What Do Unions Do? Incentives and Investments*

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Abstract

Using plant-level data from the U.S. Census Bureau, we show that unionized plants have lower and less effective incentives in addition to paying higher wages and benefits. Unionized plants do not exhibit the same positive associations between incentives and investment or growth found in non-unionized plants. This applies to both non-managerial and managerial employees, although with a more pronounced effect on the former group. Consequently, unionized plants experience higher closure rates, reduced investment, and slower employment growth. We also find significant spillover effects within the firm: partially unionized firms also offer higher wages and maintain weaker incentives in their non-unionized plants compared to their industry peers. These effects are economically significant and account for half of the estimated reduction in incentives observed in unionized plants. This pattern aligns with the hypothesis that incentives in non-unionized plants create disutility for the median worker. Such spillovers reduce employment and efficiency and make firms less attractive as potential targets, reducing the market's effectiveness in allocating corporate assets. By leveraging recent changes in state-level right-to-work laws, we provide causal evidence that states that adopt such laws experience a boost in employment and investment.

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1 Introduction

Interest in unionization in the U.S. is experiencing a revival after many years of decline. The current federal government is actively endorsing unionization as a policy priority. On the other hand, there's a persistent effort to curb union power through the implementation of Right-to-Work Laws across an increasing number of states. In light of these developments, gaining a deeper understanding of the role of unions and their impact on firm outcomes is of great importance.

In finance, most of the discussion of unionization has focused on the effect of unions on the division of the firm's cash flows between unionized labor and the firm's shareholders and the financial policies that can maximize the shareholder's portion. But there is another critically important determinant of firm outcomes: the effective use of workforce incentives. As we show below, unionized firms use incentives differently, and their outcomes are correspondingly worse.

In this paper, we use granular plant-level data from the Census of Manufactures and the recent Management and Organizational Practices Survey (MOPS) to analyze the effect of unions on firm outcomes in approximately 30,000 manufacturing plants across the U.S. In contrast to previous studies that primarily focus on industry-level unionization rates, we can measure unionization rates at the plant level. This distinction is crucial as it eliminates potential confounding factors stemming from industry-wide effects (as seen in studies relying on industry-level unionization data) or locational effects (as seen in studies relying on geographic estimates of unionization). We can examine how unionization is linked to plant-level metrics, including key elements of incentive structures, as well as labor costs, investment levels, plant exits, and productivity. This granularity also allows us to compare unionized and non-unionized plants within the same firm, locality, and industry.

We have six main findings. First, we show that unionized plants score significantly lower on all three of our measures of non-managerial incentives than non-unionized plants. For example, unionized plants are 26% less likely to have performance-based bonuses, 11% less likely to promote a worker based on performance, and 13% less likely to dismiss a worker shortly following poor performance. Furthermore, the sensitivity to pay-for-performance in these unionized plants is diminished by approximately 30%. In parallel, albeit with a more modest disparity, we also find a reduction in managerial incentives between unionized and non-unionized plants. This spillover effect from unionization onto managerial incentives is consistent with a shift in the breadth of managerial responsibilities, given the alterations in worker incentives.

Second, we find that the performance of manufacturing plants in the U.S. is strongly related to both managerial and non-managerial incentives. In particular, plants, where workers receive

performance-based bonuses and are prompted or dismissed based on their own performance, invest more and grow faster. One standard deviation increase in the usage of incentives is related to a 39% increase in employment and a 22% increase in sales. However, this relationship breaks down for unionized plants. Unionized plants not only have fewer incentives in place, but the incentives they do have are also not linked with positive outcomes on investment and growth observed in non-unionized plants. This lack of effectiveness in incentives further reduces investment levels and growth in unionized plants. We show that differences in incentives, both in terms of level and effectiveness, account for about three-quarters of the gap between unionized and non-unionized plants on these metrics.

Third, we show that incentive systems spillover from unionized plants to non-unionized plants within the same firm. Nonunion plants in the same firm as union plants also have lower wages, fewer incentives, higher exit rates, and lower investments and growth. These spillover effects are large and most pronounced for plants in the same industry or located in the same commuting zone. While the effects are most evident for non-managerial workers, both categories of workers are affected. These spillovers have important implications for the boundaries of the firm, including acquisitions and sales of plants and divisions, as well as the locations of new investments.

Fourth, our analysis of incentive spillovers within a firm allows us to estimate the maximum incentive reduction that can be attributed to the union's strategy to enhance its bargaining power by limiting the employer's ability to influence worker behavior. We find that within a firm with some union representation, the reduction of non-managerial incentives in non-unionized plants is about 43% of the reduction observed in unionized plants. Assuming that firms generally prefer to avoid unionization, the fact that incentives are lower in non-unionized plants without an on-site union acting as a bargaining agent suggests that the median worker prefers at least this level of incentive reduction. Therefore, we can infer that union strategies aimed at enhancing their bargaining power can account for at most 57% of the observed incentive reduction in unionized plants.

Next, we leverage the passage of Right-to-Work laws in Indiana and Michigan in 2012 to establish causal links between unionization and investments. Right-to-work laws grant employees the freedom to decide whether to join or financially support a union, thereby weakening the union's ability to negotiate and enforce collective bargaining agreements with the firm. We find that employment and capital expenditure on equipment increase immediately following the enactment of Right-to-Work laws. To the extent that the passage of Right-to-Work laws is exogenous at the plant level and that the laws' only effect is through its effect of the union's bargaining power, our results suggest that unions have a causal effect on employment and investment.

Finally, we explore how the unions' impact on incentives and wages differs with the concentration of the labor market. Interestingly, differences in the incentives provided by non-unionized plants vary modestly with market concentration. However, in concentrated markets, unionized plants show a greater decrease in incentives, especially in promotion and dismissal decisions. Wage levels are lower in concentrated labor markets, aligning with previous research (Autor et al. (2020)). The difference in wages between unionized and non-unionized plants is greater in concentrated markets, indicating that unions can balance out the lower wages provided by employers who leverage market power.

Overall, we document substantial direct and indirect effects of unions on various key factors. Lee and Mas (2012) find that successful union elections are associated with a 10% decline in market value over the next 18 months. Our findings suggest that the negative relationship between unionization and market value may come from two channels. First, there is a transfer effect. Unionized plants offer higher wages and more generous benefits compared to similar non-unionized plants, controlling for firm, industry, and location characteristics. The labor share is 1.9% higher in unionized plants, accounting for over 30% of the total operating income.[1] The higher labor costs translate into a significant value reduction for investors. More importantly, there is a growth effect. Unionized plants implement lower and less effective incentive contracts, particularly among non-managerial employees. The reduced incentives are associated with higher rates of business closures, lower levels of capital expenditures, and lower employment and sales growth rates. As a result, the overall value created by unionized plants decreases over time.

Furthermore, we uncover significant spillover effects from unionized to non-unionized plants within the same firm. The existence of unionized plants in a firm reduces the incentives and investment levels of non-unionized plants. These spillover effects have significant implications for corporate governance, particularly in takeover markets, resulting in segmented markets for acquisitions between unionized and non-unionized firms. Specifically, when a unionized acquirer takes over a non-unionized target, it may realize lower cash flows from the target due to wage and incentives spillovers, compared to a non-unionized acquirer. Similarly, a unionized target may be perceived as less valuable to a non-unionized acquirer than to a unionized acquirer. If the unionized segment of the market for assets is smaller, the presence of unions is likely to hinder a firm's access to efficiency-enhancing acquisitions and have general equilibrium effects on the industry as a whole.[2] Empirical support for this mechanism is provided by Fallick and Hassett (1999) and Tian and Wang

[1] The median EBIT margin in manufacturing industries (Compustat) is about 6 – 7%.

[2] Maksimovic and Phillips (2001) and Maksimovic, Phillips, and Yang (2013) analyze the role of takeover market on firm productivity.

(2021), who show that non-unionized firms are less likely to acquire unionized plants.

The rest of the paper is organized as follows. In Section 2, we present the general framework and set up our hypotheses. Section 3 describes our samples and presents summary statistics. Section 4 presents our findings regarding the direct effect of unionization, and Section 5 illustrates the spillover effects on non-unionized plants within the same firm. We use the change of Right-to-Work status as an exogenous shock at the plant level to draw causal inferences between unionization and firm investments in Section 6. Section 7 connects our research with other extensively discussed topics pertaining to unionization, and Section 8 concludes.

2 Discussion and Literature Review

In finance research, the central question evolves around how unions, with their ability to negotiate wages above the market rate and exploit sunk fixed capital, influence the incentives of the firm's owners regarding capital investment (Baldwin (1983), Bronars and Deere (1993b)) and their strategic implementation of financing and cash policies to strengthen future bargaining power (Bronars and Deere (1991), Klasa et al. (2009), Matsa (2010)).

In addition to potentially altering the division of cash flows, unions may also influence the internal structure of a firm, particularly its incentive system (Jensen and Meckling (1976), Lazear (2000), and Bloom and Van Reenen (2011)). We focus on these effects. A large body of research has highlighted the crucial role of optimal incentive contracts and worker monitoring in driving a firm's value creation process (Bloom and Van Reenen (2007), Bloom et al. (2013), Benders et al. (2019)). Moreover, incentives may also affect the job satisfaction of employees. Some employees may not prefer incentive structures that require them to work intensely or expose them to the firm's business risk. In this case, unions may negotiate for lower incentives to align the preferences of their members, even at the direct cost of foregoing higher wages and the indirect cost of reducing firm value. Others may prefer an incentive structure that allows them to increase their labor income by expanding more effort.

