor costs. In Table 4, our analysis suggests that the employment-premium cost relation does not vary across firm size, suggesting that external financial constraints are unlikely to explain our findings. Instead, our findings are consistent with firms optimizing over their production function and responding to changes in labor cost.

6 Effects of Health Insurance Premiums on Workers Across Skill Levels

In this section, we investigate the role of employer-sponsored health insurance premiums on the career outcomes of individual workers across skill levles. We switch to the individual-year panel discussed in Section 3.3 and estimate Equations 4 and 5.

6.1 Worker Retention

Table 6 reports the second-stage results. Our dependent variable is an indicator for whether a worker is retained by his or her $t-1$ employer, i.e., *1(Retained)*. Recall that results in Table 2 indicate that increases in health insurance costs lead to lower retention rates for the average worker inside the firm. We now focus on the differential effects of insurance premiums on workers across skill levels that are affiliated with the same employer in the year $t-1$. Thus, all regressions include firm-year interactive fixed effects, and we are interested in the interactive coefficients of insurance premium and worker skill. We hypothesize that low-skill workers are more likely to be separated from firms for two reasons. First, the same increase in premiums will raise the the relative cost of employing low-income workers by more than high-income worker. Second, low-skill workers are more readily substituted by machines and automation.

Columns (1) through (3) report the results for worker retention rates. Our main measure of worker skill is their average earnings in the past five years (*Worker Past Earnings*). Results from column (1) suggest that, when employers face higher health insurance premium, low-skill workers face a lower retention rate, and thus a higher separation rate than high-skill workers. Note that the variable, *Worker Past Earnings*, has already been standardized. An inter-quartile difference in worker skill (0.5) is associated with a 0.06 difference in the coefficient for *Log(Premium per Person)*, which is around 20% of the main effect on retention (reported in column (5), Panel B of Table 2). To interpret it directly, a one-standard-deviation increase in premium per person (0.42) is associated with around 2.4 percentage points difference in the retention rates of high- and low-skill workers.

In column (2), we further include worker age fixed effects to limit our comparison among workers of the same age. This helps account for the fact that workers of different ages also have differential turnover rates. Our results remain largely unchanged. In column (3), we further control for the interaction between insurance premiums and other measures of worker skill, including manual score and routine score. As discussed in Section 3.3, these metrics are constructed using the ACS data, which covers a smaller sample of workers. Notably, the coefficient estimates of *Log(Premium per Person)*$\times$ *Worker Past Earnings* are similar between column (2) and column (3), suggesting that wages, as the main component of firms' labor costs, are an important and unique channel through which health insurance costs affect workers. This is consistent with our argument that health insurance imposes a fixed costs on eligible workers, which makes up a larger share of firms' costs of hiring low-skill workers. The results in column (3) also suggest that manual workers are more likely to separate from their current employers when insurance firms charge higher premiums. In column (4), we test the effect of shocks to health insurance costs on worker retention in $t+1$ and continue to find a significant coefficient. This suggests that increases in insurance premium generate a persistent effect.

Table 6 About Here

Overall, our evidence shows that health insurance premiums generate more severe consequences on the retention of low-skill, manual workers.

6.2 Worker Unemployment

The previous subsection describes the results that low-skill workers are more likely to separate from firms than high-skill workers. One natural question is whether low-skill workers quickly land at other jobs, which will offset the effect of increased health insurance costs on these worker. To examine this question, we regress the indicator variable *1(Unemployed)* on the interaction between insurance premiums and worker skill measures. To take into account the fact that workers may transition to a contractor position, we set *1(Unemployed)* to be zero if the worker earns any income as a contractor.

Table 7 presents the results from this analysis. The specifications strictly follow the ones in Table 6. Results in columns (1) to (3) indicate that after a rise in health insurance premiums, low-skill, low-income workers are more likely to become unemployed. An inter-quartile change in worker skill (0.5) is associated with a 0.015 difference in the coefficient for *Log(Premium per Person)*. This means that a one-standard-deviation increase in premium per person (0.42) leads to around a 0.6 percentage point unemployment gap between high- and low-skill workers, around 11% of the sample average value. Results in column (4) further show that this differential unemployment effect persists in the following year as well.

Table 7 About Here

The results in Table 7 suggest that the effect of increased health insurance costs on low-income workers' separation with their previous employers is not offset by workers finding other jobs. Findings in Table 7 also indicate that the earlier result that low-income workers' retention rate decreases is unlikely explained by low-income workers' voluntarily changing jobs.

6.3 Worker Part-Time Status

As employers face higher labor costs arising from health insurance premiums, they could respond by transitioning from relying on full-time workers to part-time ones. As firms are not required by the ACA to provide healthcare insurance for part-time workers (those work under 30 hours per week). An the cost of providing health insurance benefits increase, firms are likely to shift some workers to part-time.

We examine the prevalence of this response by regressing an indicator for whether an individual is a part-time worker on the interaction of health insurance premium as well as measures of worker skill. At the firm-year level, untabulated results suggest that there is no statistically significant change in the ratio of part-time employees. Next, we examine whether health insurance costs affect workers' likelihood of becoming part-time varies across workers' skill levels. Table 8 reports the results. We find that low-skill individuals are more likely to become part-time employees than high-skill ones. This is likely because for firms, an increase in health insurance costs raises the relative costs of low-skill, benefits-eligible workers than high-skill ones. Results in this section thus highlight an important channel through which firms respond to health insurance cost increases.

