Adaptation to Climate-induced Regulatory Risk: A Labor Perspective*

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Abstract

We investigate the impact of climate-induced labor regulations on technology adoption and employment at the plant level, focusing on the Heat Illness Prevention Standard (HIPS) implemented in California and Washington. This standard, designed to protect outdoor workers from heat-related risks, varies in impact across occupations and industries. Employing a difference-in-differences approach, we find that following the implementation of HIPS, plants in these states with greater labor exposure significantly increase their information technology (IT) intensity compared to those with lesser labor exposure and those in states without HIPS. This increase in IT capital is accompanied by a reduction in employment levels. These strategic responses mitigate regulatory pressures and enhance labor productivity, eliciting a positive reaction from investors when the automation level is sufficiently high.

Keywords: Climate Change; Extreme Heat; Heat Illness Prevention Standard (HIPS); Adaptation; Information Technology (IT); Employment.
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"I am mobilizing an all-of-government effort to protect workers...from extreme heat. The Department of Labor, the Department of Health and Human Services, the Environmental Protection Agency, and other agencies will work together to help ensure that the American people have safe and healthy working conditions, provide cooling assistance to homes and neighborhoods, and coordinate with state and local officials to bolster their resilience and address the impacts of this threat."

- Joe Biden, Sep 2021

1 Introduction

The global response to climate change is increasingly acknowledging its severe implications for human health, as highlighted by the 2023 United Nations Climate Change Conference (COP28) and its first "Health Day". This initiative signifies a global agreement on the importance of integrating climate resilience into public health systems to counter the health threat posed by increasing heat risks. This consensus is supported by extensive research (e.g., Luber and McGeehin, 2008; Mora et al., 2017; Park et al., 2021; Gibb et al., 2024), and has prompted regulatory interventions on labor safety. Despite growing research in climate finance, firms' adaptation strategies to climate-related regulations, particularly regarding the labor market, are understudied. Our paper aims to address this gap by examining how firms adapt to the United State's first heat-related labor regulation for outdoor workers, the Heat Illness Prevention Standard (HIPS), implemented in California in 2005 and in Washington in 2006.[1]

HIPS mandates essential safety measures for outdoor workers to mitigate heat-related risks. However, its implementation raises important questions about the economic and operational effects on affected firms. Specifically, the requirements to enhance protections for outdoor workers may increase labor costs, thereby reducing the efficiency of human capital as a production input. Furthermore, HIPS introduces litigation risks and the possibility of reputational damage for firms.[2] To better understand firms' strategic

[1]The *Asunción Valdivia Heat Illness and Fatality Prevention Act (2021)* highlights federal efforts to establish heat safety standards. Yet, as of May 2024, no federal standard has been finalized. For institutional backgrounds and perspectives from various regulators, see Section 2 and Online Appendix Section B.

[2]California has been rigorously enforcing HIPS since its implementation, as evident by 45,889 heat-related inspections and 20,947 violations cited between 2005 and 2019, which impose significant operating costs and legal liabilities on firms. Non-compliance with HIPS may result in severe repercussions such as crimi-

adjustments to these challenges, we investigate how firms in California and Washington utilize information technology (IT) to mitigate the labor costs and production inefficiencies induced by HIPS, aligning with broader trends towards automation and technology-enhanced production processes in the modern economy (e.g., Autor et al., 2003; Karabarbounis and Neiman, 2014; Acemoglu and Restrepo, 2019).

Employing a difference-in-differences research design, we analyze the interaction effects of HIPS implemented in California and Washington with varying degrees of plant-level labor exposure to heat on IT intensity from 2001 to 2007. Our analysis leverages detailed data from the Computer Intelligence Technology Database (CiTDB) database, which includes plant-level metrics such as IT capital, employment, location, industry classification, and the parent company, among others. We measure IT intensity as the number of computing devices (PCs and laptops) and servers per employee.

We define the interaction term between HIPS and labor exposure by first identifying each plant's geographic location to determine HIPS applicability and then quantifying each plant's labor exposure using industry and occupational-level data. Plants in California and Washington are required to comply with HIPS in 2005 and 2006, respectively. Following Xiao (2021), labor exposure is measured prior to the implementation of HIPS and is derived from the Occupational Employment and Wage Statistics (OEWS) and the Occupational Information Network (O*NET). The OEWS data provides the number of employees in each occupation within four-digit NAICS (NAICS4) industries, and O*NET's work context scores, which range from 1 to 5, indicate the required intensity of outdoor activities for each occupation. We calculate a weighted average of outdoor intensity for all occupations within a NAICS4 industry, using weights that correspond to the proportion of employees in each occupation within that industry. This composite index of labor exposure helps us assess each plant's specific exposure to HIPS based on its industry classification.

nal charges, imprisonment, financial penalties, barring managers and safety supervisors from the industry, and damage to firm reputation. We discuss these aspects in detail in Section 2 and Online Appendix Section B.

We find that following the implementation of HIPS, plants in California and Washington with greater labor exposure to HIPS significantly increase their IT intensity compared to those with lesser labor exposure and those outside these states where HIPS were not implemented. This finding remains robust after the inclusion of county-by-year and county-by-industry (NAICS2) fixed effects, which control for time-varying differences across counties and the importance of a NAICS2 industry in a county. Our results are further supported by within-firm, and within-firm and within-state analyses, accounting for heterogeneities across firms and firm-state pairs. The economic magnitude of our findings is substantial as well. The implementation of HIPS leads to a 2.9% greater increase in IT intensity for plants in California and Washington with a one-standard deviation increase labor exposure.

Our identification strategy posits that pre-HIPS changes in IT intensity are independent of industry-level and geographic exposure to the regulation, after accounting for time-varying differences across plants, industries, states, and counties. To examine this parallel trends assumption behind our difference-in-differences approach, we examine dynamic changes in IT intensity around the implementation of HIPS. We find that differences in IT intensity across plants with varying labor exposures and in different locations are insignificant from zero in the pre-HIPS period. However, more treated plants immediately adjust toward higher IT intensity relative to their less treated counterparts following the implementation of HIPS. This evidence supports the parallel trends assumption and ensures the reliability of our empirical design.

Furthermore, we examine changes in plant-level IT capital and employment separately to determine what drives the increase in IT intensity. Our analysis reveals that this increase stems from both an increase in IT capital and a decrease in employment levels. Specifically, a one-standard deviation increase in labor exposure to HIPS leads to a 2.6% increase in computers and a 1.3% reduction in employment among treated plants. This finding indicates that treated plants use IT capital as a substitute for labor to mitigate rising labor costs induced by HIPS. Additionally, we verify the plant-level results using firm-level data on capital and employment from the Compustat/CRSP Merged database.

We observe a significant increase in capital intensity (i.e., property, plant, and equipment (PPENT) per employee) among treated firms following the implementation, characterized by an increase in PPENT and a decrease in employment.

Next, we explore cross-sectional heterogeneities in changes in IT intensity around the implementation of HIPS. First, we find that the effects are weaker in industries employing higher proportions of skilled workers, consistent with existing literature documenting that low-skilled tasks are more susceptible to automation (e.g., Graetz and Michaels, 2018). Furthermore, prior studies show that labor unions strengthen workers' bargaining power and frequently intervene in firms' employment and wage decisions (e.g., Lewis, 1986; Chen et al., 2011). As a result, labor unions may monitor firms' compliance with HIPS or compel firms to adopt measures exceeding HIPS requirements to protect workers from heat risks, leading to further increases in labor costs. This is evidenced by our results showing more pronounced effects in industries with higher unionization rates. Last, we examine the role of pre-HIPS IT utilization, finding that plants with substantial pre-HIPS IT investments demonstrate a lower capacity for further IT capital enhancements post-HIPS, compared to their counterparts with lower initial IT investments.

In the last step of our analysis, we explore the implications of mitigating HIPS-induced labor costs through automation for labor productivity and firm value. Our investigation indicates that the strategic shift towards capital-intensive production processes enhances labor productivity. Market investors acknowledge this strategic shift, particularly when firms' automation efforts are significantly high. Together, these findings affirm the critical interplay between regulatory compliance, technological advancement, and economic decision-making in the face of climate change.

In addition to our primary analysis, we conduct extensive robustness checks to validate our findings. These include testing the effects of HIPS and labor exposure on plant-level IT intensity under various sample constructions and model specifications (e.g., Poisson regression). We ensure our results are not only statistically significant but also robust across multiple conditions.

Our study makes several contributions to the literature. First, it enriches the rapidly expanding field of climate finance (e.g., Bernstein et al., 2019; Addoum et al., 2020; Hong et al., 2020; Giglio et al., 2021; Stroebel and Wurgler, 2021; Addoum et al., 2023; Pankratz et al., 2023; Pankratz and Schiller, 2023), particularly the discussions on regulatory risks associated with climate change (e.g., Ilhan et al., 2021; Seltzer et al., 2022; Bartram et al., 2022; Bolton and Kacperczyk, 2023; Ivanov et al., 2024). While existing research primarily focuses on carbon-related regulations, our work uniquely examines climate-induced regulations on extreme heat and workplace safety. Specifically, we investigate the implementation of HIPS in California and Washington that safeguards outdoor workers from climate-induced heat risks, which has been effective in reducing workplace injuries (Park et al., 2021). Our paper extends the discussion by investigating the effects of climate regulations on human capital management at the plant and firm levels, revealing that firms respond to HIPS by increasing their investment in IT to mitigate rising labor costs.

Second, our paper contributes to the literature that investigates the adaptation and mitigation strategies employed by various economic agents to address climate challenges, as highlighted in studies such as Fankhauser (2017), Dillender (2021), and Lai et al. (2023), which offer critical insights for businesses adapting to an era of increasing temperatures. More relatedly, Pankratz and Schiller (2023) show that customers terminate existing supplier relationships when suppliers experience heat shocks. Somanathan et al. (2021) finds that onsite climate controls, such as air conditioning, can alleviate heat-induced productivity losses in India. Two contemporaneous works by Xiao (2021) and Xiao (2023) examine automation as an adaptation strategy to mitigate the physical risks of extreme heat, i.e., the direct damages of extreme heat to labor and corporate performance. Our research distinguishes itself by closely examining regulatory responses to extreme heat and the impact on the efficiency of human capital as a production input. Moreover, we specifically analyze plant-level technology investments in automation, contrasting with the broader discussions of firm-level capital-labor substitution or general disclosures of automation-related news in their studies. Our analysis reveals that U.S businesses adapt to climate-induced labor regulations by substituting IT for labor to address challenges to their human capital and improve production efficiencies.

Third, this research enhances our understanding of the micro-foundations of production functions, emphasizing the increasing importance of technology in driving automation and shaping the modern capital-intensive economy (e.g., Brozen, 1957; Jones, 2005; Acemoglu and Restrepo, 2019). Our findings corroborate the notion that technological substitution is partly a response to elevated labor costs, which are in turn a consequence of enhanced climate risks and the ensuing regulatory mandates. This insight sheds light on the dynamic relationship between technological advancement and labor economics in the context of climate change and adaptation strategies.

Overall, our study not only provides empirical evidence to theoretical frameworks within these literature but also highlights the practical implications for policymakers and businesses confronting the multifaceted challenges of climate change, technological transformation, and job creation.

The remainder of this paper is structured as follows: Section 2 provides the institutional background; Section 3 details the data, measures, and sample for empirical analysis; Section 4 discusses the main results and conducts some robustness checks; Section 5 explores the implications for labor productivity and firm value; and Section 6 concludes.

2 Institutional Background

This section delineates the regulatory landscape governing heat illness prevention in the workplace, starting with the history of the Occupational Safety and Health Administration (OSHA), its approach to heat-related hazards, and the evolution of federal and state-level regulations, with a focus on California's Heat Illness Prevention Standards and their enforcement.[3]

[3] We also present views from various regulators on heat-related issues in Online Appendix Section B, including the House and Senate, the Biden Administration, the Environmental Protection Agency, the Department of Labor, and the National Institute for Occupational Safety and Health.

2.1 The Occupational Safety and Health Administration

The Occupational Safety and Health Administration, established under the Occupational Safety and Health Act of 1970 by the U.S. Department of Labor, is mandated to ensure safe and healthy working conditions. Despite its comprehensive safety standards, OSHA lacks a specific mandate for heat illness prevention, a gap underscored by the National Institute for Occupational Safety and Health (NIOSH)'s recommendations since 1972.[4] In the absence of specific standards for heat risks, OSHA can cite the General Duty Clause of the Occupational Safety and Health Act (OSH Act) when dealing with heat-related incidents in the workplace.[5] However, its enforcement is primarily reactive, offering remedies only after incidents of illness or death have already occurred. This enforcement process is lengthy, frequently dependent on the availability of critical documents such as death certificates, autopsy reports, and additional evidence. Additionally, the Occupational Safety and Health Review Commission (OSHRC) imposes stringent criteria for applying the General Duty Clause to heat-related cases, as evidenced in *Secretary of Labor v. A.H. Sturgill Roofing, Inc.*[6] The ruling of this case sets a precedent and significantly limits OSHA's ability to penalize employers for insufficient protections against heat

[4]NIOSH has been recommending OSHA to establish heat stress exposure standards since 1972, but OSHA didn't act on these recommendations. Despite subsequent updates and further suggestions from NIOSH, OSHA has remained unresponsive. Examples of these recommendations are: "Criteria for a recommended standard: Occupational exposure to hot environments, 1972," "Criteria for a Recommended Standard: Occupational Exposure to Hot Environments (Revised Criteria 1986)," and "Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments, 2016." Meanwhile, various public interest groups have made significant efforts to urge OSHA to implement a standard for heat-related workplace safety, yet all have been unsuccessful. Notable is the petition led by Public Citizen available at https://bit.ly/2KGG1WG. OSHA's response is available at http://bit.ly/2KFB8wZ.

[5]See "OSH Act of 1970".