There may be a second consideration that leads to lower use of incentives in unionized establishments. Unions may negotiate contractual provisions that limit the management's authority to provide incentives and monitor employees without union oversight. The reduction in management discretion in rewarding or punishing workers makes it harder for the firm to implement incentive structures that could weaken the union's bargaining power, albeit indirectly reducing firm value. This can be seen as the union equivalent of management strategies to diminish union bargaining

power, as discussed by previous studies such as Baldwin (1983) and Matsa (2010), among others.

Unions not only affect the incentives of their members directly but can also indirectly influence the incentives of manufacturing plant managers. Managers receive their incentives partly to motivate them to supervise their subordinates' performance, implement incentive programs, and enhance efficiency. However, when union contracts reduce worker incentives and limit workplace flexibility, they may curtail managerial initiatives and monitoring scope. As a result, this curtailment of managerial discretion can lead to a predicted decline in incentive payments to managers. Thus, we expect unionized plants to have higher wages but lower organizational incentive structures:

Hypothesis 1 (H1): *Unionized plants will have higher non-management labor costs and lower use of incentives for both managers and non-managers than non-unionized plants.*

How does the disparity in incentives between unionized and non-unionized firms affect investment levels and sales growth? In general, a positive relationship is expected between incentives, investments, and growth, as incentives typically serve as a motivating factor for employees to give their best effort. Moreover, even when unionized establishments have formal incentive plans, certain procedures and dispute resolution processes are pre-determined ex-ante through collective bargaining between the firm and the union. These contractual arrangements could limit the flexibility of management and restrict their ability to take certain actions. For example, the enforcement of the Weingarten Rules (NLRB vs. Weingarten, Inc. 420 U.S. 251, 88 LRRM 2689) poses significant challenges for management in unionized plants to link performance to behavior that is observable but legally unverifiable. More generally, unionized workplaces tend to the enforcement of promotion by seniority (Abraham and Farber (1988)). As a result, the same formal incentives associated with positive plant outcome metrics in non-unionized establishments may not yield similar outcomes in unionized establishments. For parallel reasons, the relation between managers' incentives and plant performance will also be attenuated in unionized plants.

Hence, we hypothesize that both of these consequences of unionization, higher wages and less effective use of incentives, have implications for plant performance.

Hypothesis 2 (H2): *The positive relation between incentives, growth, and investment is weaker in unionized plants.*

This hypothesis is consistent with findings in Chava et al. (2020), who show that unionized firms increase investment and employment after the passage of right-to-work laws and union's bargaining power is reduced. Similarly, Bloom et al. (2019) find a positive effect on employment following the

enactment of right-to-work using the MOPS data. Our goal is to offer insights into the channels that lead to these changes. We posit that these effects are economically significant and that the major differences in outcomes between unionized and non-unionized plants can be explained by two factors: the effectiveness and level of labor incentives and the higher wages in unionized plants.

Hypothesis 3 (H3): *The reduced investment and slower growth in unionized plants compared to their non-unionized counterparts can be largely attributed to less effective incentives and higher wages.*

Spillovers may occur from unionized to non-unionized plants if the firm attempts to preempt the unionization of its other plants by voluntarily granting partial union benefits to non-unionized employees, thereby reducing their incentives to seek union representation.[3] This implies that the firm will either increase wages above market levels, vary incentives, or both. Such spillovers are economically important in their own right and can be used to make inferences about the motivation for reduced incentives in unionized plants.

To obtain the right to represent workers in an establishment, a union typically has to win a majority vote in a proposed bargaining unit.[4] The role of wages in preempting unionization is straightforward. Higher wages benefit the currently employed workers. Thus, the firm may unilaterally increase wages in non-unionized plants to preempt unionization. How the firm should set incentives in their non-unionized plants relative to their unionized plants depends on the unions' motives for negotiating lower incentives. We consider two cases. The first, which we call the "Homogeneous Outcomes Hypothesis", is that the median non-managerial employees prefer incentives set lower than what a firm striving to maximize shareholder value would establish. This may occur either because such a level of incentives causes them to bear too much of the firm's business risk or work at an intensity that they do not find desirable. In this scenario, unions use their bargaining power during contract negotiations to represent their members' interests and push for agreements that match their preferred incentive levels. The second scenario, referred to as the "Entrenchment Hypothesis", posits that unions strategically restrict management's ability to provide rewards or impose penalties on workers beyond what the median worker would prefer. This strategy aims to build unity among union members, strengthening the union's bargaining power during negotiations with the firm.

[3]Holmes (2006) argues that union status is an "experience good" and that unionization is "contagious" in the sense that it spreads spatially to nearby establishments within a community. Previous studies have documented within-firm wage spillovers for both managers (Duchin, Goldberg, and Sosyura (2017)) and rank-and-file workers (Gopalan, Hamilton, Kalda, and Sovich (2021)).

[4]DiNardo and Lee (2004) and Dinlersoz et al. (2017) describe the certification process.

Firms that want to preempt the unionization of their non-unionized plants will be motivated to reduce their reliance on incentives voluntarily if they believe that doing so reduces the attractiveness of a union. The extent to which they can reduce incentives is bounded by the preferences of the median worker. Thus, by comparing the level of incentives in non-unionized plants between a non-union firm and a union firm, we can obtain a lower bound for the incentives implied by the Homogeneous Outcomes Hypothesis. The higher the probability of unionization, the tighter the bound. On the other hand, since firms do not negotiate with a union for their non-unionized plants, there is no reason for them to reduce incentives below the incentives implied by the Homogeneous Outcomes Hypothesis. Thus, any differences between the incentive level of the firm's non-unionized plants and unionized plants provide an upper bound to the economic effect of the Entrenchment Hypothesis. Thus, all other things being equal, smaller spillovers in incentives between unionized and non-unionized plants of the same firm would suggest that the lower incentives of unionized plants are driven mostly by unions' strategic considerations rather than by worker preferences.

The spillovers in incentives for non-managerial workers will have parallel effects on managers' incentives in the firm's nonunionized plants. In particular, spillover reductions in incentives for non-managerial workers to preempt unionization will also reduce the incentives required to motivate managers. The following hypothesis sums up these arguments:

Hypothesis 4 (H4): *There will be spillovers from a firm's unionized plants to its non-unionized plants, resulting in higher-than-market wages. If the Homogeneous Outcomes Hypothesis holds, the non-unionized plants in a unionized firm would have lower incentives compared to similar plants in non-unionized companies, and the difference provides a lower bound on the incentives suggested by the Homogeneous Outcomes Hypothesis. On the other hand, within the union firm, the difference in incentives between unionized and non-unionized plants provides an upper bound for the additional incentive cuts implied by the Entrenchment Hypothesis.*

Under Hypothesis 4, the finding of spillover effects would imply that the observed lower incentives and their less effective implementation in unionized plants, as compared to non-unionized ones, aren't just due to the union trying to curb management's power and enhance its negotiating strength. In the next section, we use this understanding to estimate the upper bound on the incentive decrease that could result from the union's strategic efforts to improve its bargaining position.

A further implication of Hypothesis 4 is that markets for corporate acquisitions, both total firms, and divisions, will be divided into unionized and non-unionized segments, reducing allocative

efficiency. Unionized firms or establishments will be less valuable to non-unionized acquirers than to unionized acquirers. Similarly, acquisitions of non-unionized firms by unionized firms may be less valuable because of potential spillovers to the newly acquired plants. As such, it rationalizes the empirical results that non-unionized firms are less likely to acquire unionized plants Tian and Wang (2021). Consequently, the unionization of the firm or its division can alter the market segment for acquisitions, potentially reducing the firm's value.

In addition, this segmentation in the acquisition market, influenced by spillover effects, can have further indirect implications on managerial incentives. Bertrand and Mullainathan (2000, 2003) show that the acquisition market is vital in motivating CEOs. Reducing the number of potential acquirers is likely to adversely affect managerial performance and require alternative mechanisms for managers, such as concentrated ownership or more high-powered incentive contracts.

However, from the perspective of unions, spillover effects imply that their presence within a firm creates an externality for non-unionized workers, including those in different locations. To the extent that the employees of non-unionized plants obtain partial benefits of union membership without union fees, the attractiveness of unions is reduced. Thus, spillovers do not benefit unions directly.

If the influence of unionization extends to non-unionized plants within the same firm, can we anticipate varying degrees of impact across different plants? Existing research has shown that when employees seek social comparison, particularly with their colleagues, they tend to choose individuals who are physically close to them, with whom they interact regularly, and possess more information (Festinger (1954), Kulik and Ambrose (1992), Luttmer (2005)). For example, Obloj and Zenger (2017) find that increased proximity between branches of a bank, where employees in some branches are eligible for prizes that employees in others are not, results in reduced productivity among employees in the disadvantaged branches. Alcácer and Zhao (2012) demonstrate that employee interactions increase when they are involved in related or interdependent tasks. Therefore, we predict that the spillover effects we expect from unionization will be stronger when the unionized and non-unionized plants are more similar and physically closer to each other.