TABLE 8 ABOUT HERE

7 Effects of Health Insurance Premiums on Worker Wages and Plan Participation

In this section, we provide evidence consistent with firms changing eligibility and/or passing insurance cost increases on to workers. While our analysis here is only suggestive due to data limitations, we find two pieces of complementary evidence. First, we show that, in response to increases in premiums, the number of plan participants in a firm drops to a greater extent than do the number of employees. Second, despite this decline in employee participation, average growth in wages (which are observed net of deductions) for incumbent workers remain unchanged. In the final subsection, we discuss how the our estimates are consistent with the argument that firm-specific shocks to premiums induce shifts in both labor supply and labor demand, which confounds our ability to estimate a demand elasticity absent additional structural assumptions.

7.1 Overall Plan Take-up

Firms have discretion to decide the split between employer and employee contributions towards health insurance premiums. As such, one potential option is to pass all costs on to workers in the form of higher employee contributions. Since employee take-up is voluntary, one would expect that such a policy would induce a decline in participation. Likewise, by cutting hours or increasing the stringency of eligibility requirements in other ways, employers may induce declines in plan participation.

Table 9 About Here

We investigate how worker participation in employer-sponsored health insurance plans change following shocks to plan premiums. In columns (1) through (3) of Table 9, we examine the effect of health insurance premiums on the number of plan participants in a firm. The results include analogous specifications to the main employment specification (Table 2B), except that our outcome variable is the log number of plan participants rather than the number of employees. Regardless of the specification, we estimate that increases in premiums are associated with substantial changes in the number of participants (with elasticities between -0.76 and -0.77), which are 2-3 times larger than our baseline employment effects. We next directly check whether insurance premiums affect the fraction of workers that enroll in an employer-sponsored health insurance plan. We do so by computing the ratio of the number of plan participants to total employment, i.e., the "take-up ratio," and use this ratio as the dependent variable in our 2SLS approach. Columns (4) through (6) reports the results. Across all fixed effects specifications, we estimate large declines in the participant-worker ratio in response to rising health insurance costs.

Overall, our findings suggest that plan participation is substantially more responsive to health insurance costs than employment counts. This means that, following a hike in insurance premiums, at least part of the workers that remain in the firm stop enrolling in health insurance plans. This could be due to an increase in employee contribution, a reduction in the attractiveness of the plan, or more restrictive eligibility standard.

7.2 Wage Changes for Incumbent Workers

In the last step of the individual-level analysis, we investigate whether changes to health insurance premiums affect worker wage growth. This inquiry could generate enhance our understanding regarding the effect of insurance costs on workers. As we will discuss more in the next section, the fact that firms have discretion over the size of employee contributions implies that both the labor supply and demand curve likely shift as health insurance costs increase. As a result, we do not have a clear prediction on how wages should change. In addition, one complication is that our wage measures are gross wages after workers' own health insurance contribution and other benefits deduction. Given that the health insurance take-up rate decreases, an average workers' own health insurance contribution also decreases. If gross wages stay the same, after benefits deductions, wages should go up. A third issue is that as we argued earlier, firms can shift full-time workers to part-time status, which also complicates the interpretation of any effect on worker wages.

Nevertheless, we examine the effect of health insurance costs on workers' wages. We compute each retained worker's wage growth rate by comparing current-year wages (t) as well as next-year wages ($t + 1$) to wages from four years ago ($t - 4$). This is because our instrument is constructed using data starting from $t - 3$, and could influence wage rates starting from that point in time. We continue to rely on the IV approach to examine the causal effect of insurance premiums.

Table 10 reports second-stage results from the wage analysis. While the coefficients on premiums are positive, they are not statistically significant. As we caution earlier, it is difficult to interpret these results. However, these results help rule out the possibility that the worker turnover result we documented is unlikely to be triggered by better outside employment opportunities.

TABLE 10 ABOUT HERE

7.3 Discussion: Why Premium Changes Induce both Labor Supply and Labor Demand Changes

Our main employment estimates in section 5 suggest that a one-percentage-point increase in premiums results in 0.2% decline of employed workers, implying a large elasticity of employment to total labor costs if taken at face value. However, for reasons we discuss here, we advise against such a naive interpretation. It is not straightforward to derive a labor demand elasticity directly from our estimates because rising health insurance costs likely induce both labor demand and labor supply responses.

For concreteness, we begin with several definitions. A firm's average cost per worker includes wage net of deductions plus the expected health insurance premium, which depends on both premiums and the probability a worker participates. Notice that the split between employer and employee contributions is only relevant to the extent that it changes workers' take-up decisions. If firm total expenses are held constant and take up does not change, a $1 increase in employee contributions is offset by a $1 decrease in employer contributions. While one would measure a $1 increase in gross (pre-deduction) wages, total employer expenses and workers' take home wages (gross wages minus workers' own contributions) are unchanged.

Holding firms' total labor expenditures (take home wages plus premiums) constant, if premiums increase and take up stays unchanged, workers' take-home pay decreases, which reduces the supply of labor. To see this, suppose that, prior to the shock, total gross compensation is \$W, which includes the insurance premium \$C. After the shock, premiums rise from \$C to \$C + \$X. If take up of plan benefits does not change, an increase in health insurance premiums is isomorphic to shifting a firm's labor supply curve up by \$X. The reason is that, holding total expenditure \$W fixed, a larger share of the \$W in labor costs (wages + premiums) is spent on premiums for plans that do not change in quality, lowering workers' take home wages by \$X. Thus, it is natural to expect that rising premiums will induce labor supply shifts, a factor which would allow us to cleanly estimate the slope of the labor demand curve all else constant.

However, all else is not held constant. Firms can (and likely do, according to our estimates) lower the take-up rate by lowering eligibility and/or increasing employee contributions. Among workers that stay with the firm, some will opt out of their employers' health insurance and choose alternative options such as their spouses' employer-sponsored plans. As noted above, the fact that typical employee contributions are substantially smaller than premiums implies that firms value worker take-up. For instance, there is likely to be a dynamic surplus from current take-up: workers may be more attached if they are enrolled in their employers' health plans. While it is costly to provide insurance benefits in the present, it potentially allows firms to retain valuable human capital and reduce expected future additional costs (e.g., search costs; consistent with table A1).

