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

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**Abstract**

Employer-sponsored health 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' recent losses, which is plausibly exogenous to their customers who are employers. Using Census microdata, we show that following an increase in premiums, firms reduce employment. Relative to higher-income coworkers, lower-income workers see a larger increase in their likelihood of being separated from their jobs and becoming unemployed. Firms also invest more in information technology, potentially to substitute labor.

Keywords: Health insurance, insurer losses, worker skills, firm employment, labor composition, inequality, technology investment, automation

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# 1 Introduction

While health insurance protects households from the financial repercussions of health shocks, its costs are large and rapidly rising. Health insurance is often sponsored and heavily subsidized by employers in the U.S.; as of 2021, over half of Americans are covered by employer-sponsored health insurance and U.S. employers contributed $16,253 on average in health insurance premiums per family plan.[1] Unlike many other labor costs such as wages and payroll taxes, health insurance costs do not scale with individual productivity, so these costs are even larger as a fraction of overall compensation for low-income workers. Ceteris paribus, higher health insurance costs can act as a fixed cost or "head tax" and depress demand for labor, especially for the types of low-income workers that also face increasing displacement risk from other well-documented headwinds in the labor market.[2] In part due to these potential labor market distortions, the role employers should play in health care provision is the subject of a heated policy debate. In this paper, we speak to these distortions by studying how plausibly exogenous variation in firms' health insurance costs affects employment, and how the effect varies across workers along the income spectrum.

Holding the health insurance takeup rate fixed, an increase in health insurance premiums would likely manifest as some combination of an increase in total labor costs per worker (earnings + firm contributions) paid by the firm and a decrease in take-home pay net of health insurance (earnings - worker contributions) received by the worker. The former case creates incentives for firms to lay off workers while the latter creates incentives for workers to leave. Thus, in theory, increases in health insurance costs should reduce firms' demand for labor. The answer becomes less clear when one considers labor market frictions. For instance, firms may be able to pass most of the cost increases onto workers if their labor supply is sufficiently inelastic, if workers can avoid paying higher premiums by obtaining comparable coverage elsewhere (e.g., through spouses or private

[1] See, KFF Employer Health Benefits Survey, 2021 https://www.kff.org/report-section/ehbs-2021-summary-of-findings/.

[2] A number of papers document a weakening demand for low- and middle-skill workers in the U.S. See, e.g., Acemoglu and Autor (2011), Karabarbounis and Neiman (2014), Autor (2014), Autor et al. (2020), and Kehrig and Vincent (2021).

plans), or if workers are inattentive to changes in their contribution to the benefit. Even without cost passthrough, labor adjustment costs might prevent firms from responding sufficiently to transitory cost increases. It is thus an empirical question whether and to what extent changes in health insurance costs affect firm employment.[3]

Moreover, the average employment effects may mask important heterogeneity across worker types, as there may be distributional implications of changes in health insurance costs. If employment does adjust 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 firms' costs or employees' net-of-insurance pay 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 test these hypotheses, 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. Specifically, we collect this information from Form 5500, which is a mandatory filing for firms with benefit plans covering more than 100 participants. We also gather insurer regulatory filings to extract data on the losses of firms' insurance providers. We find that, following a plausibly exogenous increase in health insurance premiums, firms reduce employment. The decline in retention is particularly large among low-income workers, whose likelihood of unemployment also increases more than high-income workers. In conjunction with these patterns, the nature of firms' non-labor input usage changes. Specifically, we document an increase in investments in information technology following the shock, consistent with firms substituting labor with technology.

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, but costlier health insurance

[3]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 reduced the number of workers covered by health insurance, but not the total number of employees.

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 health insurance premiums that are plausibly exogenous to firm-level conditions. Specifically, we use idiosyncratic variation in insurers' losses as an instrumental variable for premiums faced by their customers, i.e., employers.

We expect insurer losses to affect the premiums they charge for several reasons. First, existing evidence suggests that negative financial shocks often create incentives for firms to prioritize immediate cash flows over more distant ones.[4] Second, ACA guidelines specifically cap insurers' profits in three consecutive years and therefore tie potential premium increases to recent losses. Higher recent losses provide room for insurers to raise prices under these guidelines. Third, past losses affect insurers' beliefs about future claims. We elaborate on these mechanisms in Section 2. Regardless of the 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 its customers' labor and technology investment policies. This is our key exclusion restriction.