[6]A.H. Sturgill Roofing, Inc., a Dayton, Ohio-based commercial roofing company, faced an OSHA inspection and citation after an employee collapsed and died from heat exposure while working on a roof. The citation included two serious violations: first, for exposing employees to excessive heat under the General Duty Clause of the Occupational Safety and Health Act (29 U.S.C. § 654(a)(1)), and second, for failing to train employees on recognizing and avoiding heat-related illness risks (29 C.F.R. § 1926.21(b)(2)). However, OSHRC overturned both citations (for more details, see OSHRC Docket No. 13-0224). OSHRC reversed OSHA's verdicts against Sturgill Roofing, ruling that OSHA failed to establish the existence of heat hazards or feasible means of abatement. OSHRC further criticized OSHA's use of the General Duty Clause in this case. The Commission wrote: *"While practical considerations may have led OSHA, over the years, to rely on the general duty clause in lieu of setting standards, the provision seems to have increasingly become more of a "gotcha" and "catch all" for the agency to utilize, which as a practical matter often leaves employers confused as to what is required of them."*

risks in the workplace. Consequently, the application of the General Duty Clause to heat-related cases is severely limited, nearly non-existent. Furthermore, an internal OSHA study concludes that the General Duty Clause fails to effectively incentivize employers to implement preventive measures against heat-related illness (Arbury et al., 2016).

2.2 Federal Regulations on Heat Illness Prevention

Amidst a growing public health crisis exacerbated by extreme heat, the *Asunción Valdivia Heat Illness and Fatality Prevention Act* was introduced in 2021, compelling OSHA to develop heat-specific safety standards.[7] This legislative push, coupled with the Biden Administration's initiatives following record-setting temperatures in 2021,[8] signaled a proactive shift towards establishing concrete federal regulations for heat illness prevention. However, the rulemaking process, initiated by OSHA's publication of an Advance Notice of Proposed Rulemaking (ANPRM) for Heat Injury and Illness Prevention, is intricate and lengthy, reflecting the challenges of translating broad health concerns into actionable workplace standards.[9] As a result, as of May 2024, no federal-level heat illness prevention standards have been established in the U.S.

2.3 State Regulations on Heat Illness Prevention

In the absence of federal standards, states like California, Minnesota, Oregon, and Washington have led the way in establishing heat illness prevention regulations. For instance, Minnesota enacted a heat illness standard in 1997 that exclusively governs indoor workplaces. California was the first to set a standard for outdoor workers through emergency

[7]See "S.1068 - Asuncion Valdivia Heat Illness and Fatality Prevention Act of 2021" and H.R.2193 - Asunción Valdivia Heat Illness and Fatality Prevention Act of 2022. This bill is named after Asunción Valdivia, a farmworker who succumbed to heatstroke in 2004 after working 10 hours in temperatures reaching 105°F.

[8]See "FACT SHEET: Biden Administration Mobilizes to Protect Workers and Communities from Extreme Heat" and "Statement by President Joe Biden on Mobilizing the Administration to Address Extreme Heat."

[9]The rule-making process also involves a legal process that requires the agency to establish that there is significant risk, a standard that is difficult to meet. Marc Freedman, a vice president at the U.S. Chamber of Commerce, said that "*It's very difficult to regulate something like heat exposure...We can all say there's a hazard there, but reducing that to a question of a standard and when an employee is going to be in trouble and what that threshold of exposure is going to be for an employer to protect against is very vexing.*"

action in August 2005, becoming permanent in July 2006. Washington issued an emergency standard for outdoor workers in 2006 and 2007, solidifying it permanently in 2008. Oregon enacted rules for both indoor and outdoor workers in response to the 2021 summer emergencies, formalizing them in May 2022. Our paper focuses on the risks of heat exposure for outdoor workers due to climate change by analyzing California and Washington's heat standards.[10] These standards mandate accessible water and cooling, training for supervisors and workers, and comprehensive risk control and symptom response plans. California's heat standard, due to its pioneering role and impact, serves as the basis for our discussing of regulation, enforcement, and compliance in the next section.[11]

2.4 California Heat Illness Prevention Standard

2.4.1 Origins of California HIPS

California has been a leader in ensuring employee safety and health, particularly in recognizing heat hazards as significant risks for workers. This recognition led to the state's pioneering move to adopt the first standard for outdoor workplace heat risks in 2005, as outlined in the *California Code of Regulations Title 8, Section 3395*.

The campaign for a heat standard began in 1984 when the Los Angeles Librarians' Guild, joined by over twenty union locals and the Los Angeles Committee on Occupational Safety and Health, petitioned California OSHA (Cal/OSHA) for a statewide heat stress standard. This request emerged from incidents of librarians suffering from heat illnesses in inadequately insulated and cooled libraries. After years of inaction, Cal/OSHA revisited the heat standard issue in the late 1990s, establishing an Advisory Committee with diverse stakeholders to formulate a draft for public commentary. The proposed 2002 standard aimed to protect both indoor and outdoor workers from heat illness. Yet, the board did not advance the standard further.

[10]Indoor heat can arise from production processes like steel making and cooking. These risks are beyond the scope of our paper because they are endogenous to firms' production processes and are not caused by climate change.

[11]In Online Appendix Section C, we briefly describe differences between the California and the Washington standards. We also discuss the standards in Minnesota and Oregon.

In 2005, the United Farmworkers (UFW) union and the California Rural Legal Assistance Foundation championed Assembly Bill 805, advocating for a comprehensive heat illness prevention standard. Before the Senate's approval, a severe heat wave causing multiple worker fatalities prompted the state to enact an emergency temporary standard for outdoor workers, later made permanent in 2006.

Overall, this historical oscillation between action and inaction underscores the unpredictable and reactive nature of California's approach to heat illness prevention, culminating in the sudden adoption of HIPS in 2005. More importantly, the emergency use of HIPS represents a significant and plausibly exogenous policy shock impacting exposed California firms and plants.

2.4.2 Requirements of California HIPS

The California Code of Regulations outlines comprehensive requirements for employers to protect outdoor workers from heat exposure. We summarize some key points below.[12]

[1] **Provision of water**. Employers must ensure access to fresh, pure, and suitably cool drinking water at no cost to employees at all times.

[2] **Access to shade**. When the temperature exceeds 80°F, the employer shall maintain enough areas with shade at all times that are either open to the air or provided with ventilation or cooling. Timely access to shade should be available upon an employee's request when the temperature is below 80°F.

[3] **Cool-down rest**. Employees shall be allowed and encouraged to take preventative

[12]More details can be found in "§3395. Heat Illness Prevention in Outdoor Places of Employment" and "Heat Illness Prevention Enforcement Q&A". Cal/OSHA has continually revised and increased the stringency of these rules since their initial implementation. Notably, the high-heat procedures were adopted in 2010 and only apply to the following industries: agriculture, construction, landscaping, oil and gas extraction, and transportation and delivery of agricultural products and of construction or other heavy materials (e.g., furniture, lumber, freight, cargo, cabinets, industrial or commercial materials). The temperature threshold for access to shade was 85°F in the 2005 standard and decreased to 80°F in the 2015 revision. Emergency response procedures and acclimatization protocols were more explicitly outlined in distinct clauses in 2015, although the core concepts had already been incorporated into the 2005 version. Since the implementation of HIPS, Cal/OSHA has also undertaken multiple outreach and education campaigns, particularly notable ones in 2010 and 2012.

cool-down rests in the shade to prevent overheating, with no pressure to return to work until they have recovered from any signs of heat illness.

[4] **High-heat procedures**. At temperatures of 95°F or higher, employers must implement specific high-heat procedures, including but not limited to frequent and effective communication between onsite employees and supervisors, a mandatory buddy system, and close monitoring of employee health conditions.

[5] **Emergency Response Procedures**. Effective emergency response procedures shall be implemented, ensuring that clear and precise directions are available for emergency responders, including contacting emergency medical services and arranging for employee transport to medical providers.

[6] **Acclimatization**. A new employee in high-heat areas must be closely monitored by a supervisor or designee for the first 14 days of employment.

[7] **Prevention and Training**. Employers must develop and maintain effective heat illness prevention plans and training programs that educate employees about heat hazards, heat illness, abatement measures, and their rights.

2.4.3 Enforcement of California HIPS

Cal/OSHA has been rigorously enforcing HIPS since its introduction, conducting 45,889 heat-related inspections and citing 20,947 violations from 2005 to 2019.[13] This contrasts sharply with federal OSHA's 142 nationwide inspections resulting in heat-related citations under the General Duty Clause between 2013 and 2017.[14] Recent research by Park et al. (2021) indicates a significant decrease in workplace injuries in California following HIPS implementation, with annual injuries reducing from approximately 6,100 to 4,250.

Importantly, enforcing HIPS has significantly increased operational costs for businesses. Employers face challenges in maintaining compliance with HIPS, such as pro-

[13] Refer to Online Appendix Section D.1 and Figure D.1.

[14] See "Extreme Heat and Unprotected Workers" by Public Citizen. Further, an internal OSHA study by Arbury et al. (2016) finds that federal OSHA had 84 heat enforcement cases in 2012 to 2013 and over 80% employers did not rely on national standard approaches to heat illness prevention.

viding sufficient water and shade, as well as medical support and training. For instance, one respondent in the "*Final Performance and Evaluation Report*" of the California Heat Illness Prevention Campaign in 2012 complained that - *"Having to follow the buddy rule when the job really only needs one employee, but because they are outdoors and working in field, they have to have a buddy. That costs the company."* Another labor contractor mentioned that supplying enough water was a challenge and the operating costs had increased - *"I have 500 workers and having to keep water within reach and filled to at least half way has made it so that I hire three extra people to just focus on monitoring and moving water up so that it is within reach of workers."*[15]

Additionally, HIPS introduces significant litigation risks and potential reputation damages for employers. Non-compliance can lead to substantial civil and criminal penalties, with fines varying widely based on the severity of the violation, from minor amounts to several million dollars. Noteworthy cases underscore the serious repercussions of failing to adhere to these standards. For example, Merced Farm Labor Contractor was penalized $262,700 due to a worker's heat-related death in 2008.[16]

Furthermore, managers and safety supervisors may also be subject to criminal charges, fines, and imprisonment. In the Merced case, the owner Maria De Los Angeles Colunga was sentenced to 40 hours of community service and three years of probation. Her brother, the safety coordinator at Merced, pleaded guilty to a felony count of violating a health or safety regulation that requires 480 hours of community service and five years probation.[17]

Survey feedback from Californian employees highlights the positive impacts of strict enforcement of HIPS, noting improved training, communication, and overall treatment by employers. This shift is attributed to the fear of legal consequences, demonstrating the

[15]See "California Heat Illness Prevention Campaign - Final Performance and Evaluation Report".

[16]See Online Appendix Section D.2 for more details.

[17]n another case, Bumble Bee Foods agreed to pay $6 million to settle a case regarding the death of a worker in 2012. The company's safety manager Saul Florez and plant director Angel Rodriguez were charged with willfully violating worker safety rules. Saul Florez pleaded guilty and was sentenced to three years of formal probation and 30 days of community labor. He also received a fine of $19,000 and was required to take work-safety classes. Angel Rodriguez agreed to do 320 hours of community service, pay $11,400 in fines and take work-safety classes. See "Bumble Bee to pay $6M in oven death; 2 managers will pay $30K".

efficacy of HIPS in promoting safer working condition.[18]

3 Data, Measures, and Summary Statistics

3.1 Labor Exposure to Climate Risk and HIPS

As discussed in Section 2, the HIPS adopted in California and Washington are designed to mitigate heat-related risks for outdoor workers, thereby affecting industries variably based on their reliance on outdoor labor in production. Industries employing a higher proportion of outdoor workers are more significantly impacted by HIPS compared to those with fewer outdoor workers. Following Xiao (2021), we construct an index to quantify the intensity of outdoor work required across different industries at the NAICS4 industry level. We then map this index to each plant according to its NAICS4 industry classification, since each plant has its own industry classification and that can be different from the parent company's main industry classification.

We start by collecting industry-specific occupational data from the Occupational Employment and Wage Statistics (OEWS) provided by the U.S. Bureau of Labor Statistics (BLS). This data includes occupations needed in each industry, the number of employees working in each occupation, and wage estimates for each occupation. Next, we gather information on outdoor intensity for each occupation, both current and historical, from the Occupational Information Network (O*NET) program of the U.S. Department of Labor, focusing on the working context of "*Outdoors, Exposed to Weather*". In this context, O*NET assigns a score to each occupation based on the question - "*How often does this job require working outdoors, exposed to all weather conditions?*" This score captures the frequency of outdoor activities required for workers in each occupation to perform their duties under extreme heat and other weather conditions. The scoring system ranges from

[18]These substantial litigation risks associated with non-compliance strongly incentivize employers' adherence to HIPS. Several examples of feedback from respondents in the "*Final Performance and Evaluation Report*" include: (1) "*Now [employers] provide training, take care of their people. They want them to feel well and healthy.*"; (2) "*I have seen more communication, that workers are listened to more now. I think it's because of fear of the consequences.*"; (3) "*Now employers are afraid. Before they didn't care, and since many were undocumented they took advantage of them. Now there isn't so much abuse.*"; (4) "*At first they didn't like us to teach this, but after Cal/OSHA fined them they've been helping a little more.*"

“1" (no exposure) to “5" (daily exposure).[19] A higher score indicates a greater degree of an occupation's exposure to changing climates when performing job duties, meaning that workers in these occupations are more adversely affected by extreme heat and thus benefit more from HIPS protection.