Higher premiums make it more costly for firms to induce health insurance take-up, and thus, lower the dynamic surplus and thus the marginal benefit per dollar of current labor expenditure. As a result, firms' labor demand curve shifts to the left. Therefore, while our results suggest that firms are quite responsive to health insurance costs, it is not easy to directly infer a labor demand elasticity absent more structural assumptions.

8 Health Insurance Premiums and Firms' Technology Investment

One way firms can respond to rising health insurance premiums is by adopting labor-saving technologies and automating part of its workforce. We examine this hypothesis by estimating Equations 2 and 3 for firms' technology budget, provided by Aberdeen Technologies. Table 11 reports the results from our two-stage-least-square approach. Panel A presents the results from the first stage, and Panels B and C provide results from the second stage. The dependent variable in Panel B (C) is the natural logarithm of a firm's per-employee budget on personal computers (total IT budget). We follow the same specification as in our baseline approach, starting with firm fixed effects and year fixed effects, and then layer on more stringent fixed effects, including industry-year, state-year, and state-industry-year interactive fixed effects.

Consistent with results in Table 2, we find that past insurer losses are a strong predictor of insurance premiums charged. The predicted increase in insurance premium in turn leads to a significant increase in firms' technology spending, both in terms of computer and total IT budget. The tech spending-premium elasticity is around 1–2, higher than the estimated employment-premium elasticity (around –0.3). This is not surprising because firms face strong labor market frictions when attempting to lay off workers, but should face limited resistance against installing and upgrading technology.

Table 11 About Here

Taken together, our evidence is consistent with health insurance premiums being an important driver of the demand for low-skill workers. When facing an increase in premiums, firms cut employment, leading to a disproportionate separation of low-skill, routine workers. At the same time, firms speed up technology expenditure, likely to replace those workers.

9 Conclusion

Employer-sponsored healthcare insurance is a significant component of labor costs. We examine the causal effect of health insurance premiums on firms' employment, both in terms of quantity and composition, and technology investment decisions. To address endogeneity concerns, we instrument for insurance premiums using idiosyncratic variation in insurers' losses, that is plausibly exogenous to their customers, individual employers. Using Census micro data, we show that following an increase in increased premiums, firms reduce employment. Relative to higher-skilled coworkers, lower-skilled workers experience a larger increase in the probability of being laid off and remaining unemployed for two years following the shock. Firms also invest more in information technology, potentially to substitute for labor.

Our paper provides potential implications for policymakers. In particular, a downside of employer-sponsored health insurance is that it introduces dependencies between insurance costs and firm labor demand. We might also want to consider whether it is valuable to subsidize costs firms incur to provide insurance for low-income workers.

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Figures and Tables

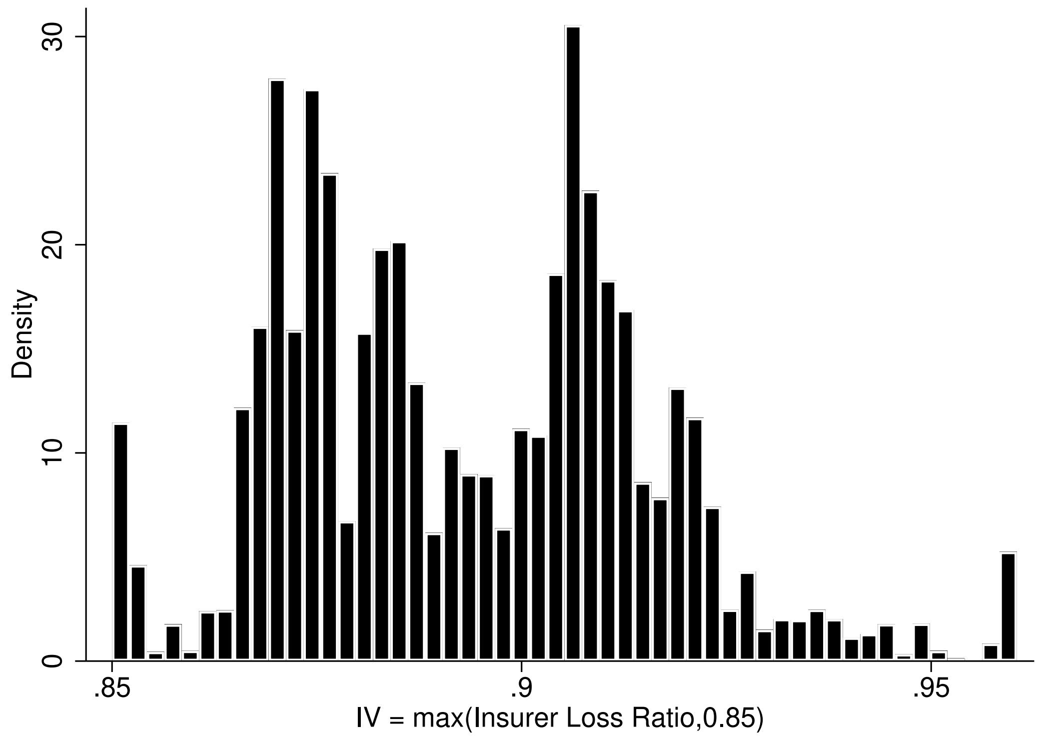
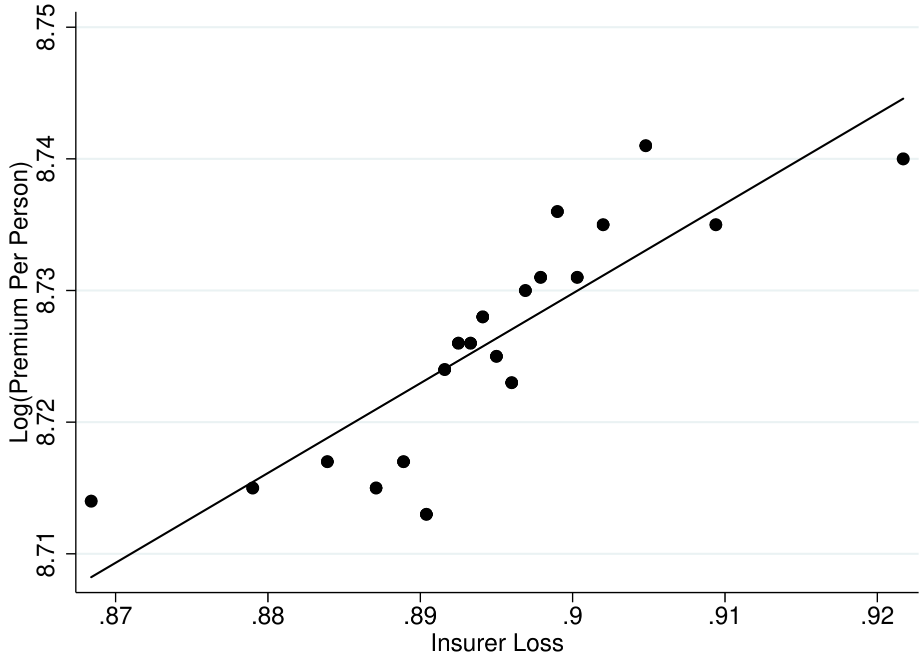