Using a two-stage-least-squares (2SLS) design, we study the effect of idiosyncratic shocks to firms' health insurance costs on subsequent firm and worker 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 higher insurer markups (proxied by the ratio of premiums to claims). This is consistent with loss-driven premium changes reflecting insurers' objectives rather than omitted employer 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 in firm-level employment. The employment

[4] See, e.g., Chevalier (1995), Chevalier and Scharfstein (1996), Gilchrist et al. (2017), Khanna and Tice (2005), and Campello (2003). For insurance markets, see, e.g., Froot and O'Connell (1999), and Koijen and Yogo (2022), Ge (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.

changes are primarily driven by a reduction in the retention rate of existing workers rather than a decline in the number of new hires. 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 effects, 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 potentially confounding firm 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 employer's location. Our results remain robust to the alternative instrument design.

We also test the hypothesis that an increase in health insurance premiums should affect lower-income workers more than their more highly remunerated coworkers. 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 employers' conditions or confounding dynamics related to industry and location. 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 1% increase in health insurance premiums leads to a larger increase in job separation likelihood by 0.1 percentage points for low-income workers compared to workers whose past earnings are one standard deviation higher.

Since we do not observe reasons for separation, it is possible that our results are driven by larger increases in the probability of low-income workers voluntarily quitting for more desirable jobs elsewhere. To shed light on this issue, we examine the probability that a worker becomes unemployed following an increase in employer-sponsored health insurance premiums. We find that, following a 1% increase in premiums, low-income workers' probability of being unemployed increases by 0.05 percentage points more than high-income workers whose average past earnings are a one-standard-deviation higher. Therefore, our individual-level results on retention are unlikely driven by low-income workers quitting for more desirable jobs. In addition, we find that low-income workers also see a larger increase in the probability of being part-time. This is consistent with the idea that firms make some low-income workers ineligible for health insurance by converting them to part-time status, since firms are not required to provide health insurance to part-time workers.

A natural question is whether firms pass the increase in health insurance costs to workers. We find that the average participation rate (the number of plan participants as a ratio to the number of employees) drops significantly with our instrumented premiums. This could be a result of increased employee contributions to health plans.[5] Another natural question is how workers' earnings change following an increase in health insurance premiums. Unfortunately, we are unable to fully answer this question since we only observe workers' net earnings, which equal gross earnings minus workers' health insurance and retirement plan contributions if they participate.

Taking stock, the results summarized so far are consistent with the hypothesis that rising health insurance premiums increase labor costs, especially for low-income workers. As a result, employment sharply declines at firms facing positive premium shocks. Our findings 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

[5] It is worthwhile to discuss other reasons for the declining participation rates. First, firms can make some workers ineligible by converting them to part-time workers. This channel is unlikely to drive our findings as we find that the part-time worker ratio at the firm-year level does not change with health insurance premiums. Second, firms can stop offering health insurance to spouses. Third, firms can stop offering health insurance to some workers. While plausible, this channel is unlikely to explain the magnitude of our findings as ACA mandates that firms with at least 50 full-time employees offer health insurance plans to at least 95% of those workers.

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-income workers seem "worse off" as they are more likely to fall into unemployment.

From the firm's perspective, lower worker plan participation likely brings long-run consequences. The fact that, even absent formal mandates, firms contribute to workers' health insurance implies that they place some value on worker plan participation.[6] When workers stop participating following a rise in premiums, they may be less productive (partly because they are more likely to leave, causing the firm to incur the cost of replacing them in the future).[7] Therefore, the marginal benefit of each worker for the firm declines, moving the firm's demand curve to the left. We thus cannot directly infer a labor demand elasticity from our estimates, 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, 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. Second, firms that have to compete in a tight labor market should be less able to pass the increased premiums to workers without losing workers to other employers. Consistent with this hypothesis, we find that firm-level employment responds more to changes in insurance premiums primarily in counties with lower unemployment rates. Third, firms with better future investment opportunities should be less responsive to a temporary increase in

[6]Note that both employers' and employees' contributions to health insurance are income- and payroll-tax deductible when employers offer Section 125 plans so there are no tax savings through employers' contributions. Section 125 plans are likely prevalent among the firms in our sample (with more than 100 plan participants), given that 92% of firms with 200 or more employees signed up for such plans as of 2012. See https://www.kff.org/report-section/tax-subsidies-for-private-health-insurance-i-federal-and-state-tax-exclusions-for-esi/.

[7]Findings by Madrian (1994), Buchmueller and Valletta (1999), Garthwaite et al. (2014) and Ouimet and Tate (2022) suggest that employer-sponsored health insurance induces stronger attachment of workers to their jobs.

labor costs as their employment level is more likely to be below its desired level. 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 main findings and shed light on the trade-offs faced by employers. Finally, we find 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 costs.