Since managerial incentives are in part determined by worker incentives, we would expect a parallel spillover in managerial incentives: the spillovers will be higher for plants in the same commuting zone or the same industry.

Hypothesis 5 (H5): *The spillover effects will be greater if the plants are in the same commuting zone or industry.*

The finding that within-firm spillovers are strongest locally has direct implications for firm expansion strategies: Spillovers create incentives for firms to locate new plants and investments at a distance from their existing facilities. However, there will be trade-offs, as research by Giroud and Mueller (2015) suggests that distant plants receive less attention and resources. Consequently, while establishing new plants distant from existing facilities may offer the advantage of stronger worker incentives and lower wages, they can potentially result in less effective monitoring, and reduced productivity.[5]

Taken together, Hypotheses 1 to 5 suggest that the impact of unionization extends far beyond wage adjustment and extends to various aspects of the firm's operations, including investments, capital intensity, the market for assets, and even potential changes in ownership structure.

Our framework also allows us to explore the effect of incentives on two related issues that have generated research interest in the literature. Several recent papers suggest that real wages often depart from competitive levels when local labor markets are highly concentrated. In this context, we investigate the extent to which unions raise compensation above competitive market levels and act as a counterweight to concentrated employers. If non-union wages are depressed due to the market power of monopsonistic employers, unions have greater potential to create value for their members relative to non-unionized workers. They can not only extract monopsonistic profits from the employer but also engage in further collective bargaining.

The influence of an employer's market power on incentives is more nuanced, but it aligns in the same direction. Technological factors partly shape optimal incentives, which are set to be at the optimum in non-unionized plants functioning in a free market. If these incentives increase beyond this point, they might yield diminishing returns. Therefore, at a basic level, a non-unionized employer with significant market power might choose to use this power to reduce overall wages more than to adjust incentives. This asymmetry implies that the effect of local monopsony on the union incentive differential will be less than it is on the union wage premium.

Hypothesis 6 (H6): *(A) The union wage premium is higher in concentrated labor markets. (B) The relative use of incentives in unionized and non-unionized plants is less sensitive to employer market power than the union wage premium.*

Labor economists have shown that unions are generally associated with lower levels of investments (Hirsch (1992), Fallick and Hassett (1999), and Denny and Nickell (1992)), innovation

[5]In a case study of General Electric and Boeing, Holmes argues that such trade-offs are key to understanding new plant location. Only new plants with important R&D interdependencies, which would be costly to separate, are located close to existing unionized facilities. "New manufacturing Investment and Unions," https://www.minneapolisfed.org/article/2013/new-manufacturing-investment-and-unions-epp,accessedJune3,2023.

(Bradley et al. (2017)), and growth.[6] While existing research supports these stylized facts, it is important to note that most U.S. studies are not derived from a broad sample of establishment-level micro data on plant outcomes or unionization status. The focus of much of the discussion revolves around strategic considerations arising from unions' bargaining power. The constrained ability to employ optimal incentives in unionized firms is likely to result in lower labor productivity relative to capital while, at the same, increasing the relative cost of labor. As noted in Hypothesis 2, this will lead to a decrease in overall investment. However, as labor becomes relatively more expensive, it is optimal for the firm to substitute labor with capital and increase the capital-labor ratio at the lower investment level:

Hypothesis 7 (H7): *Unionized plants will have higher capital-labor ratios than non-unionized plants.*

To empirically test these hypotheses, we use granular plant-level data in manufacturing industries from the U.S. Census Bureau. The granularity of our data allows us to account for both industry and location-fixed effects, providing a more robust analysis. In contrast to earlier studies that relied on aggregate industry-level unionization rates, our approach enables us to observe the degree of unionization at each plant directly. However, it is important to acknowledge that a significant portion of our analysis is inevitably descriptive since it is hard to derive country-wide instruments for unionization.[7] Nonetheless, we take advantage of the fact that during our sample period, two states passed Right-to-Work laws, which weakened the unions' bargaining power. This policy change enables us to perform a Difference-in-Differences analysis, albeit within a short window, which provides us with a causal interpretation of several of our findings.

3 Data and Summary Statistics

We construct our sample of manufacturing plants from the Census of Manufacturers (CMF) and the Annual Survey of Manufacturers (ASM) at the Census Bureau. The CMF is taken every five years, ending in years 2 and 7, and covers all establishments in the manufacturing industries with paid employees. Between the two CMF years, the ASM tracks approximately 50,000 manufacturing plants annually and covers all plants with more than 250 employees. Smaller plants are randomly selected every fifth year to complete a rotating five-year panel. For ASM, reporting is mandatory

[6] For a contrary view on growth, see Bronars and Deere (1993a).

[7] We also note that given the existence of spatial spillover effects discussed in Holmes (2006) and our Hypothesis 5 above, our estimates may understate the causal effect of unions on firm variables since some of these are likely to captured by location fixed effects.

once a firm is selected to participate. Establishments must report to the government by law, and fines are levied for misreporting. In both datasets, permanent identifiers are assigned at the establishment and the firm level, which allows us to track all establishments under the same firm at each point and follow an establishment over time.

We obtain detailed plant-level data on the value of shipments, production costs (material and energy), and capital stock (in equipment and structures). In addition, information is provided on labor costs, including the number of employees, the total number of hours worked (production workers only), wages (production and non-production workers), and costs of providing various benefits (pension, health, and others). We compute two wage measures - the average wage (Wage), calculated as the total wage bill divided over the total employment, and the hourly wage (Wage_Hr), the ratio between wage paid to production workers over the total number of hours worked by production workers. The latter is especially useful in our setting, as union membership mainly applies to production workers. We compute the cost per worker to cover health, pension, and other fringe benefits(Ben_Heath, Ben_Pen, and Ben_Other) by dividing the total dollar cost reported for each category by the total number of employees. We also compute the aggregate benefit cost per worker (Ben_Total) by aggregating the cost of three components. We calculate two productivity measures - value added (VA) and total factor productivity (TFP). VA is the difference between the total value of shipments minus production costs (material and energy) and contract work, adjusted for the change in work-in-process inventories between the beginning and end of the year. TFP is calculated using cost shares of capital input, labor input (hours), and intermediate goods input, following Foster et al. (2001).

We collect information about union status and incentives at the plant from the Management and Organizational Practices Survey (MOPS). MOPS was first delivered as a mandatory supplement to the ASM in 2010 to collect data on management practices (in three main sections: monitoring, targeting, and incentives) and organizational structure. It was sent electronically and by mail to plants included in the ASM, and the Census received responses from approximately 36,000 plants, about 75% of all recipients (see Bloom et al. (2013), and Bloom et al. (2019) for a detailed discussion of MOPS).

Our main sample consists of about 30,000 plants included in the 2010 ASM that report positive employment and value of shipments and have at least ten non-missing responses from MOPS.[8] We follow these establishments over time to 2017, the year of the last available census, and use the ASM to fill in information between the two census years (2012 and 2017). Since small firms selected

[8]The same criterion is used in Bloom et al. (2019) to create a clean MOPS sample.

to participate in the 2010 ASM are only required to stay in the panel for five years (i.e., 2010-2014), their information can be limited from 2014 until the next census year (2017).

We also supplement our sample with the Longitudinal Business Database (LBD) at the Census. The LBD is a plant-level dataset, constructed based on surveys and administrative records from the IRS, that contains information on business plants and firms with paid employees. It covers all industries in the U.S. We use the LBD to identify other (non-manufacturing) plants owned by the same firms in our sample and to cross-validate the exit status for plants that do not appear in the 2017 CMF.

We define our main unionization measure based on the answer to Question 36 in MOPS - "What percentage of all employees at this plant were members of a labor union?" The respondents were given six categories - 0%, 1-20%, 21-40%, 41-60%, 61- 80%, and more than 80%. The variable (Union) takes the median of the category chosen. We also define an indicator variable, D_Union, if at least some workers in the plant belong to a labor union. In our sample, 80.1% of the plants do not have any labor union, and 13.3% of plants have more than 60% of the workers as members of labor unions.[9] Industries with the highest percentage of union membership are Paper (37%), Petroleum and Coal (30%), and Primary Metal (26%). Industries such as Computer and Electronics (2%) and Printing (5%) have the lowest percentage. There is also a large heterogeneity across locations. Union membership in manufacturing industries is high in the midwest (IL, OH, and KY are all at 21%, IN is 20%, and MI and WI are 18%) and low in the south (SC, NC, GA, and FL are also below 6%). Figure 1 presents the distribution of union membership in U.S. manufacturing across industries and locations.