Utilizing the OEWS and O*NET data, we construct an index of labor exposure to climate risk and, consequently, to HIPS in the following way.

$$Labor\ Exposure_{i,t} = \sum_{o=1}^{O_{i,t}} \left(\frac{Emp_{i,o,t}}{Emp_{i,t}} \times Score_{o,t} \right) \tag{1}$$

where i denotes industry, o denotes occupation, and t denotes year. $O_{i,t}$ is the total number of occupations in industry i and year t. $Score_{o,t}$ is the occupational score of outdoor intensity from the O*NET program for occupation o in year t. $Emp_{i,o,t}$ is the number of employees working in occupation o in industry i and year t. $Emp_{i,t}$ is the total number of employees in industry i and year t. Therefore, this index is a weighted average of all occupations' outdoor scores in a NAICS4 industry, with the weight being the percentage of employees working in a given occupation within an industry.[20]

3.2 Plant-level IT Intensity

We obtain plant-level data on IT capital and employment from the Computer Intelligence Technology Database (CiTDB), provided by Aberdeen (previously known as “Harte Hanks”). This dataset include detailed information of each plant's name, location, industry, IT adoption, employment, sales, and parent company. IT adoption covers many IT-related equipment, such as PCs, servers, terminals, printers, storage devices, telecommunication platforms, and wide-area network (WAN) equipment. CiTDB collects and maintains the data's accuracy and timeliness through monthly extensive interviews, surveys, and web

[19]Specifically, a score of “1" indicates that workers in this occupation are *never* exposed to any weather conditions during the working process. “2" indicates “*once a year or more but not every month*." "3" indicates "*once a month or more but not every week*." "4" indicates “*once a week or more but not every day*." “5" indicates “*every day*."

[20]See Xiao (2021) for further discussions of the data, selection of working contexts, examples of occupations and industries with varying exposures, the validation process, and its distribution across labor skill levels, sectors, and counties.

scraping. This data has became a crucial source of information on IT usage and investment among U.S. firms and is extensively used by large technology firms for sales and marketing purpose, which exerts a strong market discipline on data quality. Additionally, it also has been widely used in academic studies on corporate IT investment and the implications, including Bloom et al. (2012, 2014); Tuzel and Zhang (2021); Dai and Qiu (2022); Pierri and Timmer (2022); Ouimet et al. (2023).

We construct our sample from CiTDB and impose several carefully selected criteria to ensure a robust analysis. First, we narrow the sample period to 2001 - 2007, allowing us to perform a difference-in-differences analysis around the adoption of HIPS in California in 2005 and Washington in 2006, while avoiding distortions introduced by the 2008 financial crisis. Second, our sample includes all plants located in California and Washington, as well as some plants located outside these states. Specifically, for plants outside California and Washington, we include those whose parent firms employ at least 20% of their workforce in industries significantly impacted by HIPS in California and Washington (e.g., labor exposure above the sample median). Although these plants outside California and Washington are not directly impacted by HIPS, the time-varying differences across them provide a benchmark for estimating the effects of HIPS on plants in California and Washington, thereby controlling for various confounding factors that could bias our estimate, such as industry trends. Third, only plants with a minimum of five employees and five computers are considered to ensure they operate at a sufficient scale. Fourth, we exclude any plants with incomplete data regarding location, industry classification, employment, and IT capital throughout the sample period, which helps eliminate survivorship bias. Lastly, we exclude plants operating in elementary and secondary education services, finance, non-profit, public administration, utility, and unclassified industries to maintain the focus and relevance of our sample. This methodical approach to sample construction aims to create a coherent and representative dataset for analyzing the impact of HIPS on plant-level IT adoption and employment within the targeted industries and regions.[21]

[21]In Online Appendix E, we discuss changes to these requirements and alternative methods of sample construction, and demonstrate the robustness of our results.

Following prior research, we categorize PCs, laptops, and servers together under the umbrella of computers and measure plant-level IT intensity as the natural logarithm of the number of computers per employee (e.g., Brynjolfsson and Hitt, 2003; Bloom et al., 2012, 2014; Zhang, 2019; Tuzel and Zhang, 2021; Ouimet et al., 2023). This measure is used because the number of computers is consistently available during our sample period and is a physical quantity that can be measured consistently across plants and time.

3.3 Additional Data

We obtain data on public firms and their balance sheet information from the Compustat/CRSP Merged database.

3.4 Summary Statistics

Table 1 reports the statistics of plant-level variables used in our empirical analysis. Our sample is at the plant-year level and includes 6,029 plants across 3,065 firms from 2001 to 2007. 68% of the pants are located in California, 13% are in Washington, and the other 19% are in other states. *Log(Computers/Employment)* measures the plan-level IT intensity and has a mean of -0.579 and a median of -0.553, with a standard deviation of 0.627, indicating substantial variations across plants. Furthermore, the average plant's exposure to the HIPS (*Labor Exposure*) is 2.087, with the upper 95^{th} percentile reaching 3.136 and the lower 5^{th} percentile at 1.578, highlighting a considerable range in exposure levels across plants.

4 The Implementation of HIPS and Plant-level IT Intensity

4.1 Empirical Methodology

To identify the causal impact of the implementation of HIPS on plant-level IT intensity, we estimate the following difference-in-differences model:

$$\begin{aligned} Y_{f,p,s,i,t} = & \mu_p + \tau_{s,t} + \theta_{s,i} + \pi_{i,t} + \beta_1 \, \textit{Labor Exposure}_i \times \textit{HIPS}_{s,t} \\ & + \beta_2 \, \textit{Labor Exposure}_i + \beta_3 \, \textit{HIPS}_{s,t} + \delta \boldsymbol{X}_{f,p,s,i,t} + \varepsilon_{f,p,s,i,t} \end{aligned} \tag{2}$$

where f denotes firm, p denotes plant, s denotes state of a plant, i denotes industry of a plant, and t denotes year. $Y_{f,p,s,i,t}$, the dependent variable, represents a plant's IT intensity, defined as the natural logarithm of the total number of computers (desktop and laptop PCs) and servers per employee (*Log(Computers/Employment)*). $Labor\ Exposure_i$ represents the pre-HIPS average exposure of a NAICS4 industry to the HIPS, as defined in Equation (1). $HIPS_{s,t}$ is an indicator variable that is set to one for plants located in California or Washington, beginning in the year each state implemented the Heat Illness Prevention Standard (HIPS)—2005 for California and 2006 for Washington—and remains at one in subsequent years. It is set to zero for all years prior to HIPS implementation and for plants in states that did not adopt HIPS. $X_{f,p,s,i,t}$ is a vector of controls including lagged natural logarithm of the number of computers and lagged natural logarithm of the number of employees. We also employ various fixed effects to control for unobserved heterogeneity in our analysis. Specifically, μ_p denotes plant fixed effects. $\tau_{s,t}$ represents state-by-year fixed effects, and $\theta_{s,i}$ represents state-by-NAICS2 industry fixed effects. $\pi_{i,t}$ denotes NAICS2 industry-by-year fixed effects. In stricter models, we substitute state-by-year fixed effects with county-by-year fixed effects and replace state-by-NAICS2 industry fixed effects with county-by-NAICS2 industry fixed effects to achieve a finer granularity of control. Furthermore, to facilitate within-firm comparisons, we incorporate firm-by-year fixed effects. In our most rigorous model specification, we introduce firm-by-state-by-year fixed effects, enabling a more detailed within-firm and within-state analysis.

Our empirical strategy utilizes the HIPS implementation in California (2005) and Washington (2006) to examine its causal impact on plant-level utilization of IT capital. We focus on the coefficient estimate β_1, which measures changes in IT intensity in more treated plants (plants in California and Washington with greater labor exposure to HIPS) against less treated plants (plants in California and Washington with lesser labor exposure to HIPS) and control plants (plants outside California and Washington). Although plants outside California and Washington are not directly impacted by HIPS, the time-varying differences across these plants provide a benchmark for estimating the effects of HIPS on plants in California and Washington, thereby controlling for various confounding factors that could bias our estimate, such as industry trends. Our causal inference relies on the parallel trends assumption, which posits that pre-HIPS IT intensity trends are similar across plants, after accounting for heterogeneities across plants, industries, states, and counties. We present evidence to support this assumption in our subsequent analysis.

We expect β_1 to be positive and statistically significant, indicating that HIPS encourages more treated plants to increase IT adoption relative to use of human capital as production inputs. The coefficients β_2 and β_3 are absorbed by plant (μ_p) and state-by-year ($\theta_{s,t}$) fixed effects, respectively.

4.2 Plant-level IT Intensity

Table 2 presents the results from estimating Equation (2). Column (1) includes plant, NAICS2 industry-by-year, and state-by-year fixed effects to account for time-invariant characteristics at the plant level and time-varying differences across NAICS2 industries and states. The positive and statistically significant coefficient of the interaction term *HIPS* $\times$ *Labor Exposure* suggests that plants with higher exposure to HIPS increase their IT intensity more than plants with lower exposure, following the implementation of HIPS. This differential effect highlights how varying degrees of regulatory impact influence technological adaptation strategies across plants. In column (2), we control for a plant's previous year's computers and employment, while column (3) introduces state-by-NAICS2 industry fixed effects to control for the importance of a NAICS2 industry in a state. The robustness of our findings is evident across these specifications. The economic magnitude is also considerate. The implementation of HIPS leads to a 2.9% greater increase in IT intensity for treated plants with a one-standard deviation higher labor exposure.

Column (4) replaces state-by-year with county-by-year fixed effects and state-by-NAICS2 industry with county-by-NAICS2 industry fixed effects, affirming that our results are not attributable to county-level or county-industry heterogeneities. Furthermore, column (5) includes firm-by-year fixed effects for a within-firm analysis, and column (6) extends this to a firm-by-state-by-year fixed effects model, allowing comparisons of plants with varying HIPS exposures but within the same firm and state. This approach addresses potential biases from heterogeneities across firms or firm-state pairs. Our findings persist under these conditions.

Moreover, acknowledging the potential for Type-I and Type-II errors in our difference-in-differences analysis due to the staggered HIPS adoption in California and Washington (Baker et al., 2022), columns (7) to (12) replicate the analysis of columns (1) to (6) by excluding plants in Washington, which allows us to focus on the adoption of the HIPS in California. The consistency of our results, along with similar economic magnitudes, underscores the robustness of our findings.

4.3 Dynamic Treatment Effects

Our difference-in-differences analysis hinges on the premise that pre-HIPS shifts in IT intensity are independent of industry-level regulation exposures and plant locations, after controlling for time-varying differences across plants, industries, states, and counties. To validate this, we examine dynamics of IT intensity around the adoption of HIPS in Table 3, employing specific indicators for periods before and after HIPS enactment. Specifically, *HIPS (T-4)*, *HIPS (T-3)*, *HIPS (T-2)*, *HIPS (T)*, *HIPS (T+1)*, *HIPS (T+2)* are indicators equal to one if the plant is located in a state that will adopt HIPS in four years, will adopt HIPS in three years, will adopt HIPS in two years, adopts HIPS in the current year, adopted HIPS one year ago, or adopted HIPS two years ago, and zero otherwise. *Labor Exposure* × *HIPS (T-1)* is the benchmark and thus omitted.

Results in Table 3 show insignificant coefficient estimates for Labor Exposure × HIPS (T-4), *Labor Exposure* × *HIPS (T-3)*, and *Labor Exposure* × *HIPS (T-2)*, indicating no pre-treatment effects. Conversely, from the year of HIPS adoption onwards, the interaction terms, i.e., *Labor Exposure* × *HIPS (T)*, *Labor Exposure* × *HIPS (T+1)*, and *Labor Exposure* × *HIPS (T+2)*, yield positive and significant coefficients. Dynamic changes in IT intensity plotted around HIPS implementation corroborate these findings, as shown in Figure 1. Prior to HIPS, differences in IT intensity dynamics among plants with varying exposures are close to zero, affirming the parallel trends assumption. Post-HIPS, more treated plants exhibit notable increases in IT intensity compared to less treated plants. Collectively, these findings address concerns about reverse causality or the violation of the parallel trends assumption, showing that the observed increases in IT investment relative to human capital among treated plants can be attributed to the policy's introduction, rather than to pre-existing trends.

4.4 Decomposition: Plant-level IT Capital and Employment

Our hypothesis posits that HIPS implementation elevates labor-related costs, prompting affected plants to substitute human capital with IT capital as production inputs. So far, our results on IT intensity support this conjecture. Furthermore, our hypothesis predicts an increase in IT capital and a decrease in employment when decomposing IT intensity into its IT and employment components. We test this prediction in Table 4. The dependent variable is the natural logarithm of the number of computers (desktop and laptop PCs) and servers (*Log(Computers)*) in columns (1) - (4) and the natural logarithm of the number of employees (*Log(Employment)*) in columns (5) - (8). Analysis in columns (1), (2), (5), and (6) use all plants in our sample, while analysis in columns (3), (4), (7), and (8) excludes plants located in Washington. In line with our conjecture, the coefficient estimate of *Labor Exposure* $\times$ *HIPS* is positive and statistically significant for total IT capital in columns (1) - (4) but negative and significant for total employment in columns (5) - (8), with varying fixed effects. The economic magnitudes are also significant. The implementation of HIPS results in a 2.6% increase in IT capital and 1.3% decrease in employment for treated plants with a one-standard deviation higher labor exposure. This evidence further supports our hypothesis that treated plants counter HIPS-induced labor costs by substituting IT for labor.

We plot the dynamic effects of HIPS on total IT capital and employment in Figures 2 (A) and (B), respectively. Mirroring the patterns on IT intensity, HIPS implementation triggers an immediate increase in IT capital and a concurrent drop in employment among more treated plants, distinguishing them from their less-treated peers.

4.5 Robustness

4.5.1 Robustness: Plant-level IT Intensity

In Online Appendix Section E, we provide further analyses to affirm the robustness of our main findings regarding plant-level IT intensity. First, we conduct robustness checks using alternative criteria for sample selection, specifically evaluating how our main results persist when considering changes in (1) the inclusion of plants outside California and Washington; (2) plant size, as determined by the number of onsite employees and computers; (3) the strictness in excluding plants with missing data during the sample period. Our analyses demonstrate that the main conclusions about plant-level IT intensity are consistent across these different sample construction methods. Second, we examine the impact of HIPS on the logarithm growth rates of plant-level computers and employment. Consistent with our baseline findings, the implementation of HIPS positively influences the growth rate of plant-level computers but negatively impacts the growth rate of employment. Third, to address the concerns regarding the logarithmic transformation of the dependent variable (Cohn et al., 2022), we employ fixed effects Poisson and linear regression models and use the number of computers (desktop and laptop PCs) per employee as the dependent variable. Our results remain robust.