We conclude by bringing additional data to test whether firms invest in automation technology in response to health insurance costs, potentially to replace low-income workers. To do so, we leverage 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 health insurance premiums is associated with around a 1–2% increase in the IT spending per person in a firm. We find a similar estimate for the personal computer 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 on firms and workers. 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 sources 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) find that part-time employment increases.[8] Our paper is particularly related to Tong (2021), who finds that increased healthcare costs reduce 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 and, importantly, document heterogeneous impacts of different workers within the firm.

To the best of our knowledge, all of the prior papers in this literature use aggregate shocks that often can confound with other macro or regional shocks, as well as affect many employers and employees' outside options for obtaining health insurance. For example, the Affordable Care Act affects a large number of employers in complex ways and also affects individuals' ability to obtain health insurance independent of employers. Our paper distinguishes itself by using 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 paper is related to contemporaneous work Ouimet and Tate (2022), who analyze all non-wage benefits, including health plans, leave, and retirement. The two studies not only examine different types of non-wage benefits, but also focus on different variations in benefits and document different worker-level outcomes. Consistent with our results, Ouimet and Tate (2022) find that higher benefits instrumented by peer firms' benefits lead to lower reliance on low-wage workers. We focus on idiosyncratic premium shocks arising from insurance providers and document the labor market impacts of increases in health insurance costs on low-income workers, who experience a greater increase in job separation and unemployment rates. The two studies complement each other and jointly advance the understanding of firms' responses to non-wage labor costs.

We are also related to Finkelstein et al. (2023), who calibrate a theoretical model about how the employer-sponsored health insurance regime contributes to higher equilibrium

[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 arguments in Dey and Flinn (2005)).

wages earned by high-skilled workers. We empirically examine how the premiums of employer-sponsored health plan premiums on the employment outcomes of workers across the skill spectrum.

Second, 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, Bena et al. 2022).

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 less explored, yet important part of labor input cost, namely health insurance premiums. Our study highlights its heterogeneous effect on workers across income levels, potentially shedding light on another source of deteriorating labor demand for low-wage workers. 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 estimate the causal effects of health insurance premiums on employer and employee outcomes by instrumenting premiums with 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 firms and workers.

There are several reasons why larger losses can lead insurers to charge higher premiums for employer customers.[9] First, past losses generate greater pressure for firms to increase

[9] Note that health insurers do not face regulatory restrictions in their pricing in the large group market,

short-term profits, even if such actions can hurt long-term profits due to various reasons such as a gradually shrinking customer base. The reason is that losses can tighten financial constraints, making liquidity especially valuable for insurers' current operations. If the elasticity of short-term demand for insurance to premiums is low, increasing premiums can increase liquidity in the short term. 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 short-run 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 in every three consecutive years in a state-market or rebate customers. In other words, insurers' pricing is capped at a level in proportion to recent losses. Some insurers may be constrained by this restriction due to low claim payouts in the past two years and cannot reach their optimal pricing. Higher recent losses can thus allow these insurers to raise 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, for an employer's insurer, losses affect expectations regarding the future costs of the *entire* operating portfolio, comprised of the insurer's many customers in many different locations and industries.

The validity of our instrument relies on it satisfying 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

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) argues, for long-term products, such as those sold by life insurance companies, whether selling the product increases or decreases insurers' short-term liquidity and capital also matters for how firms change product prices.

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 insurers' losses could reflect macroeconomic 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, insurance premiums increase for a firm even if its insurer experience higher losses from states outside of the firm's employment locations. 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 without losing a large number of customers. 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. 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, changing insurance plans is costly for employees, as they may lose valuable relationships with existing healthcare providers due to changes in coverage networks. They also have to spend time learning the often complex 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 discuss in Section 5.2, we find that firms do not become more likely to switch insurers after their insurers suffer larger losses.

Moreover, we note that the switching argument is likely to lead to a weak first-stage result. We instrument for current premiums using losses incurred by the firm's prior (rather than current) insurer. Suppose firms are able to switch to other insurers to avoid increasing premiums due to prior insurers' losses. This type of switching should 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 employer, including its name, employer identification number (EIN), location, and phone number. More importantly, the data include the total premium paid, the number of participants, and the insurer for each plan-year observation. 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 observation. 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 more to health 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 the Centers for Medicare & Medicaid Services (CMS). Under the Affordable Care Act, health insurers need to report the 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 with "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

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

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 to 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 insurers' National Association of Insurance Commissioners (NAIC) group codes reported in the CMS data. Specifically, we sum up the aforementioned numerators (denominators) across all individual divisions within a conglomerate. The aggregation at the conglomerate level is motivated by two reasons. First, with the active internal capital market within insurer groups (see Ge 2022, Niehaus 2018, and Oh et al. 2022), 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:

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

[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.