Figure 1: [INSERT FIGURE HERE]

For incentives, we focus on three dimensions - performance-based bonuses, promotion decisions, and dismissal decisions, separately for managers and non-managers. For bonuses, we include answers to two questions: (1)"What percent of non-managers at this plant received performance bonuses?" with answers of 20% or less, 20-40%, 41-60%, 61-80%, or more than 80%, and (2) "What were non-managers' performance bonuses usually based on?", with choices of own performance, team or shift performance, For example, union's performance, firm performance, or no performance bonuses. The first question asks about the coverage of performance-based bonuses, and the second question is about the criterion used in determining performance. Similar to the unionization measure, we take the median of each category chosen for the first question. For the second question,

[9]Percentages for the five categories are 80.1%, 1.5%, 1.6%, 3.6%, 7.3%, and 5.9%, respectively.

we normalize each response to a score between zero and one, with the responses associated with the most structured management practices receiving a value of one, and translate five categories into the following values (1, 3/4, 1/2, 1/4, and 0), following prior work (Bloom et al. (2013), Bloom et al. (2019)). The average score of these two questions is defined as the bonus measure for non-managers (Bonus_NM). Plants with more than 80% non-managers receiving performance bonuses based on workers' own performance have the highest value.

Two of the questions in MOPS center around promotion and dismissal decisions. Respondents are asked about the primary way non-managers were promoted - solely based on performance, mainly based on performance, marginally based on performance, or no promotion, and the consequence of under-performance for non-managers - dismissed within 6 months, dismissed after 6 months, or rarely or never dismissed. Again, we normalize each response to a score between zero and one, with the strongest incentives receiving a value of one (Promotion_NM, Dismissal_NM).[10] The same set of questions was asked about managers, which allows us to compute the corresponding incentive scores on the manager side (Bonus_M, Promotion_M, and Dismissal_M).

MOPS includes several questions about how decisions are made within the firm and decision authorities about new product introduction, product pricing, advertising, and capital investments. For example, whether a specific decision is made at the plant level, at the headquarter, or a combination of the two. We normalize the response for each decision into a score between zero and one, with the most decentralized (centralized) response receiving a value of one (zero). We then average the scores of all five questions for the level of decentralized decision (Decision). Appendix A provides a detailed description of the mapping between responses and the translated numerical score for all variables used in the paper. The exact mapping is used in Buffington et al. (2017).

Table 1 compares plants with or without union membership. Union plants have higher value of shipments and more employment, and they also pay higher wages and provide more generous benefits. For example, the average wage per worker is 11% higher, and the hourly wage for production workers is 19% higher in unionized plants. In the meantime, the average benefits per worker are 45% higher in union plants. The difference in pension benefits is most substantial - union workers receive almost twice the amount of pension benefits relative to non-union workers. Incentives are weaker in union plants for non-managers across all three dimensions - they are less likely to receive performance-based bonuses, be promoted based on performance, or be dismissed due to underperformance. Interestingly, the opposite is true for managers - managers in union plants have stronger

[10]The scores are constructed as follows: promotion decisions solely based on performance (1), mainly based on performance(2/3), marginally based on performance (1/3), or no promotion (0), and underperforming non-managers will be dismissed within 6 months (1), dismissed after 6 months (1/2), or rarely or never dismissed (0).

incentives. Since union membership rarely applies to managers, plants with union membership may use stronger managerial incentives to counterbalance the weak worker incentives. As shown in Figure 1, union membership varies widely across industries and locations. To better understand the association between union membership and wages, benefits, and incentives, one needs to control for industry and location effects.

Table 1: [INSERT TABLE HERE]

4 Baseline Results

4.1 Union, Labor Costs, and Incentives

First, we test Hypothesis 1 on the general pattern between union status and labor costs, controlling for industry, location, and firm characteristics.

4.1.1 Union and Labor Costs

We consider both wages and benefits when calculating labor costs. Specifically, we focus on the hourly wage for production workers as the primary wage measure, considering their higher likelihood of union membership. Our results remain qualitatively consistent when using the average wage for all workers, albeit with a smaller magnitude.[11] For benefits, we use the total benefits provided per worker (including health, pension, and other fringe benefits) as our primary measure. We find similar patterns when examining each benefit component.

To capture the level of unionization, we use an indicator variable, D_Union, which takes the value of one if workers in the plant have union membership and zero otherwise. In addition, we control for the plant size by including the total value of shipments (Log(TVS)) and the plant age by using the number of years since it first appeared in the LBD (Log(Age)).[12] As wages and benefits can be set at the firm level, we control for the total firm employment (Log(Firm Emp)) by identifying all plants within or outside the manufacturing sector under the firm identifier using the LBD. Labor costs may be related to productivity, so we include the plant-level total factor productivity (TFP) estimated based on cost shares of capital, labor, and intermediate goods (TFP).[13] we also control workers' education levels by including the percentage of individuals with at least Bachelor's

[11] The hourly wage is calculated as the total payroll dividend by the total production hours, while the average wage is calculated as the total payroll divided by the total number of production works.

[12] Since the LBD started in 1976, the age variable is truncated.

[13] TFP is estimated using the number of production hours rather than the dollar cost.

degrees among managers and non-managers (% BA_Manager, %BA_Non-Manager). We include fixed effects to account for variations of unionization status across industries (4-digit NAICS) and locations (commuting zones). Table 2 presents our findings.

Table 2: [INSERT TABLE HERE]

Union plants, on average, pay 7.5% more in hourly wages to production workers and have 17.8% higher benefit costs after controlling for (Industry × Commuting Zone) fixed effects (Columns 1 and 3) and other firm characteristics. Our finding on wages aligns with the well-documented union wage premium (Freeman and Medoff (1984)). However, very few studies, if any, have looked at the gap in benefits between unionized and non-unionized firms. In our sample of plants, on average, benefit costs constitute approximately one-third of the wage costs, and accounting for benefit differences further widens the gap in labor costs attributable to unionization.

The estimates from regressions are smaller than what's reported in the summary statistics of Table 1 (11% and 49%, respectively). This implies that a considerable portion of the gap between unionized and non-unionized plants can be explained by industry, location, and plant characteristics. Our findings remain consistent when using the average wage for all workers (Column 2), albeit with a smaller effect size, and hold across various benefit types. Additionally, we find that larger plants belonging to larger firms and older plants offer higher wages and benefits. Furthermore, there is a positive relation between plant productivity and both wages and benefits, indicating a strong link between productivity and compensation (Stansbury and Summers (2018)). Education positively correlates to wages and benefits for both managers and non-managers.

In Columns 4 to 6, we include additional firm fixed effects. The union premium drops to about half the level in Columns 1 and 3 but remains statistically and economically significant. Our finding suggests that even within the same firm, union plants pay 4.2% higher wages and 9.9% higher benefits, controlling for industry and location fixed effects.

One plausible explanation for the union wage premium is that unionized plants have higher productivity, with collective bargaining enabling workers to share in the resulting rent. For example, Freeman and Medoff (1984) have shown that improved personnel policies and reduced employee turnover contribute to increased productivity in unionized plants. However, the evidence regarding the impact of unions on productivity is, at best, mixed. In their highly influential study, Brown and Medoff (1978) report a positive effect of unions on productivity. Using larger, more representative samples, subsequent studies have consistently found a negative effect of unionization on productivity, albeit with considerable variation across industries (Clark (1980), Hirsch (1992), Black and

Lynch (2001), among others). Additionally, research suggests that positive union productivity effects are more prominent in private, for-profit sectors where competitive pressure exists (Hirsch (2017)).

Compared to previous studies, a significant advantage of our data is our ability to identify unionization status at the plant level rather than relying on industry-level union density. Furthermore, we can estimate productivity at the plant level based on input shares in capital, material, energy, and labor. In Table 2, we show that unionized plants offer higher wages and provide more generous benefits, even after controlling for productivity (TFP). This finding suggests that productivity differences cannot solely explain increased labor costs associated with union status. To further investigate the relationship between unionization and productivity, we employ two measures - the total factor productivity (TFP), estimated based on Foster et al. (2001) and value-added, as outlined by Bloom et al. (2013).

Table 3 shows a consistently negative correlation between unionization and productivity. Our estimates indicate that unionized plants experience a productivity loss ranging from 3% to 8% in the U.S. manufacturing industries, compared to their non-unionized counterparts, after controlling for industry and location fixed effects and firm characteristics. Our results remain robust even when accounting for firm fixed effects, indicating that unionized plants are less productive than their peers in the same firm. These plant-level productivity differences are unlikely to be driven by selection since, as Dinlersoz et al. (2017) show, unions focus their organizing efforts on large and productive establishments during the early stages of their life cycles. In sum, these results challenge the notion that the wage premium associated with unions can be attributed to higher productivity in unionized plants.

Table 3: [INSERT TABLE HERE]

4.1.2 Union and Incentives

Next, we utilize survey data from the MOPS to gain insights into the differences in incentives between unionized and non-unionized firms. Additionally, we analyze the relation between realized wages and productivity overtime at the plant level to understand the dynamics of this important interaction.

Performance-Based Measures from MOPS

We examine incentive measures across three dimensions using information from the MOPS, each separately for managers and non-managers. First, we examine the prevalence of performance-based bonuses (Bonus_M, Bonus_NM). A higher score indicates a larger portion of workers in the plant receiving performance-based bonuses directly linked to their individual performance. Second, we explore the extent to which firms promote their employees based on their own performances (Promotion_M, Promotion_NM). A higher score indicates that managers or non-managers are primarily promoted based on their performances rather than other factors such as tenure or personal connections. Lastly, we assess whether employees face the consequences for poor performances (Dismissal_M, Dismissal_NM). A higher score suggests that managers or non-managers with subpar performance are more likely to be dismissed or reassigned within 6 months. The detailed definitions for these variables are described in Section 3.