Figure 1. Distribution of Instrumental Variable, Insurer Losses

This Figure displays the distribution of our main instrumental variable, *Insurer Loss*, matched to Form 5500 data.

Panel A: First Stage—Insurer Loss and Log(Premium Per Person)



Panel B: Second Stage—Predicted Log(Premium Per Person) and Firm Employment

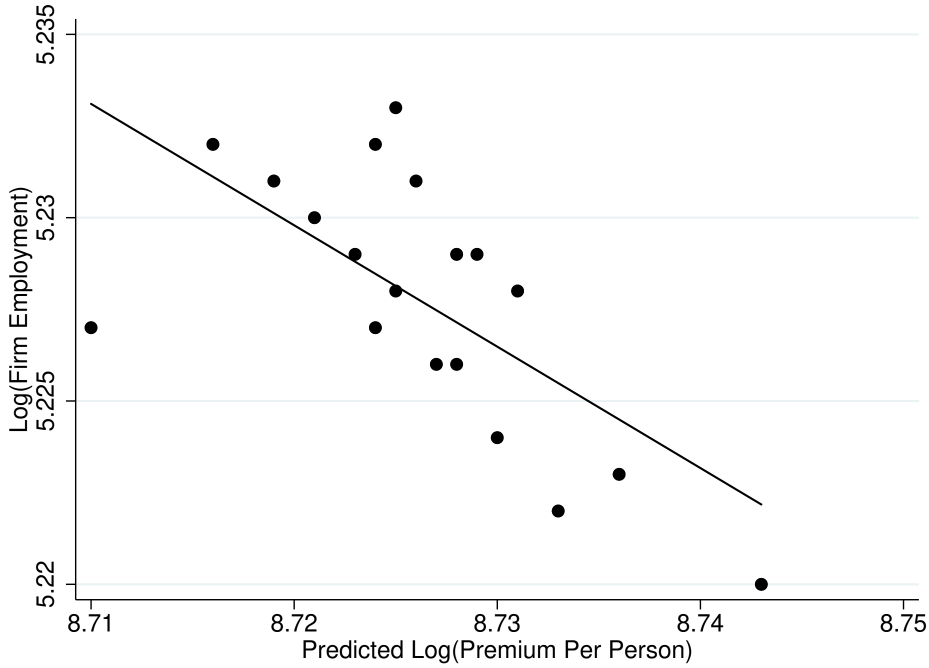


Figure 2. Binscatter Representation of Instrumental Variable Estimation

Panel A is a binned scatter plot of our main endogenous variable, *Log(Premium per Person)*$_t$, against its instrumental variable, *Insurer Loss*. Panel B is a binned scatter plot of natural log of firm employment against *Predicted Log(Premium per Person)*$_t$. *Predicted Log(Premium per Person)*$_t$ is the predicted outcome variable from regressing *Log(Premium Per Person)*$_t$ on *Insurer Loss*$_{t-3\ to\ t-1}$ along with firm and year fixed effects. We first absorb the firm and year fixed effects from all four variables.

Table 1. Summary Statistics
This table presents summary statistics for the key variables used in our study.