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 health insurance premiums. The key variable of interest is *Log(Employees)*, the log of the total 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 for 52 weeks, 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. We link the employers of taxpayers in the W2 data to their insurance plan information from F5500 based on the 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 in the total number of workers, as well as the growth rate in the number of plan participants, and exclude firms where the two differ by over 30 percentage points. We also present robustness tests where we

[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.

aggregate employment, premiums, and the instrument across all the EIN at the parent company level, where we match EINs to the 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 also based on W2 data. In this sample, we examine the differential impact of insurance premiums on high- and low-skill workers. Our main measure of worker skill is their average earnings in the past five years, excluding the years when they do not have earnings. 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 two scores describing the extent to which it requires manual and routine work, respectively. One in 40 workers is sampled every year and a worker is usually sampled at most once. We assume a worker's manual and routine scores do not change throughout the sample period.

We define three 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 and do not file any 1099 with the IRS (which are filed by contractors and ad hoc service workers). *Part-time* is an indicator that turns one if a worker works less than 30 hours in the ACS data. We choose the threshold of 30 hours because ACA mandates firms to offer health insurance to 95% of their full-time workers, defined as those working at least 30 hours a week if the firm has at least 50 full-time employees.

### 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 the insurer loss ratio are both 0.89. On average, firms in our sample employ 270 workers. Health insurance premiums are on average $6,763 per individual participant. In the individual-level panel, workers have an average likelihood of 81% of continuing working for the same employer as the previous year 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 premiums 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 bounded below at 0.85 due to the aforementioned ACA rule that insurers must spend 85% of the premiums on medical claims or rebate customers.

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, and $Premium_{i,t}$ stands for the log of premium per participant paid by firm $i$ during year $t$. Note that a firm's premiums in year $t$ is almost always determined before the start of year $t$. $Insurer\ Loss_{i,t}$ 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.

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- and low-wage 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:

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

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

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 of the workers' occupations. To ease the interpretation, we standardize these three variables so that they have a mean of zero and a standard deviation of one. $Y_{i,j,t}$ includes individual employment outcomes as defined in Section 3.3: (1) *Retained*, the dummy variable for whether person $j$ remains employed in firm $i$ during year $t$ or $t+1$; (2) *Unemployed*, the indicator for whether person $j$ becomes unemployed; (3) *Part-time*, the indicator for whether the worker is likely working as a part-time employee. 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 $\theta$, which reflects the differential effect of health insurance costs on workers across skill levels.

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

# 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 1.5% 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 number of employees in a firm (*Log(Employees)*$_t$). The fixed effect specifications in columns (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. Combined with the estimates from the first stage, a one-standard-deviation increase in insurer losses is associated with a 0.4% decline in firm employment.

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 mechanisms in columns (5) and (6), respectively. Results suggest that higher health insurance premiums are associated with a 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 statistically significant link between predicted changes in health insurance premiums and the number of new hires.

## 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 level 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.

<u>TABLE 3 ABOUT HERE</u>

Another concern regarding our result is that, when the employer is large and accounts for a meaningful fraction of the insurer's revenue, some unobservables about the employer can drive both the insurer's losses and its employment outcome. 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.[15] Column (4) shows that our results persist in this restricted

[15]Insurers' total premium revenue comes from CMS.

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 firm employment.

Could our results be driven by declines in worker health? Firms with declining worker health may struggle to keep their workers or are more likely to lay off workers. These firms may also face increasing health insurance premiums because insurers witnessed past losses related to these firms and anticipate a deterioration of worker health in the future.

We directly evaluate this argument by testing the correlation between future claims per person at the employer-year level and insurer losses. Note that only a subset of employer-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 per person. If anything, there is a weak, negative association. Results in column (2) indicate that insurer losses positively predict future markup, measured by the premium-to-claims ratio at the employer-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 charge lower premiums. In Section 2.2, we discuss the frictions in this market that can lead to insurers having substantial pricing power. These frictions partially alleviate the switching concern. Here, we explicitly examine the likelihood of a firm switching insurers when its insurer experiences larger losses.[16] We construct an

[16]We only consider the largest insurer in terms of the employer's premium when there are multiple insurers.

indicator *1(Switch Insurer)*$_{t-1 \text{ to } t+1}$, which equals one if an employer changes their insurer between year $t-1$ and $t+1$, 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 experience larger losses. This supports the idea that insurers have substantial market power and employers do not simply switch insurers to insulate themselves from the increase in premiums following their insurers' losses.