Table 4 reports our findings. Union plants score significantly lower in incentive measures, especially for non-managers. For example, for non-managers, unionized plants are 26% less likely to offer performance-based bonuses, 11% less likely to promote based on their own performance, and 13% less likely to dismiss due to underperformance. In contrast, the effect of unionization on manager incentives, although consistently negative, is considerably smaller, ranging from 15% to 33% compared to non-managers. A possible explanation for the lower incentives among managers, who are typically not union members, is that without incentives in place for non-managerial employees, there is a limited need for monitoring and oversight of managers. In other words, the lack of incentives for non-managers can spill over onto managers, contributing to their lower incentives. On the control variables, we find that larger and more productive plants are associated with more performance-based incentives. Moreover, worker education positively correlates with the implementation of performance-based incentives. Notable, the effect of education on incentive measures is more pronounced for non-managers than managers. Lastly, performance-based incentives are more commonly implemented in plants affiliated with larger firms. In Columns 7 and 8, we rerun the specification using the composite index aggregating the three components of incentive measures and find qualitatively similar results.

Table 4: [INSERT TABLE HERE]

Pay-for-Performance Sensitivity

Using data from the MOPS, we find that unionized plants are less likely to implement incentive measures such as performance-based bonuses, promotions, or dismissal. In this section, we adopt an alternative approach to capture incentives by examining the dynamic relation between realized wages and productivity at the plant level. Specifically, we investigate how wages respond to changes in productivity, similar to the concept of pay-for-performance sensitivity used in the literature to analyze managerial incentives (Core and Guay (1999)). A higher sensitivity in this context suggests the presence of stronger incentives for employees.

In our sample, small firms are observed in a five-year rotating panel, and the last available year for those included in the 2010 ASM panel is 2014. Since wages can be sticky in the short term (Hall (2005)), we measure the wage-productivity sensitivity by comparing data from 2010 (the first year of the ASM panel) to 2017 (the subsequent economic census while reporting is mandatory for all firms). To account for plant-specific effects, we construct a two-observation panel for plants included in our 2010 sample and incorporate plant-fixed effects using the following specifications:

$$Y_{pil,t} = \beta_0 + \beta_1 \times PROD_{pil,t} + \beta_2 \times (Union_p \times PROD_{pil,t}) + f_p + \gamma_i + \alpha_l + \epsilon_{pil,t} \tag{1}$$

where $Y_{pil,t}$ measures the average compensation for plant p in industry i commuting zone l at time t and $PROD_{pil,t}$ is the corresponding labor productivity. f_p, γ_i, and α_l reflect plant, industry, and location fixed effects, respectively.

β_1 is the estimate of the pay-for-performance sensitivity for all plants, and β_2 estimates the differential effect by unionization status. The unionization indicator is suppressed, given the plant fixed effects. We use two compensation measures - the logarithm of the hourly wage for production workers and the logarithm of average wages. As union membership is more likely to apply to production workers, the effect of unionization would be stronger in wages for production workers. However, using the total payout is more appropriate if performance-based bonuses are paid out separately from hourly wages. We use the value-added, normalized by labor input (total production hours (VA/TH) or total employment (VA/TE)), as a proxy for labor productivity. The results are reported in Table 5.

Table 5: [INSERT TABLE HERE]

Compensations are strongly related to productivity in all specifications. Plants with rising productivity are associated with higher compensations ($\beta_1 > 0$). However, the sensitivity is smaller

($\beta_2 < 0$) and about two-thirds in magnitude for unionized plants relative to non-unionized plants. This finding further confirms the survey evidence that unionized plants are less likely to adopt performance-based bonuses. Our finding is consistent with findings in Chen et al. (2011) that unionized firms have lower operating flexibility due to fixed wage structure.

4.2 Union and Firm Performance

So far, we have shown that unionization is positively linked with wages but negatively associated with incentives. As labor costs and incentives are important considerations to firms' investment decisions, how do these differences affect firms' investment decisions and, ultimately, survival and growth? In this section, we set to investigate these outcomes and test Hypotheses 2 and 3.

We first document the effect of unionization on firm performance. Then, we investigate the distinct roles played by differential wages and incentives within unionized and non-unionized plants. To evaluate firm performance, we merge information from two sources: the 2010 Annual Survey of Manufactures (ASM) and the 2017 Census of Manufactures (CMF). By combining these datasets, we can track plants surveyed in the 2010 ASM in 2017 to measure investments, survival, and growth. For brevity, we use a composite score as the average of all three individual incentive scores (performance-based bonuses, promotions, and dismissals) to measure total incentives separately for managers and non-managers (Incentives_M and Incentives_NM). Our results are robust if we use each component of incentives.

4.2.1 Union and Investments

Investments in our study are measured as the changes in capital stock from 2010 to 2017. Furthermore, we disaggregate the total capital expenditures into two components: structure and equipment. To estimate the relationship between unionization and investments, we estimate the following specifications:

$$CAPEX_{pil} = \beta_0 + \beta_1 \times Union_p + \phi X_p + \gamma_i + \alpha_l + \epsilon_{pil} \tag{2}$$

where $CAPEX_{pil}$ is the capital expenditure (total, structure, or equipment) for plant p in industry i and location l. $Union_p$ is an indicator variable for whether plant p has union representation, and X_{pil} is a set of firm characteristics that we control.

Our variable of interest, β_1, captures the effect of unionization on investment. Table 6 presents our findings. Unionized plants have lower capital expenditures ($\beta_1 < 0$) in both equipment and structures. Controlling for industry, location, and other observable firm characteristics such as size,

age, and human capital, unionized plants invest 3% less relative to non-unionized plants during the same period. The difference is significant at a one percent level.

The lower investments observed in unionized plants can be attributed to various factors. Hirsch (1991) argue that union has direct and indirect effects on investment. The direct effect arises from the "union tax" imposed on the returns to long-lived capital, while the indirect effect is linked to higher financing costs due to reduced profitability for unionized firms. Bradley et al. (2017) show that passing a union election results in declines in patent quantity (quality) three years after the election. In this paper, we show that unionized plants also have higher wages, weaker incentives, and lower productivity, all of which can lead to adverse effects on investments within the framework of the neoclassic model. This raises the question: To what extent can these differences account for the lower investment levels observed in unionized plants?

To answer this question, we re-estimate the investment regressions in Equation (2) but include additional controls of wage, incentives (for both managers and non-managers), and productivity, as well as their interactions with the union indicator variable. The updated specification is as follows:

$$CAPEX_{pil} = \beta_0 + \beta_1 \times Union_p + \beta_2 \times K_p + \beta_3 \times (Union_p \times K_p) + \phi X_p + \gamma_i + \alpha_l + \epsilon_{pil} \tag{3}$$

where $CAPEX_{pil}$ is the capital expenditure for plant p in industry i location l, $Union_p$ is an indicator variable for unionization, and X_p is the set of firm characteristics we control. K_p is our variables of interest, including wages, incentives, and productivity. Then, the difference in capital expenditures between unionized and non-unionized plants in the same location and industry can be expressed as:

$$CAPEX^u - CAPEX^{nu} = \beta_1 + \beta_2 \times (K^u - K^{nu}) + \beta_3 \times K^u + \phi(X^u - X^{nu}) \tag{4}$$

where β_2 captures the difference in the variable of interest (w) between unionized and non-unionized plants, and β_3 reflects the difference in sensitivity to w between unionized and non-unionized plants. The remaining (unexplained) difference is estimated by β_1. We include three variables in the set of Y, including wages (Wage), incentive scores (Incentive_NM and Incentive_M), and total factor productivity (TFP).

Results are reported in columns 2, 4, and 6 of Table 6. We find that wages are negatively related to capital expenditure ($\beta_{2,wage} < 0$), indicating that higher labor costs lead to reduced demand for investments, suggesting a complementary relationship between capital and labor. Stronger non-

managerial incentives are associated with more investments ($\beta_{2,Incetives\_NM} > 0$). This is consistent with the idea that incentives help mitigate agency problems, improve labor productivity, and thus increase the benefit derived from capital investment. Interestingly, we do not observe a significant effect of managerial incentives on capital expenditures ($\beta_{2,Incetives\_M} \approx 0$). Furthermore, we also find that more productive plants tend to have higher capital expenditure ($\beta_{2,TFP} > 0$), possibly due to more efficient use of capital stock.

Recall that unionized plants have higher wages, weaker incentives (especially for non-managers), and lower TFP, all of which are associated with lower levels of capital expenditures. In addition, we find that the effect of non-managerial incentives on investment is less important in unionized plants ($\beta_{3,Incentives\_NM} < 0$), which further widens the investment gap between unionized and non-unionized plants as indicated in Equation (3). However, we do not observe significant differential effects on wage, incentives to managers, or productivity ($\beta_{3,wage} \approx 0$, $\beta_{3,Incentives\_M} \approx 0$, $\beta_{3,TFP} \approx 0$). When explicitly controlling for differences in wage, incentives, and productivity, the coefficient for the union indicator, β_1, becomes slightly positive and insignificant from zero. This finding suggests that the lower investment rates observed in unionized plants can primarily be attributed to the differences in wages, incentives, and productivity. There exists both a level effect and a sensitivity effect. Previous studies have also documented a negative association between unionization and investments. Fallick and Hassett (1999) find a substantial reduction in capital investment when unions win in certification elections. However, to the best of our knowledge, our study is the first to examine the effect of incentives on investments in unionized plants. We show that not only lower levels of incentives in unionized plants are associated with lower investments but also that investment is less sensitive to incentives in unionized plants.