4.5.2 Robustness: Firm-level Capital Intensity

We also extend our analysis to firm-level capital intensity from the Compustat/CRSP Merged database. We focus on firms headquartered in California and Washington and measure their exposure to HIPS based on their reported industry classifications in Compustat/CRSP.[22] Capital intensity is measured as the natural logarithm of property, plant, and equipment (PPENT) per employee. In column (1) of Table 5, the coefficient estimate of *Labor Exposure* $\times$ *HIPS* is positive and statistically significant, after controlling for firm-specific time-invariant and state-level time-varying characteristics. This finding indicates

[22]See Online Appendix Section G for more details of our sample construction, summary statistics, and additional tests.

that post-HIPS, treated firms with higher exposure to the regulation experience a notable increase in capital intensity compared to their less-treated peers. We further control for firm size and other firm characteristics in columns (2) and (3), and add NAICS2 industry-by-year fixed effects to account for differences across industries in column (4). In column (5), we add state-by-NAICS2 industry effects to control for the importance of a NAICS2 industry in a state. Our results continue to hold. The increase in firm-level capital intensity is economically important as well: in column (5), firms with one standard deviation higher labor exposure experience a 9.7% increase in capital intensity following the implementation of HIPS.

Figure 3 illustrates the dynamic changes in capital intensity surrounding the implementation of HIPS. Supporting the parallel trend assumption, we find no significant differences in capital intensity across firms prior to the adoption of HIPS. Post-adoption, firms more susceptible to HIPS significantly enhance their capital intensity, distancing from their less-susceptible counterparts. Additional analysis in Online Appendix Figure G.1 attributes this rise in capital intensity to increased capital use and reduced employment levels. Together, these results corroborate the plant-level findings on IT intensity, suggesting a consistent pattern of increased capital investment in response to HIPS at both firm and plant levels.

4.6 Cross-sectional Heterogeneities

In this section, we conduct several cross-sectional analyses to better understand the underlying mechanism driving our findings. First, we assess the feasibility of substituting IT for labor in contexts where workers are vulnerable to heat, based on the ability of IT-related capital to replicate tasks performed by heat-exposed workers. Given the documented shifts away from low-skilled labor due to automation (e.g., Graetz and Michaels, 2018), we hypothesize a diminished effect of HIPS on IT intensity within plants mainly employing high-skilled workers. This hypothesis is confirmed in columns (1) and (2) of Table 6, where the influence of HIPS's on increasing IT intensity is notably weaker in industries with a larger proportion of high-skilled labor.

Next, we consider the influence of labor unions, which can strengthen workers' bargaining power and affect wage and employment policies within firms (e.g., Lewis, 1986; Chen et al., 2011). In particular, unions might push for stringent adherence to HIPS or advocate for even more protective measures against heat risks, thereby further raising labor-related costs. Reflecting this, our findings in columns (3) and (4) of Table 6 indicate a more substantial shift towards IT investment in industries with higher union presence, suggesting an attempt to mitigate increased labor costs through technology.

Finally, we explore the role of existing IT infrastructure within plants prior to HIPS implementation. Plants already heavily invested in IT might have limited scope for additional IT expansion post-HIPS compared to their less technologically equipped counterparts. Our results, shown in columns (5) and (6) of Table 6, support this notion. The negative and significant coefficient for the interaction term *Labor Exposure* $\times$ *HIPS* $\times$ *Pre-HIPS IT Intensity* implies that HIPS-driven increase in IT intensity is more pronounced in plants that were initially less endowed with IT resources, highlighting a differential capacity for technological adaptation in response to regulatory changes.

5 Implications for Labor Productivity and Firm Value

Our analysis so far provides consistent and robust evidence showing that that firms adapt to the implementation HIPS by shifting from labor to capital in their productions, a change driven by HIPS-induced increases in labor costs, which make capital a more efficient production input. This section explores how this climate-induced shift towards automation impacts labor productivity and firm value.

5.1 Labor Productivity

The move to restructure the labor force allows firms to let go of workers less efficient in high temperatures due to HIPS, while equipping the remaining staff with more capital and IT, potentially boosting productivity. However, this transition demands significant financial outlay for new capital and IT, as well as the costs of hiring and training staff to use these resources. This can disrupt regular operations and may initially reduce labor productivity, even if it proves advantageous over time. We investigate the implication of implementing HIPS for labor productivity in Table 7. Labor productivity is measured as the natural logarithm of sales per employee. In columns (1) and (2), we observe no significant impact of HIPS on labor productivity across plants with varying levels of exposure. Yet, columns (3) and (4) reveal that treated plants with greater exposure and higher IT intensity exhibit higher labor productivity post-HIPS. This pattern holds at the firm level as well in columns (5) - (8). Collectively, these findings indicate that technological advancements can counteract operational challenges induced by HIPS and enhance productivity.

5.2 Firm Value

We also investigate whether market investors value firms' automation response to HIPS. Analyzing changes in the market-to-book ratio (*M/B*), columns (1) and (2) of Table 8 show a positive and significant coefficient estimate for *Labor Exposure* $\times$ *HIPS*, indicating that the average firm's market value increases following the implementation of HIPS. Economically, firms with one standard deviation higher exposure to HIPS experience a 7.9% increase in the market-to-book ratio after its implementation. Further analysis reveals that this increase only exists among firms with capital intensity in the top 25^{th} percentile within their industry, as shown in columns (3) and (4). These results suggest that investors particularly value automation efforts by treated firms post-HIPS, but notably when such automation is substantial.

6 Conclusions

In this paper, we examine how plants with varying degrees of labor exposure to heat adapt their use of IT following the implementation of HIPS in California and Washington. We find that that plants with greater exposure to HIPS have significantly increased their IT intensity, characterized by higher investments in IT capital and reduced employment levels. This trend is consistent at both plant and firm levels, demonstrating a strategic adaptation to climate-related regulatory measures in the labor market. These adaptations highlight firms' efforts to mitigate the financial impacts of regulatory compliance by leveraging technology over labor, thereby enhancing labor productivity and attracting positive responses from market investors.

However, our findings also uncover a paradoxical outcome of these regulatory efforts aimed at protecting workers from heat risks. While HIPS is designed to enhance worker safety, its adoption has inadvertently led to a decrease in employment opportunities. This outcome presents a significant policy challenge: the need for a balanced approach that ensures worker safety in the face of climate change while sustaining job creation within the economy.

Facing the escalating challenge of global warming, the emphasis of policy efforts has largely been on the reduction of carbon emissions. This focus, while vital, often overshadows the need for interventions in other critical areas, such as safeguarding human health against heat risks. The U.S. states of California and Washington have made noteworthy strides by enacting HIPS to protect outdoor workers from the perils of heat exposure.

In conclusion, our investigation into heat-related labor regulations offers insights into the complex interplay between climate change, regulatory responses, and economic adaptation strategies. It underscores the importance of considering the broader economic implications of climate-related policies and the pivotal role of technological progress in navigating the challenges posed by climate change.

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Figures

Figure 1. Dynamic Differences in Plant-level IT Intensity Around the Implementation of HIPS

This figure presents dynamic differences in plant-level IT intensity around the implementation of HIPS in California and Washington. IT intensity is measured as the natural logarithm of the number of computers (desktop and laptop PCs) and servers per employee, *Log(Computers/Employment)*. *HIPS (T-4)*, *HIPS (T-3)*, *HIPS (T-2)*, *HIPS (T)*, *HIPS (T+1)*, *HIPS (T+2)* are indicator variables equal to one if the plant is located in a state that will adopt HIPS in four years, will adopt HIPS in three years, will adopt HIPS in two years, adopts HIPS in the current year, adopted HIPS one year ago, or adopted HIPS two years ago, and zero otherwise. *HIPS (T-1)* indicates the year before the adoption of HIPS in a state and is the omitted category. California implemented the HIPS program in 2005, followed by Washington in 2006. Detailed estimation is reported in Table 3.

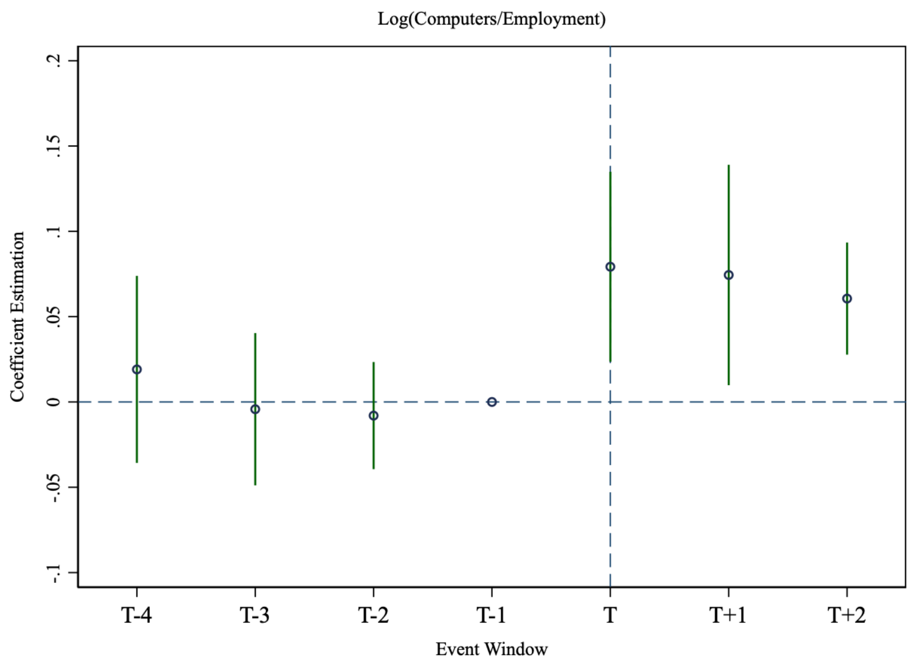
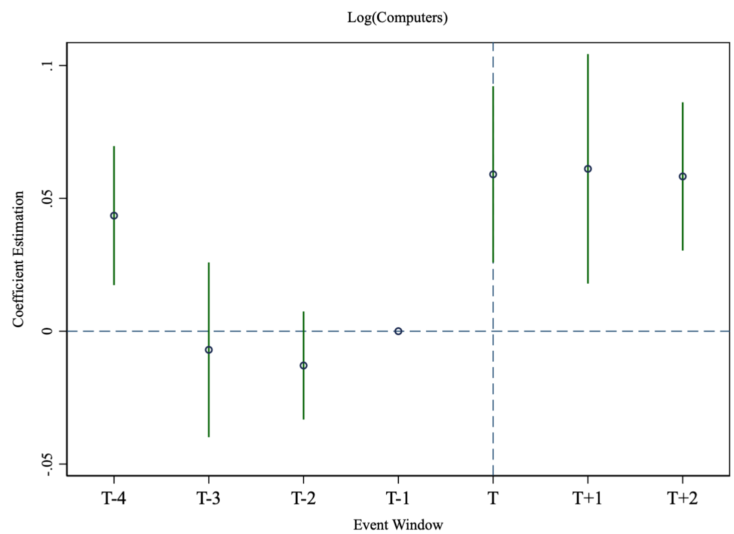


Figure 2. Dynamic Differences in Plant-level Computers and Employment Around the Implementation of HIPS

This figure presents dynamic differences in plant-level computers and employment around the implementation of HIPS in California and Washington. Figure A reports the natural logarithm of the number of computers (*Log(Computers/Employment)*) and Figure B reports the natural logarithm of the number of employees (*Log(Employment)*). *HIPS (T-4)*, *HIPS (T-3)*, *HIPS (T-2)*, *HIPS (T)*, *HIPS (T+1)*, *HIPS (T+2)* are indicator variables equal to one if the plant is located in a state that will adopt HIPS in four years, will adopt HIPS in three years, will adopt HIPS in two years, adopts HIPS in the current year, adopted HIPS one year ago, or adopted HIPS two years ago, and zero otherwise. *HIPS (T-1)* indicates the year before the adoption of HIPS in a state and is the omitted category. California implemented the HIPS program in 2005, followed by Washington in 2006.