### 5.3 Heterogeneous Effects Across Firms

In this section, 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.

TABLE 5 ABOUT HERE

First, we examine the relevance of health insurance premiums as a portion of total labor costs for employers. If a larger fraction of labor compensation paid by a firm is attributed to health insurance premiums, shocks to premiums will generate more substantial changes to labor costs. We thus compute ratios of total premiums to total wages 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-wage ratios, with a coefficient (-0.34). Effects for firms with low premium-to-wage ratios are much smaller in magnitude (-0.07) and not statistically significant.

Next, we consider the role of labor market tightness, which we measure using the unemployment rate at the county level. Firms that have to compete in a tight labor market should be less able to pass the increased premiums to workers without losing workers to other employers. Therefore, we expect that in tighter labor markets, premium increases should generate a greater effect on firm employment. To test our conjecture, we split the sample by county-level unemployment rates in year $t-1$ at the median, and report the result in each subsample in columns (3) and (4), respectively. Consistent with our hypothesis, we find that firm-level employment only changes following an instrumented increase in premiums in areas with lower unemployment rates, i.e., a tighter labor market. In counties 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 investment opportunities likely have an employment level that is further below the optimal level. Consequently, they should be less responsive to an increase in labor costs. We measure investment options with industry-level $Q$ (the ratio of the market over book value of assets for firms in an industry) in year $t-1$ using data from public firms, and assign industry-specific $Q$'s to all firms in our sample, both public and private. Columns (5) and (6) present results from high-$Q$ and low-$Q$ industries, also defined based on the 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.

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 A4, our analysis suggests that the employment-premium relation does not vary with firm size. Given that larger firms are less likely to be financially constrained, this result suggests 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 costs.

# 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 levels. 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 coefficients on the interaction between insurance premiums and worker income. Worker income is measured by past 5-year average earnings (*Worker Past Earnings*). We hypothesize that low-wage workers are more likely to be separated from firms for two reasons. First, the same increase in premiums will raise the relative cost of employing low-income workers by more than high-income workers. Second, low-income, low-skill workers are more readily substituted by machines and automation as labor costs increase.

Columns (1) through (3) report the results for worker retention rates. Results from column (1) suggest that, when employers face higher health insurance premiums, low-income workers face a larger drop in retention rate, and thus a larger increase in separation rate than high-wage workers. Recall that the variable, *Worker Past Earnings*, has already been standardized. A one-standard-deviation difference in worker skill (1) is associated with an around 0.1 difference in the effect of *Log(Premium per Person)*, which is around 36% of the main effect on retention (reported in column (5), Panel B of Table 2). To interpret it directly, a 1% increase in premiums leads to a 0.1 percentage points difference in the retention rates of high- and low-wage workers with their past earnings being one standard deviation apart.

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)*× *Worker Past Earnings* are similar between columns (2) and (3). This is consistent with our argument that health insurance imposes a fixed cost on eligible workers, which makes up a larger share of firms' costs of hiring low-wage 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 premiums 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-wage, manual workers.

## 6.2 Worker Unemployment

The previous subsection describes the results that low-wage workers are more likely to separate from firms than high-wage workers. One natural question is whether low-wage workers quickly land other jobs, which will offset any negative effect of increased health insurance costs on these workers. 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 files a Form 1099.[17]

Table 7 presents the results from this analysis. The specifications strictly follow the ones in Table 6. Results in columns (1) through (3) indicate that after a rise in health insurance premiums, low-skill, low-income workers are more likely to become unemployed. Based on column (3), a 1% increase in premiums leads to 0.03 percentage-point larger

[17] We do not observe the details including earnings reported on Form 1099.

increase in the unemployment likelihood for low-wage workers compared to high-wage workers with past earnings being one standard deviation apart. Results in column (4) further show that this differential unemployment effect persists in the following year.

Table 7 About Here

Findings in Table 7 indicate that the earlier result that low-wage workers' retention rate decreases by more is unlikely explained by low-income workers' voluntarily changing jobs more compared to high-wage workers.

### 6.3 Worker Part-Time Status

When employers face higher health insurance premiums, they could respond by transitioning from relying on full-time workers to part-time ones, as firms are not required by law to provide health insurance for part-time workers (those who work under 30 hours per week). Again, we expect firms to have stronger incentives to turn low-income workers to part-time status than high-income ones.