Table 6: [INSERT TABLE HERE]

4.2.2 Union, Survival, and Employment Growth

If unionized plants invest less, do they also grow their labor force at a slower rate? Are wage and incentive differences also associated with survival and employment growth?

Existing literature has shown that growth is lower in unionized plants (Dunne and Macpherson (1994), Freeman and Kleiner (1999)). However, the evidence regarding the impact of unionization on survival remains inconclusive. Using a regression discontinuity design (RDD) to compare plants that have narrowly passed or failed in union elections, DiNardo and Lee (2004) found no evidence that successful union organizing drives subsequent survival rates. Their study provides a convincing

case of causality. However, union elections often involve only a small portion of workers in large firms, raising questions about the generalizability of their findings to the broader sample of existing unionized plants.

One advantage of our data is the ability to cleanly identify the percentage of workers with union membership at the plant level, thus allowing us to investigate cases when unions represent a large portion of workers. To investigate survival likelihood, we first classify an "exit" as cases where a plant is present in the 2010 ASM but absent from the 2017 CMF. In addition, we cross-validate our definitions using the Longitudinal Business Database (LBD) to ensure that the identified exits are not merely the result of administrative record change or non-response to the census. The LBD, created by the Census Bureau, incorporates survey data collected from businesses and administrative records from business tax fillings obtained from the Internal Revenue Service (IRS). It covers all private non-farm employee businesses across the U.S.

To measure growth, we use the change in sales or employment during the same period. We estimate similar specifications as those in Equation 2 and 3, with or without controlling wages, incentives, and productivity. Table 7 reports the estimates.

Table 7: [INSERT TABLE HERE]

The survival rate in our sample of plants from 2010 to 2017 is about 83%. Column 1 shows that union plants are more likely to exit, even after controlling for firm characteristics, industry, and location fixed effects. Among the control variables, smaller and younger plants have higher exit rates, although plants belonging to larger firms are also more likely to exit.

Within the surviving sample of plants, we find a significant negative effect of unionization on employment growth (Column 3). Combined with lower capital expenditure shown in 4.2.1, unionized plants have lower sales growth during this period (Column 5). Sales growth in a unionized plant is about 39%

Next, we incorporate wages and incentives into the regressions. Column 2 shows that non-managerial incentives (Incentives_NM) are strongly associated with the survival rate. A one standard deviation increase in the incentive score is associated with an 8.1% increase in survival. After controlling for non-managerial incentives, the difference in survival between unionized and non-unionized plants is no longer significant.

Columns 3 and 4 estimate the differential effect of unionization on employment growth. Column 3 shows that the employment growth is about 5.5 percentage points lower in unionized plants compared to non-unionized peers during our sample period. On the control variables, we find that

younger plants in smaller firms with more educated employees also grow more in employment. Interestingly, productivity (TFP) does not affect employment growth.[14] Moving to Column 4, the results indicate that plants offering higher wages and stronger incentives (especially for non-managers) are more likely to experience workforce growth. This suggests a positive role of human capital and incentives in driving employment growth. In addition, we find a significantly negative coefficient for the interaction between non-managerial incentives and the union indicator, implying that incentives' positive effect on employment growth is largely absent in unionized plants. Similar to the results obtained from the survival analysis, once wages and incentives are controlled for, we no longer observe significant differences in employment growth between unionized and non-unionized peers. This suggests that the observed disparity in employment growth rate between unionized and non-unionized plants is largely attributed to differences in wages and incentives.

Figure 2 provides a visual representation of the estimated impact on outcomes from the level and sensitivity of incentives in unionized plants based on Tables 6 and 7. For all variables examined, including survival, capital expenditure, and employment growth, the primary driver behind the disparity between unionized and non-unionized plants is the lower sensitivity of incentives. In other words, the reduced responsiveness of worker incentives in unionized plants accounts for the majority of the observed differences across these firm outcome measures. Our finding highlights the critical role that incentives play in shaping the performance and dynamics of organizations, particularly in the context of unionization.

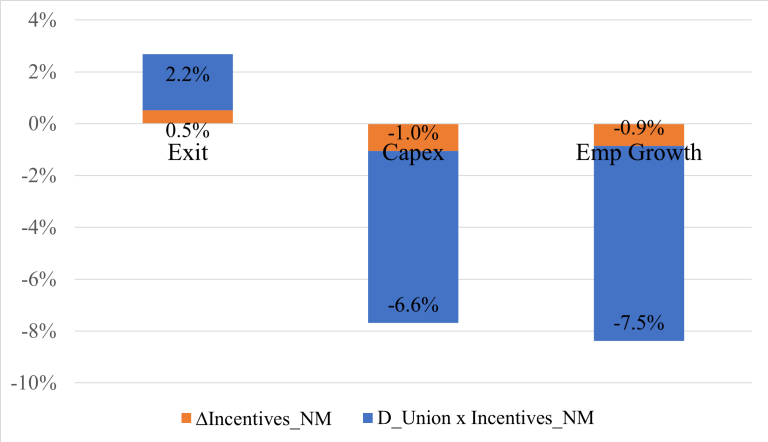


Figure 2: **Decomposition of Effects - Level vs. Sensitivity.** This figure presents the effect of non-managerial incentives on firm outcomes (from left to right): exit rate, capital expenditure, and employment growth based on estimated coefficients from Tables 6 and 7. For each variable, the orange (blue) bar indicates the estimated effect from the differential level (sensitivity) of incentives (β_1 and β_3 in Equation (3), respectively).

Taken together, our findings suggest that bargaining outcomes from union representation, such

[14] Our results on incentive variables are robust when we exclude the TFP variable in the regressions.

as higher labor costs and lack of incentives (especially for non-managers), are closely linked to lower survival rates and diminished growth in unionized plants. Thus, the impact of unions extends beyond servicing as a mechanism for improved rent-sharing arrangements for workers; it also affects the overall size of the pie for all stakeholders involved.

4.2.3 Union and Wage: Revisited

Table 2 Column 1 shows that unionized plants pay 7.5% higher wages compared to their non-unionized counterparts. However, union workers experience slower wage growth during our sample period. For example, between 2010 and 2017, the average hourly wage for production workers increased by 16.6%, while union workers experienced an increase that is 2.5% lower, controlling for industry and location fixed effects. In addition, Table 7 demonstrates that unionized plants have a higher likelihood of exiting, which often leads to significant wage losses for workers due to unemployment duration and the loss of firm-specific capital (Jacobson et al. (1993), Farber (2017), Andersson et al. (2018), Lachowska et al. (2020)). Given the lower growth rate and the higher expected cost associated with plant closure, what is the adjusted effect of union status on wages?

To assess the effect, we first normalize the wage of the non-unionized worker as one and apply the estimated wage premium to union workers in the initial period. Then, we apply the estimated annual growth rate for union- and non-union workers based on our sample and use a 4% discount rate. The net present value (NPV) of wage income, conditional on survival, is about 5.8% higher than for union workers compared to non-union workers over a five-year period. However, the gap shrinks to 1.4% over ten years due to lower wage growth among union workers. Moreover, when we adjust for survival, assuming a 25% long-term wage loss per year following plant closure (Jacobson et al. (1993)) and an unemployment spell of 2 years (Andersson et al. (2018)), the NPV premium for union workers reduces to 3.6% over five years and becomes negative over ten years.[15]

Our estimates reinforce the findings that weaker incentives in unionized plants contribute to a decrease in the overall size of the pie, resulting from a higher rate of plant closure and lower growth. As a result, the wage advantage union workers enjoy gradually diminishes over time despite stronger collective bargaining.

[15] We use the following formula to calculate the adjusted NPV: $NPV_{adj} = NPV_{unadj} \times Prob_{surv} + NPV_{unadj} \times Prob_{exit} \times (1 - \%WageLoss \times (1 - \%Unemp)$.

5 Spillover Effects

Next, we evaluate the indirect effect of unionization on other non-unionized plants within the same firm following Hypotheses 4 and 5.

5.1 Spillover Effects: Wages and Incentives

Given that unionized plants adopt different practices in wages and incentives, a natural question arises: Do these labor practices, such as higher wages and weaker incentives, extend their influence to other non-unionized plants operated by the same firm? If so, do non-unionized plants in the same firm also experience lower levels of investments and growth?

Moreover, exploring the potential spillover effects would provide insights into factors driving differential incentives in unionized plants. As mentioned in Section 2, if the preference of marginal workers primarily influences lower incentives, we would expect to observe spillover effects to non-unionized plants within the same firm, as the firm strategically seeks to deter workers from joining unions. Conversely, if the reduced incentives are driven by unions' preference to foster solidarity among workers to enhance their bargaining power, we would not observe significant spillover effects when unions are absent.