Variable	Mean	Std. Dev.	P10	Median	P90
Firm-Year Sample					
$Insurer\ Loss_{t-3\ to\ t-1}$	0.8946	0.02214	0.8695	0.8936	0.9206
$Premium\ per\ Person_t$ (in $)	6763	3138	3715	5926	11130
$Log(Premium\ per\ Person)_t$	8.726	0.4235	8.22	8.687	9.318
$\#Employees_t$	270.2	352.9	68	188	502
$Log(Employees)_t$	5.228	0.8657	4.22	5.236	6.219
$Log(Premium/Claims)_t$	1.388	1.011	0.9286	1.236	1.71
$Claims\ per\ Person_t$	5710	10410	2645	4774	9421
$Log(Claims\ per\ Person)_t$	8.476	0.541	7.881	8.471	9.151
$1(Switch\ Insurer)_{t-1\ to\ t+1}$	0.2152	0.411	0	0	1
Worker-Year Sample					
$1(Unemployed)_t$	0.02859	0.1667	0	0	0
$1(Retained)_t$	0.8143	0.3889	0	1	1
$1(PartTime)_{t\ or\ t+1}$	0.09069	0.2872	0	0	0
$Wage\ Growth_{t-4\ to\ t}$	0.1946	0.5608	-0.1496	0.07384	0.5483
$Wage\ Growth_{t-4\ to\ t+1}$	0.2044	0.6008	-0.2071	0.08539	0.6244
Aberdeen Firm-Year Sample					
$Insurer\ Loss_{t-3\ to\ t-1}$	0.8940	0.0221	0.8696	0.8922	0.9206
$Log(Premium\ per\ Person)_t$	8.6477	0.4717	8.0676	8.6151	9.2851
PC Budget per Person	393.4	723.1	54	175	833.3
Log(PC Budget per Person)	5.3026	1.0672	4.0456	5.1853	6.7375
IT Budget per Person	7586	15228	907.3	3122	16000
Log(IT Budget per Person)	8.1797	1.1290	6.8578	8.0577	9.6836

Table 2. How do health insurance premiums affect firm employment?
This table presents results from estimating the effect of health insurance premiums on the number of participants using instrumental variable and OLS approaches. Observations are at the firm-year level. Panel A (B) presents the first (second)-stage results for the instrumental variable regressions. In Panel A, the dependent variable is the natural logarithm of premium per participant. In Panel B, the dependent variable is the log number of employees in columns (1)-(4), the log number of employees retained from the previous year in (5), and the log number of new hires in (6). In each panel, we start with firm fixed effects and year fixed effects and progressively include more rigorous fixed effects. Standard errors are corrected for clustering at the firm level. See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors and are heteroskedasticity robust and clustered by firm. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Panel A: First-Stage Results, Premium per Person

Dep. Var.:*Log(Premium per Person)*$_t$	(1)	(2)	(3)	(4)
$Insurer\ Loss_{t-3\ to\ t-1}$	0.6563***	0.8464***	0.6661***	0.8699***
	(7.14)	(8.00)	(7.26)	(7.89)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes			
State-Year FE		Yes		
Industry-Year FE			Yes	
State-Industry-Year FE				Yes
Estimation Type	IV	IV	IV	IV

Panel B: Second-stage Results, Firm Employment

Dep. Var.:	*Log(Employees)*				*Log(Retained)*	*Log(NewHires)*
	(1)	(2)	(3)	(4)	(5)	(6)
Log(Premium per Person)$_t$	-0.2955***	-0.2117**	-0.2740**	-0.1674*	-0.2758**	-0.1389
	(-2.69)	(-2.26)	(-2.57)	(-1.85)	(-2.46)	(-0.64)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes				Yes	Yes
State-Year FE		Yes				
Industry-Year FE			Yes			
State-Industry-Year FE				Yes		
Estimation Type	IV	IV	IV	IV	IV	IV
Observations	92000	88000	88500	86500	91500	91500
Cragg-Donald F Stat	161.00	212.50	163.40	203.90	158.80	158.80

Table 3. Alternative specifications of the IV approach.

This table presents results from alternative specifications and robustness checks of the IV method. Observations are at the firm-year level. In column (1), we control for the log number of employees four years prior to the dependent variable, right before the period for which the instrument is constructed. In column (2), we control for commuting zone-industry-year interactive fixed effects. In column (3), we aggregate employers at the parent level based on the link between EIN and firm identifier in LBD. In column (4), we restrict the sample to only employers whose premiums make up less than 1% of the insurer-year total in the previous year. In columns (5) and (6), we instrument premiums using insurers' lagged losses from states other than the location of the focal employer. Column (5) presents the first-stage and (6) the second-stage result. For these two columns, we include firms that file Form 5500 Schedule D forms but delete reporting EINs who are an aggregation of individual firms that file Form 5500 Schedule D Part 2. See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.:	*Log(Employees)*				*Log(Premium per Person)*	*Log(Employees)*
Sample:	All	All	Parent-level	Prem<Insurers' 1%	with Multi-state Insurers	
	(1)	(2)	(3)	(4)	(5)	(6)
Insurer Loss (Other States)$_{t-3\ to\ t-1}$					0.2334***	
					(4.98)	
Log(Premium per Person)$_t$	-0.3480**	-0.2295*	-0.3043***	-0.2841***		-0.3207*
	(-2.25)	(-1.76)	(-2.58)	(-2.62)		(-1.67)
Log(Employees)$_{t-4}$	0.08649***					
	(9.76)					
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes		Yes	Yes	Yes	Yes
Commuting Zone-Industry-Year FE		Yes				
Estimation Type	IV	IV	IV	IV	IV 1st Stage	IV
Observations	67000	64500	82500	90000	69000	69000
Cragg-Donald F Stat	76.220	169.60	91.370	123.10		52.560

Table 4. Insurer losses and future claims, markups, and employer-insurer matching

This table presents results estimating the correlation between three employer outcomes related to health insurance and lagged insurers' losses. Observations are at the firm-year level. The dependent variable is the natural log of dollar claims per plan participant in year t in column (1), premium divided by claims in year t in column (2), and an indicator for whether the employer switched the insurer from year $t-1$ to $t+1$ in column (3). Insurers' losses are based on data from years $t-3$ to $t-1$. See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)
Dep. Var.:	*Log(Claims per Person)*	*Premium/Claim*	*1(Switch Insurer)*
$Insurer\ Loss_{t-3\ to\ t-1}$	-0.3131	1.7110***	-0.3374
	(-1.41)	(3.99)	(-0.81)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Estimation Type	OLS	OLS	OLS
Observations	17500	17500	65000