We test this conjecture by regressing an indicator for whether an individual is a part-time worker on the interaction of health insurance premiums and worker past wages. Table 8 reports the results. We find that, as health insurance premiums go up, low-wage individuals experience a greater increase in the likelihood of becoming part-time workers compared to high-wage ones. Results in this section 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, two pieces of evidence are worth mentioning. 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, the average growth in wages (net of deductions including workers' health insurance contributions) for all incumbent workers remains unchanged. In addition, we discuss how 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 the discretion to decide the split between employer and employee contributions toward health insurance premiums.[18] In response to premium increases, firms can pass on part or all of such increases to workers in the form of higher employee contributions. Since employee take-up is voluntary, one would expect that such a policy would discourage plan participation.

<u>Table 9 About Here</u>

We investigate how worker participation in employer-sponsored health insurance plans changes 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 analyses again use our instrumental variable approach and include analogous specifications to the main employment specification (Panel B of Table 2), except that our outcome variable is the log number of plan participants rather than the number of employees. Across all specifications, we estimate that increases in premiums lead to substantial changes in the number of participants (with elasticities between -0.76 and -0.77), which are 2-3 times that of 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

[18]One exception is ACA's affordability mandate: workers' contributions need to be less than a percentage of their household income. The percentage varies over time and was 9.56% in 2018.

dependent variable in the second stage of our 2SLS approach.[19] Columns (4) through (6) report the results. Across all fixed effects specifications, we estimate large declines in the take-up 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 some of the workers that remain in the firm stop enrolling in health insurance plans, likely due to increases in employee contribution. With a lower take-up rate, workers potentially become less attached to the firm, which can be costly to the firm in the long run.

## 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. As we will discuss more in the next section, the fact that firms have discretion over the size of employee contributions implies that changes in health insurance costs could shift both labor supply and demand curves. As a result, we do not have a clear prediction on how wages should change. One more complication is that worker wages are measured in net of workers' own health insurance contributions and other benefits deductions. As health insurance take-up rate decreases, the average employee contribution to health insurance across all workers also decreases. This means that net-of-deduction wages should go up if gross wages stay the same. A third issue is that as we argued earlier, firms can shift full-time workers to part-time status differentially for high- versus low-wage workers, 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 wages in year $t$ as well as in $t+1$ to wages from $t-4$. This is because our instrument is constructed using data from $t-3$ to $t-1$, and could influence wage rates starting from $t-3$. We continue to

[19] The number of participants includes eligible dependents. Thus, we do not strictly measure the "take-up ratio". However, this caveat of our measurement will unlikely change the interpretation of our results.

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 suggest that the worker turnover result we documented is unlikely to be triggered by better outside employment opportunities.

<u>Table 10 About Here</u>

### 7.3 Discussion: Why Premium Changes Induce Both Labor Supply and Labor Demand Changes

Our main employment estimates in Section 5 suggest that a 1% 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 the reasons we discuss below, we advise against inferring a labor demand elasticity from our estimate, because rising health insurance costs likely induce both labor demand and labor supply responses.

The usual vertical axis for supply and demand curves presents wages. In our setting, the vertical axis should present wages plus firms' health insurance contributions. Assume that the health insurance take-up rate stays constant. When health insurance premiums increase, holding wages plus firm contributions fixed, workers will need to contribute more for their health insurance. Suppose premiums rise by $X. Holding the take-up rate and firm contribution fixed, workers have to contribute $X extra for their health insurance, reducing their take-home pay by$X. This shifts a firm's labor supply curve up by $X. This should allow us to estimate the slope of the labor demand curve.

However, as we show above, take-up rates do not stay constant, but insteadl decline with higher premiums. 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, lower take-up is costly to the firm in the long-run. The fact that typical employee contributions are substantially smaller than premiums implies that firms value worker take-up. For instance, workers may be more attached if they are enrolled in their employers' health plans. In other words, while costly in the short-run, providing insurance benefits helps firms retain valuable human capital and reduce expected additional costs in the future (e.g., search costs; consistent with Table A1).

Higher premiums make it more costlier 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 their 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 present 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 (per-employee 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. The predicted increase in insurance premiums in turn leads to a significant increase in firms' technology spending, both in terms of computer and total IT budget. In untabulated results, we also find that the total PC budget and IT budget increase following the instrumented shock.[20] The tech spending-to-insurance pre-

[20]Results are disclosed but not presented in this draft

mium elasticity is around 1–2, higher than the estimated employment-premium elasticity (around –0.3). This could be because firms can face severe labor market frictions when attempting to lay off workers (e.g., severance package), 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-wage workers. When facing an increase in premiums, firms cut employment, leading to a disproportionate separation of low-wage, routine workers. At the same time, firms speed up technology expenditure, acquiring assets that complement high-wage workers.