To test Hypothesis 4, we take advantage of a unique feature of the plant-level census data. It assigns unique and separate identifiers of plants and firms, allowing us to track all plants under the same firm over time. We first identify union firms as those with at least one unionized plant. Then, within union firms, we further define union industries as those with at least one unionized plant. For example, a firm with four plants - plants A1 and A2 in industry A and B1 and B2 in industry B. A1 is a unionized plant. In this example, A2 is a non-union plant in a union industry, while B1 and B2 are non-union plants in a union firm. Using this definition, we separate plants in our sample into four categories by their unionization status - (1) unionized plant, (2) non-unionized plant in the firm's union industry, (3) non-unionized plant in a union firm outside the union industry, and (4) non-union plant in a non-union firm. Similarly, we also define another set of categorizations based on location. We define union commuting zones for union firms as those with at least one unionized plant. The complement set, therefore, is non-unionized plants in union firms but outside the union commuting zone. Again, the benchmark is the set of non-unionized plants in non-union firms.

Since plants with similar characteristics are more likely to adopt common compensation and incentive practices and develop social ties that facilitate the flow of information, we expect a

stronger spillover effect in union firms within union industries or union commuting zones.

Our main goal is to examine whether higher wages and weaker incentives observed in unionized plants extend to non-unionized plants within the same firm. Similar to Section 4.2, we use a composite score to capture all three individual incentive scores (performance-based bonuses, promotions, and dismissals) separately for managers and non-managers (Incentives_M and Incentives_NM). Our results are robust when we use each individual component. Table 8 reports our findings.

Table 8: [INSERT TABLE HERE]

Columns 1 to 3 use industry-based categories. We find a significant spillover effect, wherein non-unionized plants in union firms pay higher wages and have lower incentive scores. Additionally, the effect is stronger for non-unionized plants in the same industry as the unionized plants. Compared to non-unionized plants in non-union firms (the omitted reference group), unionized plants have a 13% wage premium, followed by a premium of 8.1% for non-unionized plants in union industries, and a premium of 4.5% for plants in union firms outside union industries. Similar patterns are observed for incentives, with a more substantial effect observed for non-managers. For example, among non-unionized plants, if the firm also operates a unionized plant in the same industry, the incentive score for non-managers is 14.5% lower. On the other hand, for non-unionized plants outside of the union industry, the effect is lower at about 9.7%.

Columns 4 to 6 of Table 8 use the location-based categories and show consistent patterns. We observe significant effects from unionized to non-unionized plants within the same firm. These effects are particularly strong for non-unionized plants located in the same commuting zone as the union plants. Unionized plants, for example, have 33.4% lower non-managerial incentives compared to plants in non-union firms. In comparison, non-unionized plants in the same commuting zone experience a reduction of 21.7% in non-managerial incentives, while those in different commuting zones have an 8.2% decrease. These findings, as discussed in Section 2, align with the Homogeneous Outcomes Hypothesis, suggesting that workers' preference for lower incentives attributes to approximately two-thirds of the observed differential in incentives between unionized and non-unionized plants. It is worth noting that a significant spillover effect on incentives is also observed among managerial employees. As outlined in Section 4.1.2, the lower levels of managerial incentives can be a result of spillover from non-managerial employees - the absence of incentive systems for non-managerial employees reduces the need for monitoring and oversight of managers, thus contributing to the observed decrease in managerial incentives.

Figure 3 presents the estimated coefficients from Table 8 and shows persistent and significant

spillover effects by industry and location.

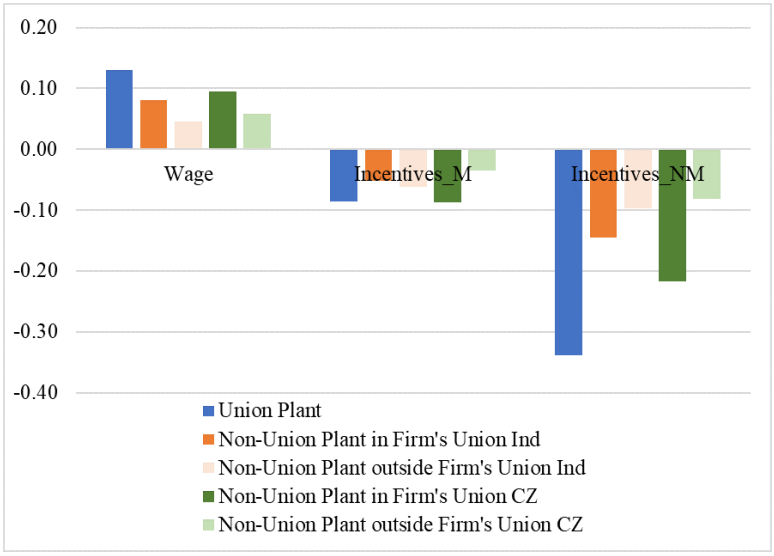


Figure 3: **Spillover Effect - Wages and Incentives.** This figure plots estimated coefficients of the effect of unionization on wages and incentives (for both managers and non-managers) from Table 8. We separate non-unionized plants in union firms based on two mutually exclusive categories - industry and location. The omitted group for each regression is non-unionized plants in non-union firms.

The presence of spillover effects aligns with the Quiet Life Hypothesis proposed in Section 2, which suggests that unions cater to the preference of marginal workers and leverage their bargaining power to achieve lower incentives. In addition, our finding that the spillover effects are positively related to the proximity (industry or location) between unionized and non-unionized plants is consistent with the benchmarking channel proposed in Duchin, Goldberg, and Sosyura (2017). The labor practices in unionized plants can impact the practices in non-unionized plants through intra-firm compensation benchmarking. The more similar non-unionized plants are to their unionized peers, the greater the pressure for the firm to keep conformity, resulting in stronger spillover effects.

The spillovers documented here imply that unionization status can be a significant consideration in mergers and acquisitions. Acquiring a target firm with unionized plants could introduce significant costs to the acquiring firm's existing plants. The finding is consistent with Fallick and Hassett (1996), who find that firms with similar union status tend to merge. The potential spillover costs associated with acquiring a unionized firm are also consistent with findings in Tian and Wang (2021), which show that unionized firms are less likely to be targeted for takeovers and when they are, tend to receive lower takeover premiums.

5.2 Spillover Effects: Firm Performance

We show that non-unionized plants operating within the same firm as the unionized plants also have higher wages and weaker incentives. If these higher labor costs and lack of incentives are associated with adverse outcomes in terms of survival, investments, and growth, as shown in Section 4.2.1, we would expect to see similar effects on non-unionized plants in union firms due to spillover effects.

To estimate the spillover effect on firm performance, we follow similar specifications as that in Equation 4 with three outcome variables, including survival, capital expenditure, and sales growth. The findings are presented in Table 9.

Table 9: [INSERT TABLE HERE]

Columns 1 to 3 focus on industry-based categories for spillovers, while columns 4 to 6 use location-based categories. We find that non-unionized plants within the same firm as unionized plants also experience higher exit rates, lower capital expenditure levels, and lower employment growth. Regarding the location effect, we find that non-unionized plants located in the same commuting zone as unionized plants are more likely to have higher exit rates and lower employment growth than those located outside the union commuting zones. Additionally, non-unionized plants operating in the union industry are more prone to lower employment growth than those operating outside of the union industry. Figure 4 presents a visual representation of the estimated coefficients from Table 9.

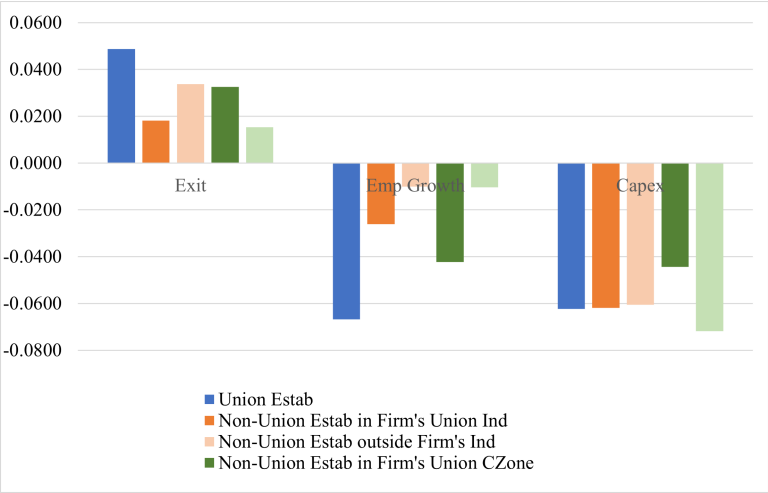


Figure 4: **Spillover Effect - Firm Performance.** This figure plots estimated coefficients of the effect of unionization on firm performance (for both managers and non-managers) from Table 9. We separate non-unionized plants in union firms based on two mutually exclusive categories - industry and location. The omitted group for each regression is non-unionized plants in non-union firms.