Table 5. Heterogeneous effects of health insurance costs on employment across firms. This table presents results estimating the effect of health insurance premiums on the number of employees using the instrumental variable approach. Observations are at the firm-year level. We present the second-stage results of the instrumental variable regressions, where log premium per person is instrumented with lagged insurer losses. The dependent variable is the log number of employees. In each column, we use a subsample. We only include firms that have a lagged total premium to total wage ratio higher than or equal to the median that year in column (1), and lower than the median in column (2). We only include firms in counties whose lagged unemployment rate is higher than or equal to the median that year in column (3), and lower than the median in column (4). We only include firms whose lagged industry Q (measured using publicly traded firms) is lower than or equal to the median that year in column (5), and higher than the median in column (6). At the bottom of the table, we present p-values from testing the differences between each pair of subsamples. See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Sample Partition:	*Total Premiums/Wages*		*County Unemployment*		*Industry Q*	
	High	Low	Low	High	Low	High
Dep. Var.: *Log(Employees)*	(1)	(2)	(3)	(4)	(5)	(6)
Log(Premium per Person)$_t$	-0.3418*	-0.07457	-0.4936*	-0.1722	-0.5167**	-0.2744
	(-1.93)	(-0.64)	(-1.72)	(-1.02)	(-2.31)	(-1.17)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Estimation Type	IV	IV	IV	IV	IV	IV
Observations	45000	43000	38500	34500	27000	26500
Cragg-Donald F Stat	62.950	113.50	26.730	56.570	44.970	41.380
p-value of difference	0.2064		0.3336		0.4471	

Table 6. Health insurance premiums and the retention of high- and low-skill workers.
This table presents results estimating the differential effects of health insurance premiums on worker retention likelihood depending on the worker's past five-year average wages. Observations are at the worker-year level. We present the second-stage results of the instrumental variable regressions, where log premium per person and its interaction terms with individual characteristics are instrumented with lagged insurer losses and its interaction terms with individual characteristics. The independent variable is an indicator of whether the worker is retained in year t by their $t-1$ employer in columns (1)-(3), and in year $t+1$ by their $t-1$ employer in column (4). We classify workers as retained if they receive wages from their year $t-1$ employer that are at least the federal minimum wage at 20 hours per week. The independent variables include log premium per person interacted with workers' log of past average wages and a score for how manual or routine their occupation is in the ACS survey. Controls include workers' log of past average wages in columns (1)-(2), and manual and routine scores for columns (3)-(4). For ease of interpretation, we standardize the values of workers' log of past average wages, as well as manual and routine scores. We weight observations with the inverse of the number of employees at each firm, to reduce the influence of large firms. Each column includes firm-by-year fixed effects. In columns (2)-(4), we also add worker age fixed effects. See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.:	$1(Retained)_t$			$1(Retained)_{t+1}$
	(1)	(2)	(3)	(4)
Log(Premium per Person)$_t$ × Worker Past Earnings	0.1123***	0.09836***	0.09329***	0.1259***
	(5.46)	(5.37)	(4.01)	(4.15)
Log(Premium per Person)$_t$ × Worker Manual Score			-0.04484**	-0.05837**
			(-2.12)	(-2.09)
Log(Premium per Person)$_t$ × Worker Routine Score			-0.004051	-0.006736
			(-0.37)	(-0.45)
Controls	Yes	Yes	Yes	Yes
Firm-Year FE	Yes	Yes	Yes	Yes
Age FE		Yes	Yes	Yes
Estimation Type	IV	IV	IV	IV
Observations	24510000	24510000	4528000	4528000

Table 7. Health insurance premiums and the unemployment of high- and low-skill workers.
This table presents results estimating the heterogeneous effect of health insurance premiums on unemployment outcomes depending on worker skill. Observations are at the worker-year level. We present the second-stage results of the instrumental variable regressions, where log premium per person and its interaction terms with individual characteristics are instrumented with lagged insurer losses and its interaction terms with individual characteristics. The independent variable is an indicator of whether the worker is unemployed in year t, and in year $t+1$ in column (4). We classify workers as unemployed if their W2 wages are lower than the federal minimum wage at 20 hours per week and do not file any IRS 1099 filings. The dependent variables include log premium per person interacted with workers' log of past average wages and a score for how manual or routine their occupation is in the ACS survey. Controls include workers' log of past average wages in columns (1)-(2), and manual and routine scores for columns (3)-(4). For ease of interpretation, we standardize the values of workers' log of past average wages, as well as manual and routine scores. We weight observations with the inverse of the number of employees at each firm, to reduce the influence of large firms. Each column includes firm-by-year fixed effects. In columns (2)-(4), we also add worker age fixed effects. See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.:	$1(Unemployed)_t$			$1(Unemployed)_{t+1}$
	(1)	(2)	(3)	(4)
Log(Premium per Person)$_t \times$ *Worker Past Earnings*	-0.03072***	-0.03153***	-0.05123***	-0.04794***
	(-4.41)	(-4.51)	(-4.49)	(-3.41)
Log(Premium per Person)$_t \times$ *Worker Manual Score*			0.004908	0.02211*
			(0.58)	(1.74)
Log(Premium per Person)$_t \times$ *Worker Routine Score*			-0.008314*	0.002043
			(-1.65)	(0.29)
Controls	Yes	Yes	Yes	Yes
Firm-Year FE	Yes	Yes	Yes	Yes
Age FE		Yes	Yes	Yes
Estimation Type	IV	IV	IV	IV
Observations	24510000	24510000	4528000	4528000