# 9 Conclusion

Employer-sponsored health 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, as well as technology investment decisions. To address endogeneity concerns, we design an instrument for insurance premiums using idiosyncratic variation in insurers' losses, that is plausibly exogenous to their customers, i.e., individual employers and their workers. Using Census microdata, we show that following an increase in increased premiums, firms reduce employment. Relative to higher-wage coworkers, lower-wage 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 employment. Regulations might consider the value of subsidizing the costs of providing health insurance to low-income workers.

Our paper also speaks to the persistent decline in the labor share and a weakening demand for low- and middle-skill workers in the U.S. (e.g., Acemoglu and Autor (2011), Karabarbounis and Neiman (2014), Autor (2014), Autor et al. (2020), Kehrig and Vincent (2021)). A growing body of research investigates various determinants of this structural shift, including technological progress, trade exposure, and offshoring pressure, which are forces that have made substitutes increasingly competitive (e.g., Allen (2001), David et al. (2013), Pierce and Schott (2016), Dorn et al. (2017), Acemoglu and Restrepo (2019), Acemoglu and Restrepo (2020)). Health insurance costs, which have been rising faster than inflation and wages, could be an alternative and complementary channel that exacerbates the decline in firms' labor demand for these workers. Although our paper documents the partial equilibrium effects of idiosyncratic shocks to health insurance costs, we highlight that such costs could be distortionary to firms' employment and worker composition.

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# Figures and Tables

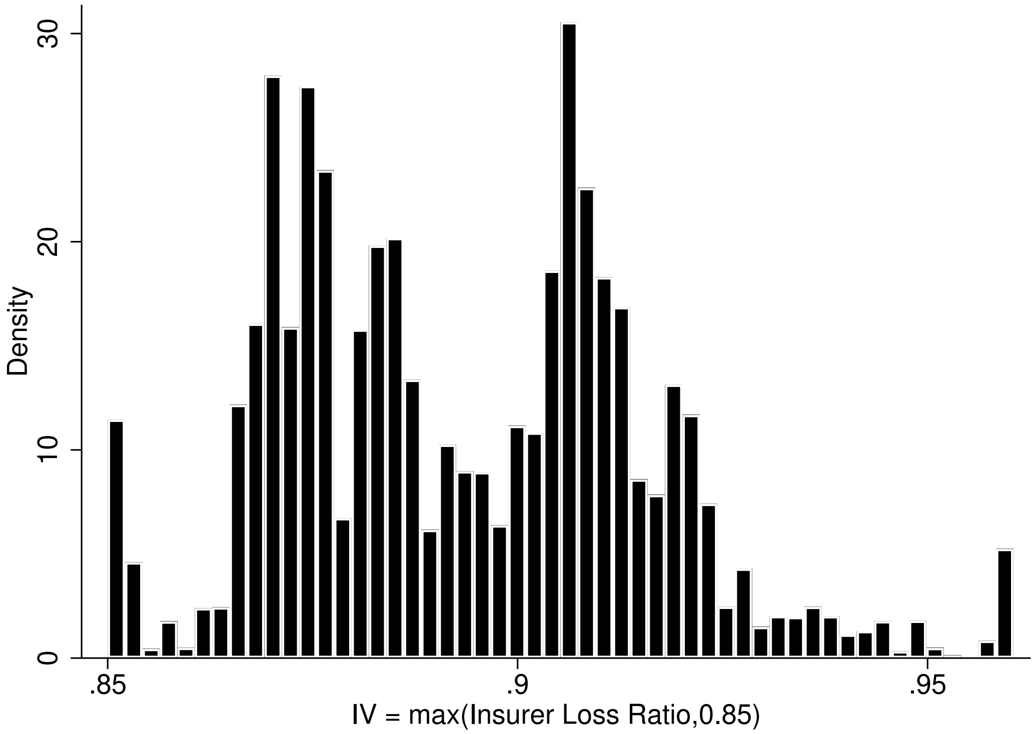
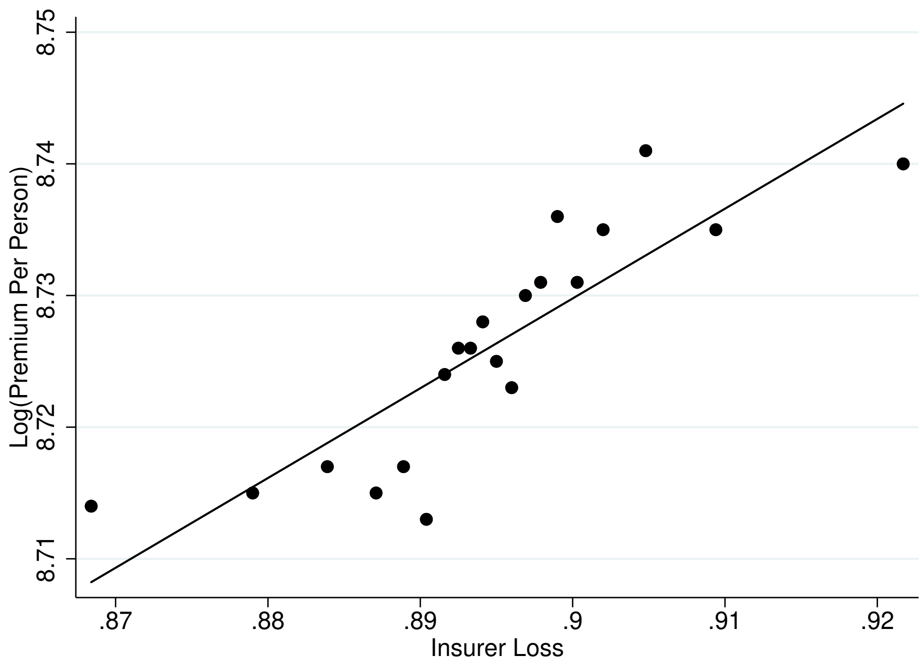