(A) Log(Computers)



(B) Log(Employment)

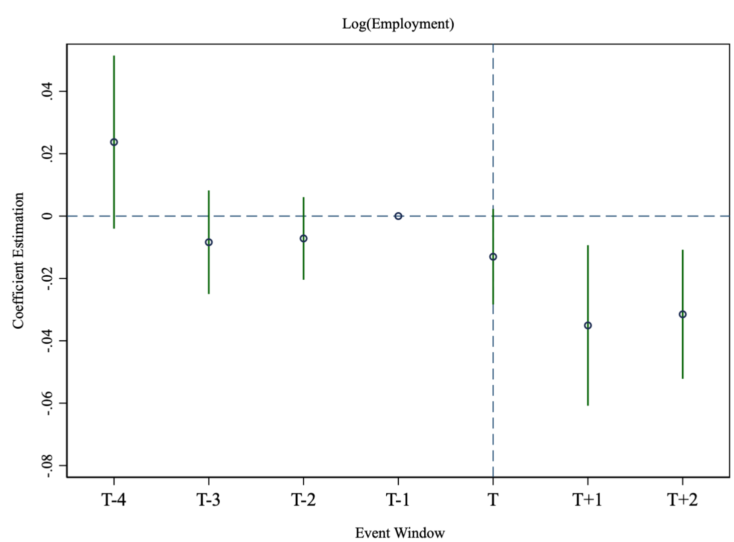
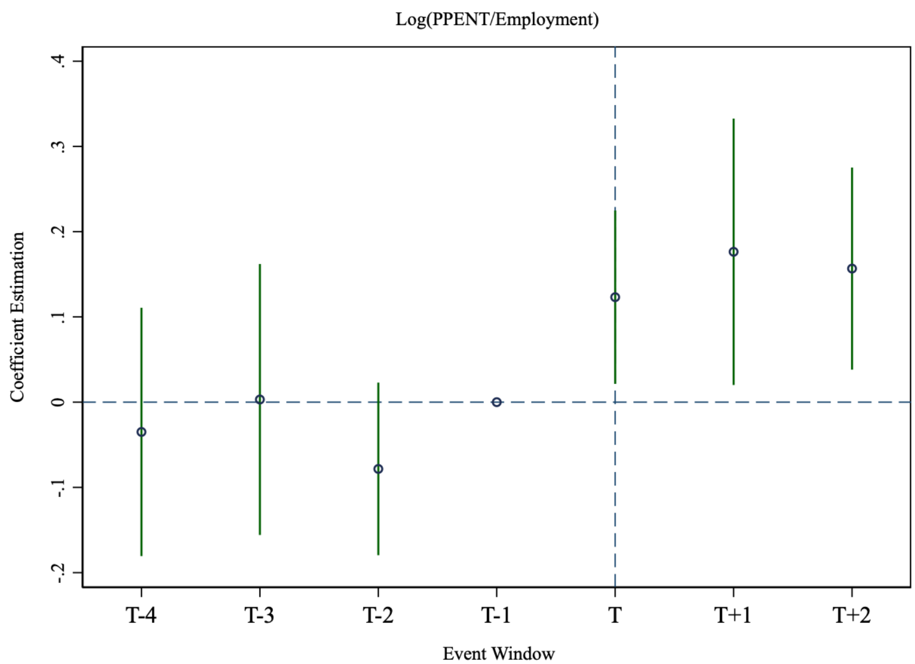


Figure 3. Dynamic Differences in Firm-level Capital Intensity Around the Implementation of HIPS

This figure presents dynamic differences in firm-level capital intensity around the implementation of HIPS in California and Washington. Capital intensity is measured as the natural logarithm of property, plant, and equipment (PPENT) per employee, *Log(PPENT/Employment)*. *HIPS (T-4)*, *HIPS (T-3)*, *HIPS (T-2)*, *HIPS (T)*, *HIPS (T+1)*, *HIPS (T+2)* are indicator variables equal to one if the plant is located in a state that will adopt HIPS in four years, will adopt HIPS in three years, will adopt HIPS in two years, adopts HIPS in the current year, adopted HIPS one year ago, or adopted HIPS two years ago, and zero otherwise. *HIPS (T-1)* indicates the year before the adoption of HIPS in a state and is the omitted category. California implemented the HIPS program in 2005, followed by Washington in 2006.



Table

Table 1. Summary Statistics

This table presents summary statistics of plant-level variables used in empirical analyses. *Log(Computers/Employment)* is the natural logarithm of the number of computers (desktop and laptop PCs) and servers per employee. *Log(Computers)* is the natural logarithm of the number of computers (desktop and laptop PCs) and servers. *Log(Employment)* is the natural logarithm of the number of employees. *Log(Sales/Employment)* is the natural logarithm of sales per employees. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the plant is located in a state that adopts HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. The sample period is from 2001 to 2007.

	N	Mean	P5	Median	P95	SD
Dependent Variables						
Log(Computers/Employment)	42,203	-0.579	-1.649	-0.553	0.36	0.627
Log(Computers)	42,203	4.255	2.565	4.078	6.767	1.218
Log(Employment)	42,203	4.835	2.996	4.787	6.908	1.177
Log(Sales/Employment)	42,203	-2.111	-3.083	-2.095	-1.099	0.621
Independent Variables						
Labor Exposure	42,203	2.087	1.578	2.001	3.136	0.479
HIPS	42,203	0.33	0	0	1	0.47

Table 2. The Implementation of HIPS and Plant-level IT Intensity

This table presents the effects of the implementation of HIPS on plant-level IT intensity. Analysis in columns (1) - (6) includes all plants in our sample while analysis in columns (7) - (12) excludes plants located in Washington. The dependent variable is the natural logarithm of the number of computers (desktop and laptop PCs) and servers per employee, *Log(Computers/Employment)*. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the plant is located in a state that adopts HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. Controls include lagged natural logarithm of the number of computers and lagged natural logarithm of the number of employees. The sample period is from 2001 to 2007. Numbers in parentheses are standard errors. Standard errors are double clustered at the state and the NAICS4 level. ***, **, and * indicate p-values of 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Log(Computers/Employment)											
	All Plants						Exclude Washington					
Labor Exposure x HIPS	0.075**	0.061***	0.061***	0.060***	0.056***	0.066**	0.081***	0.068***	0.068***	0.067***	0.067***	0.053***
	(0.028)	(0.020)	(0.020)	(0.017)	(0.014)	(0.026)	(0.020)	(0.015)	(0.015)	(0.013)	(0.011)	(0.008)
Observations	42,189	41,846	41,846	39,863	24,163	18,195	35,126	34,851	34,851	33,148	19,732	15,869
Controls	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NAICS2 Industry x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State x Year FE	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No
State x NAICS2 Industry FE	No	No	Yes	No	No	No	No	No	Yes	No	No	No
County x Year FE	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
County x NAICS2 Industry FE	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Firm x Year FE	No	No	No	No	Yes	No	No	No	No	No	Yes	No
Firm x State x Year FE	No	No	No	No	No	Yes	No	No	No	No	No	Yes
Adjusted R^2	0.890	0.905	0.904	0.901	0.914	0.911	0.891	0.905	0.904	0.901	0.915	0.913

Table 3. The Implementation of HIPS and Plant-level IT Intensity: Dynamic Differences

This table presents the dynamic differences in plant-level IT intensity around the implementation of HIPS in California and Washington. The dependent variable is the the natural logarithm of the number of computers (desktop and laptop PCs) and servers per employee, *Log(Computers/Employment)*. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS (T-4)*, *HIPS (T-3)*, *HIPS (T-2)*, *HIPS (T)*, *HIPS (T+1)*, *HIPS (T+2)* are indicator variables equal to one if the plant is located in a state that will adopt the HIPS in four years, will adopt the HIPS in three years, will adopt the HIPS in two years, adopts the HIPS in the current year, adopted the HIPS one year ago, or adopted the HIPS two years ago, and zero otherwise. *HIPS (T-1)* indicates the year before the adoption of HIPS in a state and is the omitted category. California implemented the HIPS program in 2005, followed by Washington in 2006. The sample period is from 2001 to 2007. Numbers in parentheses are standard errors. Standard errors are double clustered at the state and the NAICS4 level. ***, **, and * indicate p-values of 1%, 5%, and 10%, respectively.

	(1)	(2)
	Log(Computers/Emplpoyment)	
Labor Exposure x HIPS (T-4)	0.011	0.019
	(0.027)	(0.027)
Labor Exposure x HIPS (T-3)	-0.010	-0.004
	(0.022)	(0.022)
Labor Exposure x HIPS (T-2)	-0.010	-0.008
	(0.014)	(0.016)
Labor Exposure x HIPS (T)	0.081***	0.079***
	(0.029)	(0.028)
Labor Exposure x HIPS (T+1)	0.074**	0.074**
	(0.035)	(0.032)
Labor Exposure x HIPS (T+2)	0.061***	0.061***
	(0.019)	(0.016)
Observations	42,189	40,201
Controls	Yes	Yes
Plant FE	Yes	Yes
NAICS2 Industry x Year FE	Yes	Yes
State x Year FE	Yes	No
State x NAICS2 Industry FE	Yes	No
County x Year FE	No	Yes
County x NAICS2 Industry FE	No	Yes
Adjusted R^2	0.889	0.886

Table 4. The Implementation of HIPS and Plant-level Computers and Employment

This table presents the effects of the implementation of HIPS on plant-level total computers and employment. The dependent variable is the natural logarithm of the number of computers (desktop and laptop PCs) and servers (*Log(Computers)*) in columns (1) - (4), and the natural logarithm of the number of employees (*Log(Employment)*) in columns (5) - (8). Analysis in columns (1), (2), (5), and (6) use all plants in the sample, while analysis in columns (3), (4), (7), and (8) excludes plants located in Washington. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the plant is located in a state that adopts HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. Controls include lagged natural logarithm of the number of employees in columns (1) - (4), and lagged natural logarithm of the number of computers in columns (5) - (8). The sample period is from 2001 to 2007. Numbers in parentheses are standard errors. Standard errors are double clustered at the state and the NAICS4 level. ***, **, and * indicate p-values of 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log(Computers)				Log(Employment)			
	All Plants		Exclude WA		All Plants		Exclude WA	
Labor Exposure x HIPS	0.065**	0.055**	0.078***	0.067***	-0.022*	-0.027**	-0.016**	-0.023***
	(0.028)	(0.026)	(0.020)	(0.017)	(0.012)	(0.012)	(0.006)	(0.006)
Observations	41,846	39,863	34,851	33,148	41,846	39,863	34,851	33,148
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NAICS2 Industry x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State x Year FE	Yes	No	Yes	No	Yes	No	Yes	No
State x NAICS2 Industry FE	Yes	No	Yes	No	Yes	No	Yes	No
County x Year FE	No	Yes	No	Yes	No	Yes	No	Yes
County x NAICS2 Industry FE	No	Yes	No	Yes	No	Yes	No	Yes
Adjusted R^2	0.935	0.934	0.936	0.935	0.941	0.939	0.941	0.940

Table 5. The Implementation of HIPS and Firm-level Capital Intensity

This table presents the effects of the implementation of HIPS on firm-level capital intensity. The dependent variable is the natural logarithm of property, plant, and equipment (PPENT) per employee, *Log(PPENT/Employment)*. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the firm is located in a state that adopts HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. Controls include the logarithm of total assets (Size), market-to-book ratio (M/B), book leverage (Book Leverage), cash holdings (Cash), and a dummy indicating that a firm pays dividends (Dividend Payer). All controls are lagged by one year. The sample period is from 2001 to 2007. Numbers in parentheses are standard errors. Standard errors are clustered at the NAICS4 level.

	(1)	(2)	(3)	(4)	(5)
	Log(PPENT/Employment)				
Labor Exposure x HIPS	0.187***	0.176***	0.178***	0.304***	0.304***
	(0.067)	(0.065)	(0.065)	(0.104)	(0.104)
Size		0.311***	0.309***	0.292***	0.292***
		(0.039)	(0.042)	(0.041)	(0.041)
M/B			0.027**	0.031***	0.031***
			(0.011)	(0.010)	(0.010)
Book Leverage			-0.038	-0.082	-0.082
			(0.131)	(0.130)	(0.130)
Cash			-0.223	-0.205	-0.205
			(0.134)	(0.139)	(0.140)
Dividend Payer			0.087*	0.100*	0.100*
			(0.049)	(0.059)	(0.059)
Observations	1,715	1,706	1,690	1,669	1,669
Firm FE	Yes	Yes	Yes	Yes	Yes
State x Year	Yes	Yes	Yes	Yes	Yes
NAICS2 Industry x Year FE	No	No	No	Yes	Yes
State x NAICS2 Industry	No	No	No	No	Yes
Adjusted R^2	0.885	0.896	0.897	0.893	0.892

Table 6. The Implementation of HIPS and Plant-level IT Intensity: Heterogeneities

This table presents cross-sectional heterogeneities in the effects of the implementation of HIPS on plant-level IT intensity. Columns (1) - (2) examine the influence of labor skill, columns (3) - (4) examine the influence of labor union, and columns (5) - (6) examine the influence of pre-HIPS IT intensity. The dependent variable is the natural logarithm of the number of computers (desktop and laptop PCs) and servers per employee, *Log(Computers/Employment)*. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the plant is located in a state that adopts HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. *Labor Skill* is an indicator variable equal to one for plants in industries with labor skills above the sample median, and zero otherwise. *Labor union* is an indicator variable equal to one for plants in industries with unionization rates above the sample median, and zero otherwise. *Pre-HIPS IT Intensity* is an indicator variable equal to one for plants with pre-HIPS average IT intensity above the industry median, and zero otherwise. Controls include lagged natural logarithm of the number of computers and lagged natural logarithm of the number of employees. The sample period is from 2001 to 2007. Numbers in parentheses are standard errors. Standard errors are double clustered at the state and the NAICS4 level. ***, **, and * indicate p-values of 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Log(Computers/Employment)					
Labor Exposure x HIPS	0.069***	0.069***	0.020	0.020*	0.092***	0.092***
	(0.024)	(0.020)	(0.013)	(0.011)	(0.023)	(0.022)
Labor Exposure x HIPS x Labor Skill	-0.058**	-0.057**				
	(0.026)	(0.023)	0.119**	0.114**		
Labor Exposure x HIPS x Labor Union			(0.047)	(0.046)		
					-0.062***	-0.065***
Labor Exposure x HIPS x Pre-HIPS IT Intensity					(0.014)	(0.014)
Observations	41,846	39,863	41,409	39,419	41,846	39,863
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes
State x Year FE	Yes	No	Yes	No	Yes	No
State x NAICS2 Industry FE	Yes	No	Yes	No	Yes	No
NAICS2 Industry x Year FE	Yes	Yes	Yes	Yes	Yes	Yes
County x Year FE	No	Yes	No	Yes	No	Yes
County x NAICS2 Industry FE	No	Yes	No	Yes	No	Yes
Adjusted R^2	0.905	0.901	0.905	0.901	0.905	0.902

Table 7. The Implementation of HIPS and Labor Productivity

This table presents the implications of the implementation of HIPS for labor productivity. Analysis in columns (1) - (4) uses plant-level data from the CiTDB, while analysis in columns (5) - (8) uses firm-level data from the Compustat/CRSP Merged. The dependent variable is the natural logarithm of sales per employee, *Log(Sales/Employment)*. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the plant/firm is located in a state that adopts the HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. *High IT Intensity* is an indicator variable equal to one if a plant's IT intensity is above the industry median, and zero otherwise. *High Capital Intensity* is an indicator variable equal to one if a firm's capital intensity is above the industry median, and zero otherwise. Controls in column (2) and (4) include lagged natural logarithm of the number of computers and lagged natural logarithm of the number of employees. Controls in columns (6) and (8) include the logarithm of total assets (Size), market-to-book ratio (M/B), book leverage (Book Leverage), cash holdings (Cash), and a dummy indicating that a firm pays dividends (Dividend Payer), and all controls are lagged by one year. The sample period is from 2001 to 2007. Numbers in parentheses are standard errors. Standard errors are clustered at the NAICS4 and the sate levels in columns (1) - (4) and at the NAICS4 level in columns (5) - (8).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log(Sales/Employment)							
	Plant				Firm			
Labor Exposure x HIPS	0.004	0.004	-0.001	-0.001	-0.046	-0.052	-0.070	-0.054
	(0.003)	(0.003)	(0.003)	(0.003)	(0.078)	(0.067)	(0.109)	(0.102)
Labor Exposure x HIPS x High IT Intensity			0.011**	0.010**				
			(0.005)	(0.004)				
Labor Exposure x HIPS x High Capital Intensity							0.278***	0.270**
							(0.095)	(0.101)
Observations	42,189	41,846	40,901	40,565	1,694	1,669	1,435	1,413
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NAICS2 Industry x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State x NAICS2 Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.989	0.989	0.988	0.989	0.851	0.857	0.838	0.846

Table 8. The Implementation of HIPS and Firm Value

This table presents the implications of the implementation of HIPS for firm value. The dependent variable is the the market value of assets divided by the book value of assets, *M/B*. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the firm is located in a state that adopts HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. *High Capital Intensity (50^{th})* is an indicator variable equal to one if a firm's capital intensity is above the industry median, and zero otherwise. *High Capital Intensity (75^{th})* is an indicator variable equal to one if a firm's capital intensity is within the top 25^{th} percentile in an industry, and zero otherwise. Controls include the logarithm of total assets (Size), book leverage (Book Leverage), cash holdings (Cash), and a dummy indicating that a firm pays dividends (Dividend Payer). All controls are lagged by one year. The sample period is from 2001 to 2007. Numbers in parentheses are standard errors. Standard errors are clustered at the NAICS4 level.