Table 8. Health insurance premiums and the part-time status of high- and low-skill workers.
This table presents results estimating the heterogeneous effect of health insurance premiums on whether a worker is part-time depending on the worker's past five-year average wages. Observations are at the worker-year level. We present the second-stage results of the instrumental variable regressions, where log premium per person and its interaction terms with individual characteristics are instrumented with lagged insurer losses and its interaction terms with individual characteristics. The dependent variable is an indicator of whether the worker works for at most 30 hours per week on average in year t or $t+1$ in the ACS response, conditional on the worker appearing in the ACS survey in year t or $t+1$. The independent variables include log premium per person interacted with workers' log of past average wages and a score for how manual or routine their occupation is in the ACS survey. Controls include workers' log of past average wages in columns (1)-(2), and manual and routine scores for column (3). For ease of interpretation, we standardize the values of workers' log of past average wages, as well as manual and routine scores. We weight observations with the inverse of the number of employees at each firm, to reduce the influence of large firms. Each column includes firm-by-year fixed effects. In columns (2) and (3), we also add worker age fixed effects. See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.: $1(PartTime)_{t\ or\ t+1}$	(1)	(2)	(3)
Log(Premium per Person)$_t\times$ *Worker Past Earnings*	-0.1583***	-0.1582***	-0.1724***
	(-5.08)	(-5.27)	(-5.25)
Log(Premium per Person)$_t\times$ *Worker Manual Score*			0.01655
			(0.65)
Log(Premium per Person)$_t\times$ *Worker Routine Score*			-0.03861***
			(-2.59)
Controls	Yes	Yes	Yes
Firm-Year FE	Yes	Yes	Yes
Age FE		Yes	Yes
Estimation Type	IV	IV	IV
Observations	4693000	4693000	4386000

Table 9. The effect of health insurance premiums on employee insurance take up.
This table presents results estimating the effect of health insurance premiums on employees' insurance take up. In columns (1)-(3), the dependent variable is the log number of health insurance plan participants. In columns (4)-(6), the dependent variable is the ratio of plan participants to employees. We include firm fixed effects and year fixed effects in columns (1) and (3), firm fixed effects and state-by-year fixed effects in columns (2) and (4), firm fixed effects and industry-by-year fixed effects in columns (3) and (6). We do not include firms that file Form 5500 Schedule D Part 2 as we do not have data on the number of participants for these firms. See Appendix A for variable definitions. *t*-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.:	*Log(Participants)*			*Participants/Employees*		
	(1)	(2)	(3)	(4)	(5)	(6)
$Log(Premium\ per\ Person)_t$	-0.7736***	-0.7667***	-0.7558***	-0.6279***	-0.7173***	-0.6226***
	(-6.05)	(-6.76)	(-6.04)	(-4.03)	(-5.12)	(-4.07)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes			Yes		
State-Year FE		Yes			Yes	
Industry-Year FE			Yes			Yes
Estimation Type	IV	IV	IV	IV	IV	IV
Observations	84500	84500	84500	80500	80500	80500
Cragg-Donald F Stat	151.60	203.50	155.70	140	187.90	144.30

Table 10. Effect of health insurance premiums on worker wage growth.
This table presents results estimating the effect of health insurance premiums on workers' wage growth rate. Observations are at the worker-year level. We present the second-stage results of the instrumental variable regressions, where log premium per person is instrumented with lagged insurer losses. The dependent variable is the growth rate of workers net-of-benefit contribution wages from year $t-4$ to t in column (1) and from year $t-4$ to $t+1$ in column (2). Each column includes firm fixed effects and year fixed effects. See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

	(1)	(2)
Dep. Var.:	$Wage\ Growth_{t-4,t}$	$Wage\ Growth_{t-4,t+1}$
$Log(Premium\ per\ Person)_t$	0.03575	0.02988
	(0.51)	(0.39)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Estimation Type	IV	IV
Observations	12420000	10660000

Table 11. Effect of health insurance premiums on firm technology investment.
This table presents results estimating the effect of health insurance premiums on firms technology investment budgets. Observations are at the firm-year level. We present the first-stage results of the instrumental variable regressions in Panel A and second-stage results in Panels B and C. The dependent variable is log premium per person in Panel A, the logarithm of per-employee PC budget in Panel B, and the logarithm of per-employee IT budget in Panel C. See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Panel A. First Stage

Dep. Var.: *Log(Permium per Person)$_t$*	(1)	(2)	(3)	(4)
Insurer Loss$_{t-3\ to\ t-1}$	0.2877***	0.3095***	0.3367***	0.4068***
	(3.81)	(3.64)	(4.20)	(4.49)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes			
Industry-Year FE		Yes		
State-Year FE			Yes	
State-Industry-Year FE				Yes
Estimation Type	IV 1st Stage	IV 1st Stage	IV 1st Stage	IV 1st Stage
Observations	132701	130368	119597	118212

Panel B. Second Stage: PC Budget

Dep. Var.: *Log(PC Budget per Person)$_t$*	(1)	(2)	(3)	(4)
Log(Premium per Person)$_t$	1.9032**	1.6429*	1.7123**	1.0944*
	(2.17)	(1.95)	(2.35)	(1.85)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes			
Industry-Year FE		Yes		
State-Year FE			Yes	
State-Industry-Year FE				Yes
Estimation Type	IV	IV	IV	IV
Observations	132533	130209	119447	118066
Cragg-Donald F Stat	29.2355	28.3907	35.5684	42.5483