**Figure 1. Distribution of Instrumental Variable, Insurer Losses**

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**

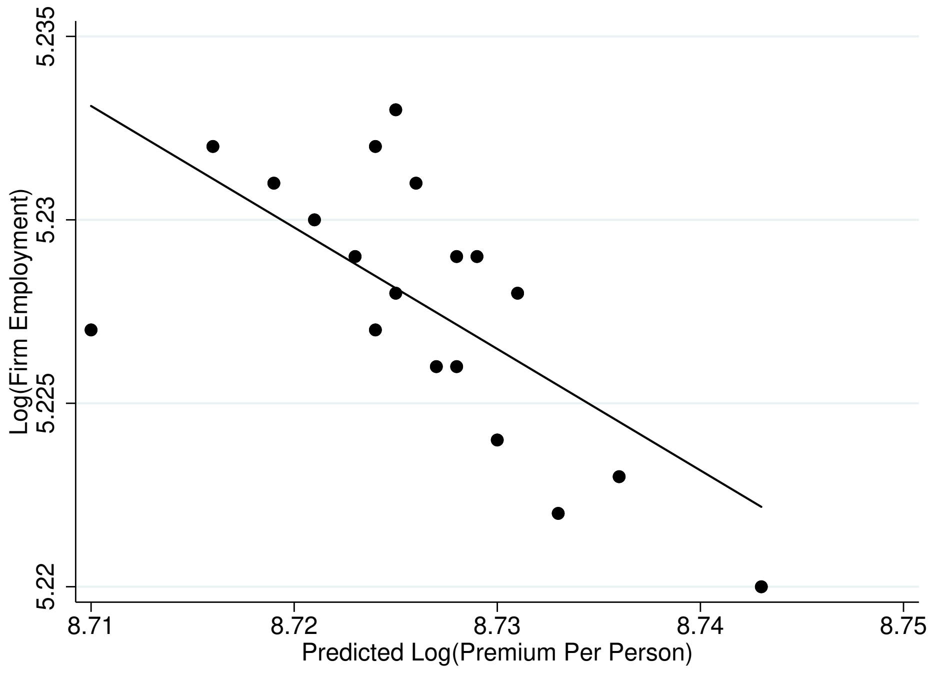



**Figure 2. Binscatter Representation of Instrumental Variable Estimation**

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-wage 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)*$_t\times$ *Worker Past Earnings* | 0.1123*** | 0.09836*** | 0.09329*** | 0.1259*** |
| | (5.46) | (5.37) | (4.01) | (4.15) |
| *Log(Premium per Person)*$_t\times$ *Worker Manual Score* | | | -0.04484** | -0.05837** |
| | | | (-2.12) | (-2.09) |
| *Log(Premium per Person)*$_t\times$ *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-wage 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-wage 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.

| Dep. Var.: | (1)<br>*Log(Employees)*$_{t+1}$ | (2)<br>*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.

| Dep. Var.: | (1) $Log(Employees)_{t-4}$ | (2) $Age_{t-4}$ | (3) $\#Children_{t-4}$ | (4) $Worker\ Gender_{t-4}$ | (5) $Worker\ Routine\ Score_{t-4}$ | (6) $Worker\ Manual\ Score_{t-4}$ |
|---|---|---|---|---|---|---|
| $Log(Premium\ per\ Person)_t$ | -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 |