	(1)	(2)	(3)	(4)
	M/B			
Labor Exposure x HIPS	0.580**	0.496**	0.391	0.362
	(0.219)	(0.218)	(0.236)	(0.240)
Labor Exposure x HIPS x High Capital Intensity (50^{th})			0.238	
			(0.289)	
Labor Exposure x HIPS x High Capital Intensity (75^{th})				0.767*
				(0.410)
Observations	1,678	1,663	1,407	1,407
Controls	No	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
State x Year	Yes	Yes	Yes	Yes
NAICS2 Industry x Year FE	Yes	Yes	Yes	Yes
State x NAICS2 Industry	Yes	Yes	Yes	Yes
Adjusted R^2	0.588	0.618	0.619	0.616

Online Appendix to

"Adaptation to Climate-induced Regulatory Risk: A Labor Perspective"

A Variable Definitions

Variables	Description
Dependent Variables	
Log(Computers/Employment)	The natural logarithm of the number of computers (desktop and laptop PCs) and servers per employee.
Log(Computers)	The natural logarithm of the number of computers (desktop and laptop PCs).
Log(Employment)	The natural logarithm of the number of employees.
Log(PPENT/Employment)	The natural logarithm of property, plant, and equipment (PPENT) per employee.
Log(Sales/Employment)	The natural logarithm of sales per employees.
M/B	The market value of assets (prcc_f $\times$ csho + dlc + dltt) divided by the book value of assets (AT).
Independent Variables	
HIPS	An indicator variable set to one for plants/firms located in California or Washington from the year each state implemented the Heat Illness Prevention Standard (HIPS)—2005 for California and 2006 for Washington—onward. It is set to zero for all years prior to implementation and for plants/firms in states that did not adopt HIPS.
Labor Exposure	Defined as the pre-HIPS average of a NAICS4 industry's exposure to heat. This measure is calculated using Equation (1) and is expressed as the weighted average of outdoor intensity across all occupations within a NAICS4 industry. Outdoor intensity for each occupation is sourced from the O*NET program. Weights are assigned based on the percentage of employees working in each occupation within the industry, as reported by the Occupational Employment and Wage Statistics (OEWS) data.
Other Independent Variables	
Size	The logarithm of a firm's total assets (AT).
Book Leverage	The book value of long-term debt (DLTT) plus debt in current liabilities (DLC) divided by total assets (AT).
Cash	Cash and short-term investments (CHE) divided by total assets (AT).
Dividend Payer	A dummy indicating that a firm pays dividends (DVC & DVP).

B Legislative and Regulatory Responses to Extreme Heat and Workplace Safety

In this section, we highlight some discussions from various regulators to demonstrate the increasing attention to climate-induced health risks faced by outdoor workers in the U.S. These authorities are progressively adopting measures to mitigate heat risks, thereby strengthening labor protections.

B.1 House and Senate[1]

"Heat illness affects workers in our nation's fields, warehouses, and factories, and climate change is making the problem more severe every year. This legislation will require OSHA to issue a heat standard on a much faster track than the normal OSHA regulatory process. Workers deserve no less."

- House Committee on Education and Labor Chairman, Bobby Scott, 2021

"I will never forget Asuncion Valdivia or how his tragic death could have been avoided...Whether on a farm, driving a truck, or working in a warehouse, workers like Asuncion keep our country running while enduring some of the most difficult conditions, often without access to water or rest. According to a 2015 study by OSHA, this has led to 37 work-related deaths and thousands of injuries and illnesses. And it has only gotten worse as climate change has led to dangerously high temperatures in parts of the country not accustomed to high heat. Every worker deserves to be protected from preventable death, and we know that requiring breaks, shade, and water can save lives.

- Representatives Judy Chu, 2021

"As climate change brings scorching heat temperatures to Southern Arizona and other places across the country, it's negatively impacting our workforce and more often creating conditions that can prove fatal...A federal OSHA standard for heat stress is necessary to protect our workers and limit their exposure to excessive heat in both indoor and outdoor environments. Climate change is no longer a theoretical threat, and lack of aggressive action to address it has made a standard to

[1] See "House, Senate Democrats Introduce Heat Stress Legislation to Protect Farm Workers."

protect our workers absolutely urgent."

- Representatives Raúl M. Grijalva, 2021

"Protecting workers from heat stress is essential, particularly as global temperatures continue to rise and extreme weather conditions become more common...Every worker deserves a safe work environment, and this legislation is an important step toward creating national standards and protections that will keep workers safe on the job as the risks of heat stress increase."

- Senator Sherrod Brown, 2021

"Whether it's in the kitchen or on a farm, heat-related illness is a severe and dangerous condition, and this bill would help keep workers safe regardless of their occupation. With rising temperatures, there is no time to delay action, and I'll continue working with my colleagues to prioritize the health and safety of our workers and get this done."

- Senator Cortez Masto, 2021

"The Asunción Valdivia Heat Illness and Fatality Prevention Act will protect workers against occupational exposure to excessive heat by:

- *Requiring the Occupational Safety and Health Administration (OSHA) to establish an enforceable standard to protect workers in high-heat environments with measures like paid breaks in cool spaces, access to water, limitations on time exposed to heat, and emergency response for workers with heat-related illness; and*
- *Directing employers to provide training for their employees on the risk factors that can lead to heat illness, and guidance on the proper procedures for responding to symptoms."*

B.2 The Biden Administration[2]

"Today, President Biden is launching a coordinated, interagency effort to respond to extreme heat that threatens the lives and livelihoods of Americans, especially workers, children, and seniors. While climate-related disasters like hurricanes, wildfires, and floods produce dramatic images of

[2]See "HFACT SHEET: Biden Administration Mobilizes to Protect Workers and Communities from Extreme Heat."

devastation, extreme heat often takes place out of sight and out of the news. But heat is the nation's leading weather-related killer.."

B.3 The Environmental Protection Agency (EPA)[3]

"*Understanding the threats that climate change poses to human health can help us work together to lower risks and be prepared.*"

"*It is important that employers understand how climate change affects the health and safety of their workers. There are actions employers can take to prepare now, such as including a climate change component in existing safety and health training. Established tools and strategies for protecting workers from climate change related hazards, such as temperature extremes and pesticide use, can be used to protect workers currently experiencing the health impacts of climate change. These tools and strategies can also be used as the basis for planning for the prevention of future health impacts on vulnerable occupational groups.*"

B.4 The Department of Labor[4]

"*Throughout the nation, millions of workers face serious hazards from high temperatures both outdoors and indoors. Amid changing climate, the growing frequency and intensity of extreme heat events is increasing the dangers workers face, especially for workers of color who disproportionately work in essential jobs in tough conditions...As Secretary of Labor, my priority is to make sure we are taking appropriate action to keep workers healthy and safe on the job.*"

- U.S. Department of Labor Secretary Marty Walsh, 2021

"*While agricultural and construction workers often come to mind first when thinking about workers most exposed to heat hazards, without proper safety actions, sun protection and climate-control, intense heat can be harmful to a wide variety of workers indoors or outdoors and during any season.*"

[3]See "Climate Change and the Health of Occupational Groups."

[4]See "US Department of Labor announces enhanced, expanded measures to protect workers from hazards of extreme heat, indoors and out" and Department of Labor announces hazard alert, steps up enforcement as extreme heat endangers workers across the nation."

- Acting Assistant Secretary for Occupational Safety and Health Jim Frederick, 2021

"*As the Occupational Safety and Health Administration works toward proposing a rule to protect workers from heat illness, we are taking several measures today to better protect workers in extreme heat...Employers have a duty to protect workers by reducing and eliminating hazards that expose workers to heat illness or injury.*"

- Assistant Secretary for Occupational Safety and Health Doug Parker, 2023

B.5 The National Institute for Occupational Safety and Health (NIOSH) [5]

"*Occupational exposure to heat can result in injuries, disease, death, and reduced productivity. Workers may be at risk for heat stress when exposed to hot environments. Exposure to hot environments and extreme heat can result in illnesses, including heat stroke, heat exhaustion, heat syncope, heat cramps, and heat rashes, or death. Heat also increases the risk of workplace injuries, such as those caused by sweaty palms, fogged-up safety glasses, and dizziness.*"

"*NIOSH urges employers to use and disseminate this information to workers. NIOSH also requests that professional associations and labor organizations inform their members about the hazards of occupational exposure to heat and hot environments.*"

[5] See "Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments".

C HIPS in Washington, Minnesota, and Oregon

C.1 Washington

The Washington HIPS for outdoor workers in general industries are codified under WAC 296-62-095, while the standards for outdoor workers in the agriculture industry fall under WAC 296-307-097.[6] The standards in California and Washington are nearly identical, mandating that employers train supervisors and workers, ensure access to water and cooling resources, and devise written plans for training, risk management and symptom response. The differences lie primarily in their scope and requirements for cooling measures. California's regulations cover all outdoor work activities year-round, while Washington's are limited to outdoor work between May and September, contingent upon reaching specific temperature thresholds associated with three categories of clothing. For example, Washington's HIPS is activated at an ambient temperature of 52°F for individuals wearing non-breathable clothing and at 89°F for any other clothing choice. The threshold of 89°F was lowered to 80°F in the 2023 amendment.

C.2 Minnesota

Minnesota adopted a heat illness prevention standard as early as 1997, *Minnesota Rules 5205.0110, General Ventilation and Temperature Requirements*.[7] However, this standard is limited to indoor workplaces and is beyond the scope of this paper. Minnesota has not yet implemented a heat illness standard for outdoor workers.

C.3 Oregon

Oregon adopted two permanent rules in May 2022, OAR 437-002-0156 and 437-004-1131,[8] to protect workers from heat-related illnesses, following directions from the Govern of Oregon Katherine Brown. The rules apply whenever an employee performs work activities, whether in indoor or outdoor environments, where the temperature equals or

[6] See Title 296 WAC: 296-62-095 and "Title 296 WAC: 296-307-097."
[7] See https://www.revisor.mn.gov/rules/5205.0110/.
[8] See https://osha.oregon.gov/pages/topics/heat-stress.aspx.

exceeds 80°F. OAR 437-004-1131 applies to agricultural workplaces and 437-002-0156 applies to all other workplaces. An exception to this rule is when an employee's exposure to heat is generated only from the work process – such as what occurs in foundries or bakeries – and is not subject to this standard. In such cases, employers must follow the requirements of OAR 437-002-0144(2). These rules closely resemble the California HIPS, such as access to shade and water, high heat practices, medical support, and training. Before their formal adoption, Oregon OSHA employed these rules as an emergency response to the deadly heat event of summer 2021.[9]

[9]See "Adoption of Temporary Rules to Address Employee Exposure to High Ambient Temperatures, 2021."

D Enforcement of the HIPS in California

D.1 Enforcement Statistics

Figure D.1 presents the year-round enforcement and outreach activities conducted by Cal/OSHA from 2005 to 2019. The initial year of HIPS enforcement in 2005 saw only 39 heat-related site inspections and 2 HIPS violations cited. However, enforcement intensity significantly increased from 2006 onwards. During 2006 - 2007, there were 1,252 inspections, 60% of which resulted in one or more heat exposure citations. The number of inspections escalated to 2,586 in 2008 and further to 3,574 in 2009. From 2005 to 2019, Cal/OSHA conducted a total of 45,889 inspections, with 20,947 violations of the HIPS cited, reflecting a citation rate of 46%.