Panel C. Second Stage: IT Budget

Dep. Var.: *Log(IT Budget per Person)$_t$*	(1)	(2)	(3)	(4)
Log(Premium per Person)$_t$	2.4606**	1.8952**	1.4078**	0.9566*
	(2.54)	(2.15)	(2.06)	(1.68)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes			
Industry-Year FE		Yes		
State-Year FE			Yes	
State-Industry-Year FE				Yes
Estimation Type	IV	IV	IV	IV
Observations	132701	130368	119597	118212
Cragg-Donald F Stat	29.3723	28.2983	35.5228	42.1396

A Variable Definition

- *Insurer Loss*: insurers' loss ratio as defined in Section 3.2
- *Insurer Loss (Other States)*: insurers' loss ratio as defined in Section 3.2, but with insurers' performance in states other than the focal firm's state
- *Log(Premium per Person)*: natural log of total firm-level health insurance premiums divided by the number of participants
- *Log(Employees)*: natural log of the firm-level number of employees
- *Log(Retained)*: natural log of the firm-level number of retained employees from the previous year
- *Log(NewHires)*:natural log of the firm-level number of newly hired employees
- *Log(Claims per Person)*: natural log of firm-level total health insurance claims divided by the number of participants
- *Premium/Claims*: firm-level total premiums divided by total claims
- *1(Switch Insurer)*: indicator for firm switching health insurer
- *Total Premiums/Wages*: firm-level total premiums divided by total wages
- *Industry Q*: industry-level average Q (measured using publicly traded firms)
- *Local Unemployment*: county-level unemployment rate based on BLS data
- *1(Retained)*: indicator of whether the worker is retained in year t by their $t-1$ employer
- *1(Unemployed)*: indicator of whether the worker is unemployed. We classify workers as unemployed if their W2 wages are lower than the federal minimum wage at 20 hours per week and do not file any IRS 1099 filings.
- *1(PartTime)*: indicator of whether the worker works for at least on average 30 hours per week in year t or $t+1$ in the ACS response, conditional on the worker appearing in the ACS survey in year t or $t+1$
- *Worker Past Earnings*: average earnings during the previous five years (excluding years with zero earnings)
- *Worker Manual Score*: worker task manual score based on ACS survey, constructed by Auto and Dorn (2013). We assume workers' manual score does not change over time.
- *Worker Routine Score*: worker task routine score based on ACS survey, constructed by Auto and Dorn (2013). We assume workers' routine score does not change over time.
- *Wage Growth*: worker-level wage growth rate
- *Log(PC Budget per Person)*: firm-level natural log of PC budget per worker
- *Log(IT Budget per Person)*: firm-level natural log of IT budget per worker

B Additional Results

Table A1. Relationship between health insurance take-up rate and worker retention rate, firm-level analysis.
This table presents results estimating the relationship between lagged health insurance take-up rate and worker retention rate in the current and subsequent year. See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.:	*Worker Retention Rate*$_t$		*Worker Retention Rate*$_{t+1}$	
	(1)	(2)	(3)	(4)
Health Insurance Take up Rate$_{t-1}$	0.02736***	0.02425***	0.03255***	0.03070***
	(37.39)	(21.18)	(33.61)	(20.62)
Year FE	Yes	Yes	Yes	Yes
Firm FE		Yes		Yes
Estimation Type	IV	IV	IV	IV
Observations	155000	145000	155000	145000

Table A2. Persistence of the Effects of Health Insurance Premiums on Firm Employment
This table reports results estimating the effect of health insurance premiums on the employment in subsequent years ($t+1$ and $t+2$). See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

	(1)	(2)
Dep. Var.:	*Log(Employees)*$_{t+1}$	*Log(Employees)*$_{t+2}$
Log(Premium per Person)$_t$	-0.3998**	-0.1148
	(-2.07)	(-0.39)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Estimation Type	IV	IV
Observations	70500	52500
Cragg-Donald F Stat	59.150	20.090

Table A3. Health insurance premiums and firm employment and worker characteristics in previous periods.
This table reports results from a pre-trend analysis where we examine the relation between health insurance premiums and firm employment prior to the period with which we construct the instrument. See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.:	$Log(Employees)_{t-4}$	Age_{t-4}	$\#Children_{t-4}$	$Worker\ Gender_{t-4}$	$Worker\ Routine\ Score_{t-4}$	$Worker\ Manual\ Score_{t-4}$
$Log(Premium\ per\ Person)_t$	-0.1364	-0.2012	-0.008048	0.00007729	-0.1129	-0.02945
	(-0.83)	(-0.23)	(-0.08)	(0.00)	(-0.48)	(-0.25)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Estimation Type	IV	IV	IV	IV	IV	IV
Observations	67000	67000	65500	66500	66500	66500
Cragg-Donald F Stat	76.170	75.110	77.160	76.190	76.930	76.930

Table A4. Differential Effects of Health Insurance Premiums on Firm Employment Across Large and Small Firms

This table reports results estimating the differential effects of health insurance premiums on the employment between firms with high and low previous employee counts. See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Employment Size $(t-1)$	Low	High
Dep. Var.: *Log(Employees)$_t$*	(1)	(2)
Log(Premium per Person)$_t$	-0.1540	-0.1710
	(-1.27)	(-1.04)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Estimation Type	IV	IV
Observations	43500	45500
Cragg-Donald F Stat	91.490	52.870
F stat of difference	0.0069	
p-value of difference	0.9336	

Table A5. The Effects of Health Insurance Premiums on New Hire Skills and Wages
This table reports results estimating the effect of health insurance premiums on the skills and wage levels of new-hire workers. See Appendix A for variable definitions. t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

	(1)	(2)
Dep. Var.:	$Wages_{t-5,t-1}$	$Wages_t$
Log(Premium per Person)$_t$	0.1489	0.1904*
	(1.31)	(1.65)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Estimation Type	IV	IV
Observations	90500	90500
Cragg-Donald F Stat	159.10	158.80