D.2 An Enforcement Case Study - Merced Farm Labor Contractor

In 2008, a tragic incident involving the death of 17-year-old farmworker Maria Vasquez Jiminez led to significant enforcement action against Merced Farm Labor Contractor. Jiminez collapsed from heat stroke and dehydration while working in conditions exceeding 100°F. Following this, Cal/OSHA issued six citations, three of which were serious and willful, with a total fine of $262,700. Despite an appeal, the citations were upheld.[10]

The fines against Merced Farm Labor Contractor include:

[1] $5,000 for failure to timely report serious injury;

[2] $1,350 for failure to train new employees about the requirements of the injury and illness prevention program;

[3] $1,350 for failure to include written procedures for complying with heat illness prevention requirements;

[4] $22,500 for failure to provide access to drinking water;

[10] See the legal record at "https://www.dir.ca.gov/oshab/Decisions/Precedential/08-3093-Maria-De-Los-Angeles-Colunga-DAR.pdf"

[5] $22,500 for failure to provide access to shade;

[6] $70,000 for failure to provide required heat illness training to employees;

[7] $70,000 for failure to provide required heat illness training to supervisors;

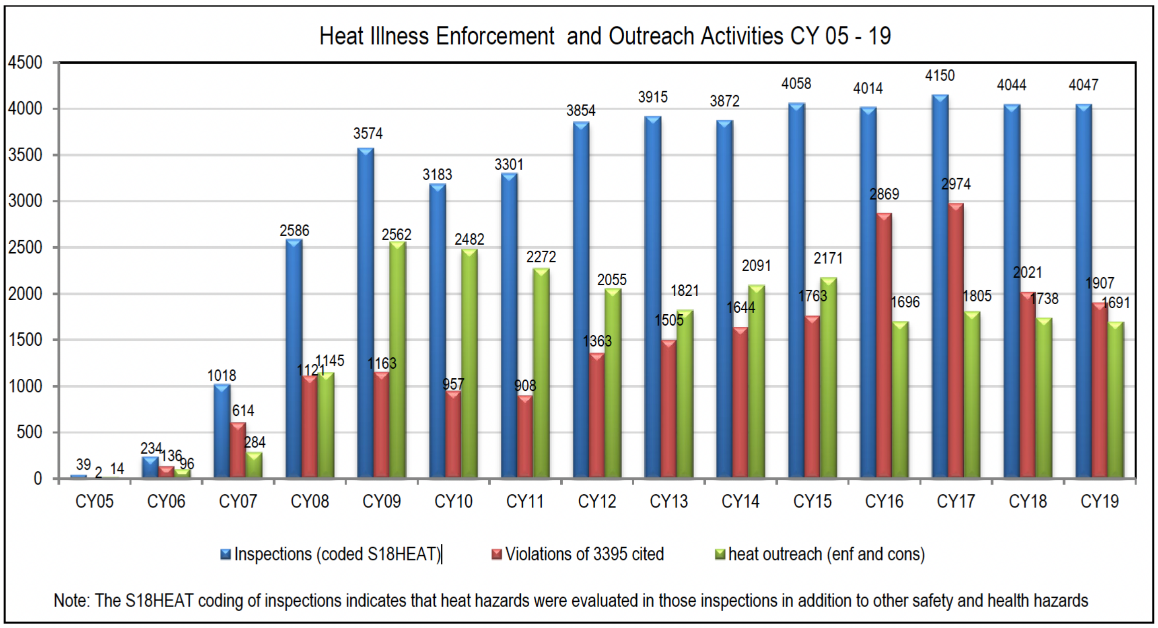
[8] $70,000 for failure to make provisions in advance for prompt medical attention.

In a further response to these violations, the Department of Industrial Relations's Division of Labor Standards Enforcement (DLSE) revoked Merced Farm Labor's license in 2008. This decision was due to non-disclosure of prior Cal/OSHA citations and non-compliance with heat illness regulations. DIR Director John C. Duncan emphasized that the enforcement reflected the company's willful violations that led to severe consequences. Specifically, Duncan stated that "*This company willfully violated the key provisions of the heat illness prevention regulations with tragic consequences...All California employers are required to provide a safe and healthful workplace and this company willfully failed to do so despite knowing the requirements contained in the heat illness regulations and continued to do so even after this terrible death.*"

A plea agreement in March 2011 resulted in Maria De Los Angeles Colunga, the former owner, receiving 40 hours of community service and three years of probation. Her brother, the safety coordinator, pleaded guilty to a felony count of violating a health or safety regulation resulting in death, receiving 480 hours of community service and five years probation. Both agreed to cease farm labor contracting activities.

Figure D.1. Heat Illness Enforcement and Outreach Activities in California

This figure presents the year-round enforcement and outreach activities conducted by Cal/OSHA from 2005 to 2019. This figure is extracted from Page 11 of the "FY 2020 Follow-up Federal Annual Monitoring Evaluation (FAME) Report."



E Robustness of the Results on Plant-level IT Intensity

In this section, we provide additional analyses and tables to demonstrate the robustness of our baseline findings regarding the interaction effects of HIPS and labor exposure to heat on plant-level IT intensity. These tests explore variations in sample construction and model specifications to ensure the robustness of our results.

When constructing the sample, we keep all plants located in California and Washington. While for plants in other states, we keep those whose parent firms have at least 20% employment in high-exposure industries (*Labor Exposure* above the sample median) in California and Washington. In Table E.1, we reconstruct our sample by using alternative thresholds to include plants outside California and Washington into our analysis. Specifically, in columns (1) and (2), we remove the 20% requirement and include all plants outside California and Washington into our sample. In columns (3) and (4), we change the threshold to 10%. In columns (5) and (6), we change the threshold to 30%. Our results remain consistent. Additionally, as can be seen, the economic magnitudes are much smaller in columns (1) - (4) when removing the requirement or using a threshold of 10%. This is consistent with our expectation that including lots of or all plants outside California and Washington that are not affected by HIPS would introduce considerable noise into the sample and estimation, which introduces attenuation bias and works against us finding significant effects.

Additionally, when constructing the sample, we require a plant to have at least five employees and five computers. We test the sensitivity of our results to this requirement in Table E.2. In columns (1) and (2), we remove the filter and include all plants into our sample, regardless of the number of onsite computers and employees. In columns (3) and (4), we use a lower threshold - a plant should have at least three computers and employees to be included in the sample. In columns (5) and (6), we increase the threshold to ten. We further increase the threshold to twenty in columns (7) and (8). Our results remain statistically significant.

In our sample, we exclude plants with missing information on locations, industries, employment, and IT capital in any year during the sample period 2001 - 2007, avoiding the survivorship bias. In Table E.3 columns (1) and (2), we relax the requirement by requiring a plant to have non-missing information during in the 2003 - 2006 period, i,e., non-missing information two years before and after HIPS for California plants. In columns (3) and (4), we only require non-missing information for the 2004 - 2006 period. Our results continue to hold.

In Table E.4, we examine the natural logarithm growth rates of computers and employment. The dependent variable in columns (1) and (2) is the annual change in the natural logarithm of the number of computers (desktop and laptop PCs), and the dependent variable in columns (3) and (4) is the annual change in the natural logarithm of the number of employment. It demonstrates that the implementation of HIPS positively influences the growth rate of plant-level computers but negatively impacts the growth rate of employment. This evidence further supports our baseline results on the levels of computers and employment.

In Table E.5, we employ alternative empirical specifications to address the concern over the logarithm transformation of the dependent variable (Cohn et al., 2022). Specifically, columns (1) and (2) use the fixed effects Poisson model and columns (3) and (4) use the linear regression model. The dependent variable is the number of computers (desktop and laptop PCs) per employee. Our results hold.

Table E.1. The Implementation of HIPS and Plant-level IT Intensity: Non-California and Non-Washington Plants

This table presents robustness checks of the implementation of HIPS and IT intensity by using different criteria to include non-California and non-Washington plants into our sample. Analysis in columns (1) and (2) includes all plants outside of California and Washinton. Analysis in columns (3) and (4) includes plants whose parent firms have at least 10% employment in high-exposure industries in California and Washington. Analysis in columns (5) and (6) requires the share to be 30%. The dependent variable is the natural logarithm of the number of computers (desktop and laptop PCs) and servers per employee, *Log(Computers/Employment)*. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the plant is located in a state that adopts HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. Controls include lagged natural logarithm of the number of computers and lagged natural logarithm of the number of employees. The sample period is from 2001 to 2007. Numbers in parentheses are standard errors. Standard errors are double clustered at the state and the NAICS4 level. ***, **, and * indicate p-values of 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Log(Computers/Employment)					
	All		>=10%		>=30%	
Labor Exposure x HIPS	0.025***	0.021***	0.035*	0.036**	0.055**	0.057***
	(0.005)	(0.005)	(0.018)	(0.018)	(0.021)	(0.019)
Observations	286,877	283,742	59,794	56,771	37,588	36,396
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes
NAICS2 Industry x Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State x Year FE	Yes	No	Yes	No	Yes	No
State x NAICS2 Industry FE	Yes	No	Yes	No	Yes	No
County x Year FE	No	Yes	No	Yes	No	Yes
County x NAICS2 Industry FE	No	Yes	No	Yes	No	Yes
Adjusted R^2	0.905	0.900	0.899	0.896	0.903	0.901

Table E.2. The Implementation of HIPS and Plant-level IT Intensity: Plant Size

This table presents robustness checks of the implementation of HIPS and IT intensity by reconstructing the sample using different plant size thresholds. Columns (1) and (2) include all plants. Columns (3) and (4) require a plant to have at least three computers and employees. Columns (5) and (6) require a minimum of ten and columns (7) and (8) require a minimum of twenty. The dependent variable is the natural logarithm of the number of computers (desktop and laptop PCs) and servers per employee, *Log(Computers/Employment)*. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the plant is located in a state that adopts HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. Controls include lagged natural logarithm of the number of computers and lagged natural logarithm of the number of employees. The sample period is from 2001 to 2007. Numbers in parentheses are standard errors. Standard errors are double clustered at the state and the NAICS4 level. ***, **, and * indicate p-values of 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log(Computers/Employment)							
	All		>=3		>=10		>=20	
Labor Exposure x HIPS	0.061***	0.060***	0.061***	0.060***	0.064***	0.062***	0.060***	0.057***
	(0.020)	(0.018)	(0.020)	(0.018)	(0.019)	(0.016)	(0.020)	(0.018)
Observations	44,793	42,668	43,233	41,146	38,444	36,556	31,240	29,534
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NAICS2 Industry x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State x Year FE	Yes	No	Yes	No	Yes	No	Yes	No
State x NAICS2 Industry FE	Yes	No	Yes	No	Yes	No	Yes	No
County x Year FE	No	Yes	No	Yes	No	Yes	No	Yes
County x NAICS2 Industry FE	No	Yes	No	Yes	No	Yes	No	Yes
Adjusted R^2	0.893	0.890	0.899	0.896	0.915	0.912	0.928	0.925

Table E.3. The Implementation of HIPS and Plant-level IT Intensity: Missing Information

This table presents robustness checks of the implementation of HIPS and IT intensity by reconstructing the sample conditional on plant-level missing information. In columns (1) and (2), we require a plant to have non-missing information during in the 2003 - 2006 period to be included in our sample. In columns (3) and (4), we require a plant to have non-missing information during in the 2004 - 2006 period to be included in our sample. The dependent variable is the natural logarithm of the number of computers (desktop and laptop PCs) and servers per employee, *Log(Computers/Employment)*. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the plant is located in a state that adopts HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. Controls include lagged natural logarithm of the number of computers and lagged natural logarithm of the number of employees. The sample period is from 2001 to 2007. Numbers in parentheses are standard errors. Standard errors are double clustered at the state and the NAICS4 level. ***, **, and * indicate p-values of 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)
	Log(Computers/Employment)			
	No-missing information in 2003 - 2006		No-missing information in 2004 - 2006	
Labor Exposure x HIPS	0.053***	0.047***	0.051***	0.046***
	(0.013)	(0.010)	(0.013)	(0.010)
Observations	60,555	58,281	73,955	71,569
Controls	Yes	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes	Yes
NAICS2 Industry x Year FE	Yes	Yes	Yes	Yes
State x Year FE	Yes	No	Yes	No
State x NAICS2 Industry FE	Yes	No	Yes	No
County x Year FE	No	Yes	No	Yes
County x NAICS2 Industry FE	No	Yes	No	Yes
Adjusted R^2	0.900	0.896	0.898	0.893

Table E.4. The Implementation of HIPS and Plant-level Computers and Employment: Log Growth Rate

This table presents analysis of the implementation of HIPS and the logarithm growth rates of computers and employment. The dependent variable in columns (1) and (2) is the annual change in the natural logarithm of the number of computers (desktop and laptop PCs). The dependent variable in columns (3) and (4) is the annual change in the natural logarithm of the number of employment. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the plant is located in a state that adopts HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. Controls include lagged natural logarithm of the number of computers in columns (1) and (2) and lagged natural logarithm of the number of employees in columns (3) and (4). The sample period is from 2001 to 2007. Numbers in parentheses are standard errors. Standard errors are double clustered at the state and the NAICS4 level. ***, **, and * indicate p-values of 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)
	Change in Log(Computers)		Change in Log(Employment)	
Labor Exposure x HIPS	0.044***	0.039***	-0.001	-0.005*
	(0.016)	(0.013)	(0.005)	(0.003)
Observations	41,846	39,863	41,846	39,863
Controls	Yes	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes	Yes
NAICS2 Industry x Year FE	Yes	Yes	Yes	Yes
State x Year FE	Yes	No	Yes	No
State x NAICS2 Industry FE	Yes	No	Yes	No
County x Year FE	No	Yes	No	Yes
County x NAICS2 Industry FE	No	Yes	No	Yes
Adjusted R^2	0.340	0.317	0.182	0.154

Table E.5. The Implementation of HIPS and Plant-level IT Intensity: Poisson and Linear Regression

This table presents robustness checks of the implementation of HIPS and IT intensity by using fixed effect Poisson model (columns (1) and (2)) and linear regression model (columns (3) and (4)). The dependent variable is the number of computers (desktop and laptop PCs) per employee. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the plant is located in a state that adopts HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. Controls include lagged natural logarithm of the number of computers and lagged natural logarithm of the number of employees. The sample period is from 2001 to 2007. Numbers in parentheses are standard errors. Standard errors are double clustered at the state and the NAICS4 level. ***, **, and * indicate p-values of 1%, 5%, and 10%, respectively.

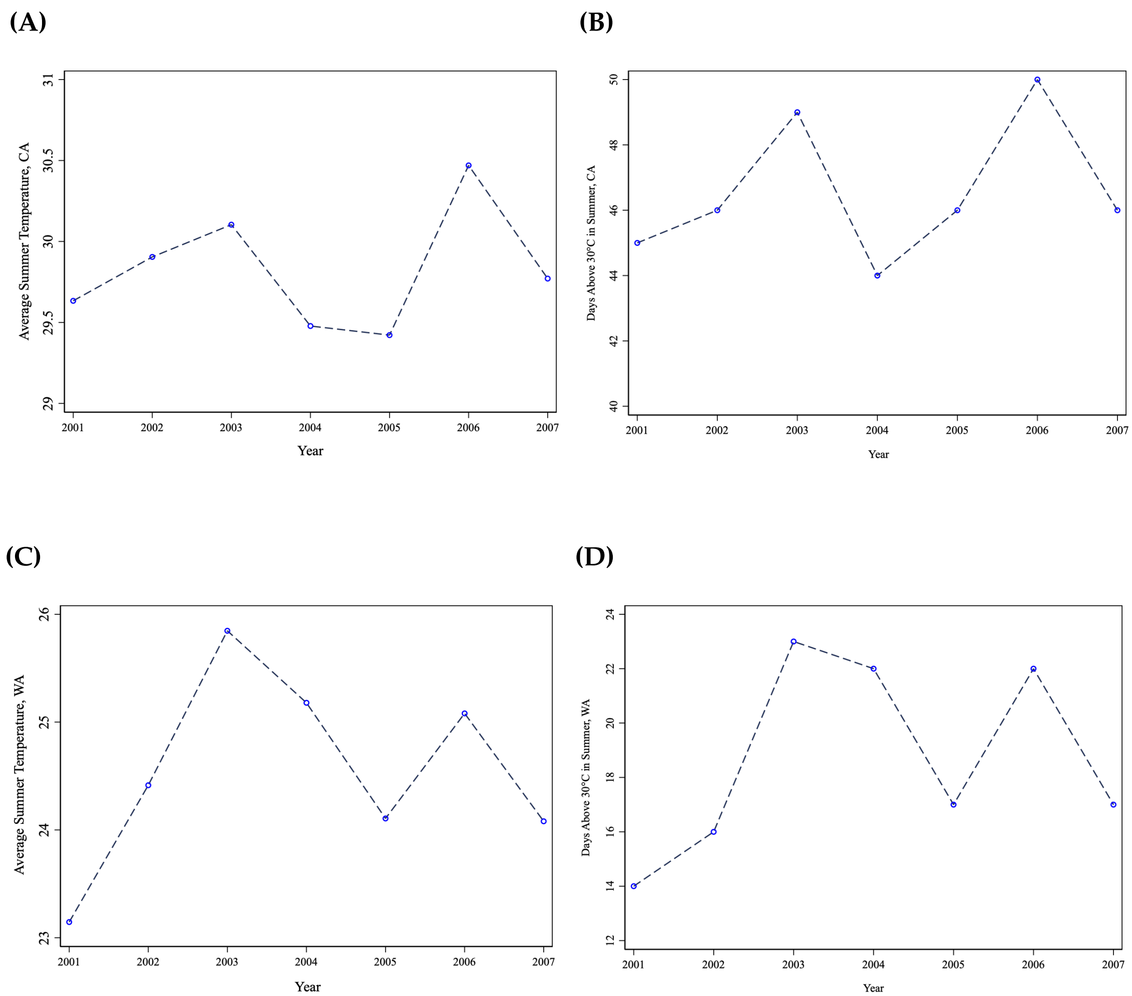
	(1)	(2)	(3)	(4)
	Computers/Employment			
	Poisson		Linear	
Labor Exposure x HIPS	0.042***	0.040***	0.041***	0.042***
	(0.016)	(0.014)	(0.015)	(0.014)
Observations	41,846	39,863	41,846	39,863
Controls	Yes	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes	Yes
NAICS2 Industry x Year FE	Yes	Yes	Yes	Yes
State x Year FE	Yes	No	Yes	No
State x NAICS2 Industry FE	Yes	No	Yes	No
County x Year FE	No	Yes	No	Yes
County x NAICS2 Industry FE	No	Yes	No	Yes
Adjusted R^2	0.129	0.129	0.905	0.901

F Temperatures Around the Implementation of the HIPS

Figure F.1 presents temperature patterns in summers around the implementation of HIPS in California and Washington. Specifically, Figure F.1 (A) presents the average daily maximum temperature in summers in California. Figure (B) presents the number of days with temperatures above the 30°C in summers in California. Figure (C) presents the average daily maximum temperatures in summers in Washington. Figure (D) presents the number of days with temperatures above the 30°C in summers in Washington. The key message from these figures is that there are no significant increases in temperatures prior to the implementation of HIPS, partially addressing concerns that the rise in IT intensity following the implementation of HIPS could be driven by increased heat risks.

Figure F.1. Temperatures Around the Implementation of HIPS

These figures present summer temperatures in California and Washington around the implementation of HIPS. Figure (A) presents the average daily maximum temperatures in summers in California. Figure (B) presents the number of days with temperatures above the 30°C in summers in California. Figure (C) presents the average daily maximum temperatures in summers in Washington. Figure (D) presents the number of days with temperatures above the 30°C in summers in Washington.



G Firm-level Evidence on Capital Intensity

This section provides additional details of the firm-level evidence on capital intensity in response to the implementation of HIPS.

First, we describe the construction of our sample of public firms from the Compustat/CRSP Merged database for analysis in Table 5. Specifically, we start with firms that are headquartered in California and Washington and exclude those in elementary and secondary education services, finance, non-profit, public administration, utility, and unclassified industries. We require each firm to have non-missing information during the sample period 2001 - 2007. We further exclude firms that change their industry classifications and headquarter locations during the sample period. Our final sample include 245 firms each year from 2001 to 2007. Table G.1 presents summary statistics of the variables used in analysis.

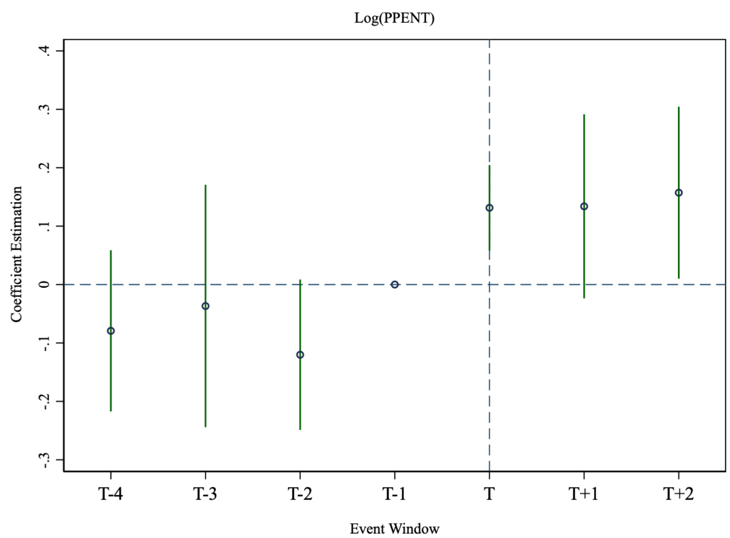
Second, we present dynamic differences in firm-level total capital and employment around the implementation of HIPS in Figure G.1. Consistent with the pant-level evidence on computers and employment in Figure 2 and firm-level capital intensity in Figure 3, we observe no significant differences in total capital and employment across firms with different exposures to HIPS in periods $T-4$ to $T-1$, supporting the parallel trends assumption. However, after the implementation of the HIPS, high-exposure firms significantly increase their capital and decrease their employment.

Third, we reconstruct the sample of public firms from the Compustat/CRSP Merged database by including all firms that are public and have plants included for analysis in Table 2, while maintaining all other selection criteria. This generates a sample of 338 firms each year during the period 2001 - 2007, including firms that are not headquartered in California and Washington but have significant shares of employment in high-exposure industries in California and Washington. We repeat the analysis of firm-level capital intensity in Table G.2. Results are consistent.

Figure G.1. Dynamic Differences in Firm-level Capital and Employment Around the Implementation of HIPS

This figure presents dynamic differences in firm-level capital and employment around the implementation of HIPS. Panel A reports the effects on the natural logarithm of a firm's property, plant, and equipment (PPENT), *Log(PPENT)*. Figure B presents the effects on the natural logarithm of the number of employees (*Log(Employment)*). *HIPS (T-4)*, *HIPS (T-3)*, *HIPS (T-2)*, *HIPS (T)*, *HIPS (T+1)*, *HIPS (T+2)* are indicator variables equal to one if the plant is located in a state that will adopt HIPS in four years, will adopt HIPS in three years, will adopt HIPS in two years, adopts HIPS in the current year, adopted HIPS one year ago, or adopted HIPS two years ago, and zero otherwise. *HIPS (T-1)* indicates the year before the adoption of HIPS in a state and is the omitted category. California implemented the HIPS program in 2005, followed by Washington in 2006.

(A) Log(PPENT)



(B) Log(Employment)

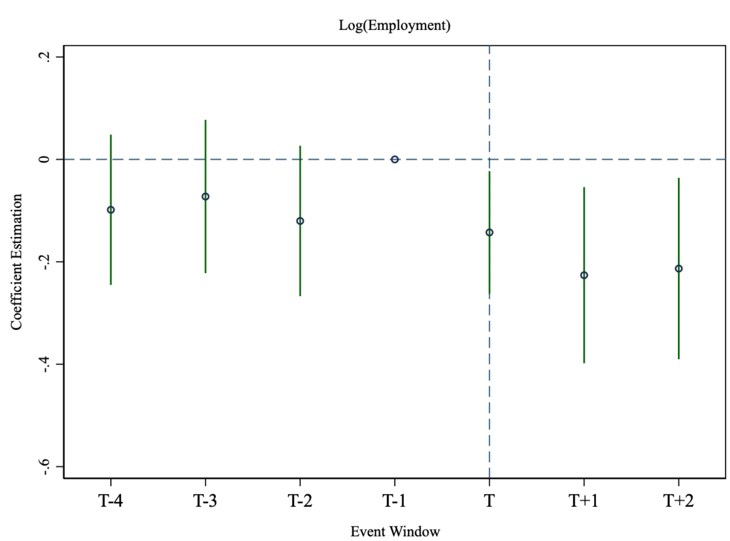


Table G.1. Summary Statistics

This table presents summary statistics of variables used for firm-level analysis in Table 5, 7 and 8. *Log(PPENT/Employment)* is the natural logarithm of property, plant, and equipment (PPENT) per employee. *Log(PPENT)* is the natural logarithm of property, plant, and equipment (PPENT). *Log(Employment)* is the natural logarithm of the number of employees. *Log(Sales/Employment)* is the natural logarithm of sales per employees. *M/B* is the market-to-book ratio. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the plant is located in a state that adopts HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. *Size* is the natural logarithm of total assets.*Book Leverage* is book leverage. *Cash* is cash holdings. *Dividend Payer* is a dummy indicating that a firm pays dividends. The sample period is from 2001 to 2007.

	N	**Mean**	**P5**	**Median**	**P95**	**SD**
Log(PPENT/Employment)	1,715	3.557	1.893	3.484	5.334	1.005
Log(PPENT)	1,715	3.798	1.063	3.574	7.218	1.919
Log(Employment)	1,715	0.227	-1.995	0.037	3.091	1.581
Log(Sales/Employment)	1,715	5.398	3.811	5.399	6.691	0.768
M/B	1,699	2.007	0.608	1.583	5.14	1.337
Labor Exposure	1,715	1.768	1.411	1.689	2.356	0.318
Size	1,706	5.891	3.787	5.686	8.821	1.482
Book Leverage	1,690	0.131	0	0.037	0.521	0.175
Cash	1,706	0.333	0.013	0.3	0.783	0.24
Dividend Payer	1,706	0.198	0	0	1	0.398

Table G.2. The Implementation of HIPS and Firm-level Capital Intensity: Alternative Sample

This table presents the effects of the implementation of HIPS on firm-level capital intensity using an alternative sample. The dependent variable is the natural logarithm of property, plant, and equipment (PPENT) per employee, *Log(PPENT/Employment)*. *Labor Exposure* is pre-HIPS average of a NAICS4 industry's exposure to the regulation, defined in Equation (1). *HIPS* is an indicator variable equal to one if the firm is located in a state that adopts HIPS, and zero otherwise. California implemented the HIPS program in 2005, followed by Washington in 2006. Controls include the logarithm of total assets (Size), market-to-book ratio (M/B), book leverage (Book Leverage), cash holdings (Cash), and a dummy indicating that a firm pays dividends (Dividend Payer). All controls are lagged by one year. The sample period is from 2001 to 2007. Numbers in parentheses are standard errors. Standard errors are double clustered at the NAICS4 and the state level.

	(1)	(2)	(3)	(4)	(5)
	Log(PPENT/Employment)				
Labor Exposure x HIPS	0.205***	0.217***	0.237***	0.141***	0.141***
	(0.026)	(0.012)	(0.012)	(0.049)	(0.049)
Size		0.212***	0.206***	0.198***	0.198***
		(0.052)	(0.053)	(0.044)	(0.044)
M/B			0.009	0.012	0.012
			(0.008)	(0.007)	(0.007)
Book Leverage			-0.013	-0.085	-0.085
			(0.080)	(0.091)	(0.091)
Cash			-0.271***	-0.262***	-0.262***
			(0.078)	(0.088)	(0.088)
Dividend Payer			0.074***	0.059***	0.059***
			(0.020)	(0.020)	(0.020)
Observations	2,324	2,314	2,307	2,293	2,293
Firm FE	Yes	Yes	Yes	Yes	Yes
State x Year	Yes	Yes	Yes	Yes	Yes
NAICS2 Industry x Year FE	No	No	No	Yes	Yes
State x NAICS2 Industry FE	No	No	No	No	Yes
Adjusted R^2	0.953	0.957	0.957	0.958	0.955

References

Cohn, J. B., Z. Liu, and M. I. Wardlaw (2022). Count (and count-like) data in finance. *Journal of Financial Economics 146*(2), 529–551.