6 The RTW Status Change

In the previous sections, we have presented strong associations between union status and lower survival, lower capital expenditures, and lower growth and demonstrated that the differential effects could be largely attributed to the influence of higher wages and weaker incentives. In this section, we leverage the recent enactment of Right-to-Work (RTW) laws in the Midwest states during our sample period. Specifically, in 2012, Indiana and Michigan passed amendments that prohibited collective bargaining agreements requiring workers to pay union dues or fees, effectively transforming into right-to-work states. This legislative change, which considerably curtails union power, can be regarded as an exogenous shock at the plant level. We adopt a difference-in-differences design by comparing unionized plants in these two states with those in four neighboring states (Wisconsin, Kentucky, Illinois, and Ohio) that remained non-right-to-work states throughout our sample period. We use the neighboring states as a control group because they share similarities in industry composition and cultural aspects with the treated states and their geographic proximity. Utilizing the change in RTW status as an event, we can isolate the selection effect of union status and shed light on the impact of diminished union power on economic outcomes.

6.1 The Main Effect

Our sample includes manufacturing plants from the six neighboring states in the Midwest included in the 2010 ASM, with Indiana and Michigan in the treated group and Kentucky, Illinois, Ohio, and Kentucky in the control group (the "Midwest" sample, hereafter).

We use the time between the most recent Census of Manufacturing (2007) and the first year of the 2010 ASM panel (2010) as the pre-period. For the post-period, we consider the years between 2012 (when the relevant law was passed) and 2014, the last year of the 2010 ASM panel.[16] Given the inherent stickiness of union status over time, we assign the union status identified from the 2010 MOPS to the entire sample period. As an alternative approach, we also identify unionized plants based on the criterion of having at least 60% workers affiliated with a labor union and find qualitatively similar results.

We consider the following specification:

$$Y_{pis} = \beta_0 + \beta_1 \times Unoin_p + \beta_2 \times (Union_p \times Treated_s) + \phi X_{pis} + f_{is} + \epsilon_{pis} \tag{5}$$

where Y_{pis} is the outcome variable, including employment growth and capital expenditures, for

[16] We did not use the 2017 CMF in this case because two of the states in the control group passed RTW in 2015.

plant p in industry i and state s. $Treated_s$ is an indicator variable for states that became right-to-work states in 2012. X_{pis} measures the plant-level characteristics, and f_{is} is the (Industry $\times$ State) fixed effects. We estimate it for pre- and post-periods separately to allow other coefficients to differ over time. Our main variable of interest is β_2, which measures the union effect between treated and control states.

Table 10 presents our findings. Panel A examines the post-period. There is a negative effect of unionization on employment growth in general ($\beta_1 < 0$), consistent with what we find from the main sample. However, unionized plants in treated states experience significant positive growth in employment following the shock ($\beta_2 > 0$). As a result, they no longer exhibit lower employment growth than non-unionized plants. The combined coefficient, $\beta_1 + \beta_2$, is very close to zero and has a p-value of 0.47.

Table 10: [INSERT TABLE HERE]

On the other hand, we do not find evidence of a differential wage change in unionized plants between treated and control states, suggesting that the increase in employment is not necessarily driven by lowering wages. One possibility is that as unions weaken their influence post-shock, firms can put in stronger incentives to motivate workers, thereby enhancing labor productivity. However, the observed lack of change in wages can also be due to the relatively shorter duration of our post-shock data and the fact that some union workers may still be covered under the previous contracts. On capital expenditures, we find a significant increase in investments in equipment and technology among treated unionized plants, mitigating the general negative effect of unionization on investment. On the other hand, the effect is only marginally positive for investments in structures. This could be due to the lumpy nature of such investments and, again, the limitation of our data, which do not extend sufficiently far beyond the shock period.

The validity of a difference-in-differences model requires the pre-assumption that there were no significant differences between the treated and control groups before the shock. Panel B of Table 10 presents estimates for the pre-shock period. We do not observe any significant differences in employment growth or capital investments among unionized plants between treated and control groups, suggesting no pre-trend between treated and control groups.

Two states in our control group implemented similar right-to-work laws after our sample period. For example, Wisconsin became an RTW state in 2015, and Kentucky adopted RTW laws in 2017. This presents an opportunity for a placebo test to evaluate the pre-trend assumptions. To do so, we re-estimate our specification in Equation 5 but replace the treated states of Indiana and Michigan

with the states of Wisconsin and Kentucky (Pseudo_Treated), which underwent a change of the RTW status after our testing period. Panel C reports our estimates. The main coefficient, β_2, which now captures the interaction effect of unions in pseudo-treated states, is insignificant across all variables, including wage, employment, and capital expenditures. This implies that there is no discernible pre-trend in unionized plants between control and those that would become treated states in the future.

In summary, using the RTW shock, we show that exogenous changes that weaken unions' bargaining power lead to increases in employment and investments, confirming that unionization *causes* underinvestment.

6.2 The Spillover Effects

We show in Section 5 that the effect of unionization extends beyond the unionized plants and affects other non-union plants within the same firms. These non-unionized plants also have lower investments, particularly those in the same industry or commuting zone as the unionized plants, attributed to spillover effects resulting from higher wages and weaker incentives associated with unionization. Therefore, we would expect a similar spillover effect following the shock of the RTW status change. As RTW laws undermine the union's bargaining power, it would lift its influence on non-union plants, thus changing their investment decisions.

To investigate this hypothesis, we construct a sample of union-affiliated plants. We first identify firms that own at least one unionized plant in the Midwest Sample, categorizing them based on whether the unionized plants are located in treated or control states. Next, we collect *non-unionized* plants operated by the same firms but located in other states, forming an "Affiliated Non-Union Sample". We define an indicator variable, ANU_Treated, which equals one if the firm that owns the plant has a unionized plant in the treated states and zero otherwise. By construction, the Affiliated Non-Union Sample is the complementary set of the Midwest Union Sample, connected through common ownership. Finally, we construct measures of employment growth and capital expenditure measures for both the pre and post-shock periods, following the same definition as in Section 6.1. Specifically, we use the time period between 2007(the last Census) and 2010 (the first year of the 2010 ASM Panel) as the pre-shock period and consider the years between 2012 (the year of the change of RTW status) and 2014 (the last year of the 2010 ASM Panel) as the post-shock period. We consider the following specification:

$$Y_{pis} = \beta_0 + \beta_1 \times ANU\_Treated_p + \phi \times X_p + f_{is} + \epsilon_{pis} \tag{6}$$

where Y_{pis} is the outcome variable for plant p in industry i and state s. $ANU\_Treated_p$ is an indicator variable that equals one if the union plant affiliated with plant p is in a treated state with RTW status change in 2012 and zero otherwise. X_p measures the plant-level characteristics, and f_{is} is the (Industry $\times$ State) fixed effects. Our main variable of interest is β_1, which measures the spillover effect from unionization between treated and control states.

Our findings are presented in Table 11. Panel A shows that following the shock, non-unionized plants affiliated with union firms in the treated states also experience higher employment growth and increased investments in equipment and technology. Similar to the main effect, there is a marginally positive effect for investments in structures, albeit not statistically significant. Our finding suggests that as the union's bargaining power weakens following the shock, its influence within the firm also diminishes. Consequently, non-unionized plants, similar to their unionized peers, undergo a positive shift in their investment, possibly due to a marked-to-market wage setting or improved incentives within the firm.

Table 11: [INSERT TABLE HERE]

7 Broader Discussion

7.1 Union and Monopsony Power

Previous research has suggested that an increase in employers' monopsony power is associated with lower wages (e.g., Azar, Marinescu, Steinbaum, and Taska (2020)). However, when unions strengthen workers' bargaining power, it can help offset the monopsony power of the employers. Benmelech, Bergman, and Kim (2022) find that the negative relation between employer concentration and wages is less pronounced in plants operating in industries with higher unionization rates. One limitation of their study is that the unionization rate is measured at the industry level and thus may correlate with other industry characteristics, such as production technology or cost structure. In contrast, we use the plant-level unionization status while controlling for industry and location fixed effects. We test our Hypothesis 6 here.

We use three concentration measures, all computed at the commuting zone level. First, we compute the Herfindahl–Hirschman index (HHI) within the industry. Second, we define a commuting-zone-industry indicator variable, D_CONC, which equals one if the industry-commuting-zone HHI defined above is in the top quartile across all commuting zones in the U.S. and zero otherwise. Lastly, we define another commuting-zone-industry indicator variable, D_Dom, that equals one if

the industry employs more than 10% of all workers in the commuting zone. In all measures, we define industries using a broader industry category based on 3-digit NAICS (compared to our industry fixed effects, which is defined at the 4-digit NAICS level) since workers often search for jobs across industries. Our results are qualitatively similar using the 4-digit NAICS. Our specification is as follows:

$$Y_{pil} = \beta_0 + \beta_1 \times Union_p + \beta_2 \times CONC_{il} + \beta_3 \times (Union_p \times CONC_{il}) + +\phi X_p + \gamma_i + \alpha_l + \epsilon_{pil} \quad (7)$$

where Y_{pil} is the wage for plant p in industry i commuting zone l. $CONC_{il}$ is the industry-commuting-zone level concentration measure. X_p includes firm characteristics we control. γ_i and α_l reflect industry and location fixed effects, respectively. β_1 captures the union wage premium in general, β_2 reflects the effect of concentration, and β_3 estimates the differential effect of concentration by unionization status.

Table 12 Panel A reports our findings. Consistent with Autor, Dorn, Katz, Patterson, and Van Reenen (2020) and Barkai (2020), we find that wages are lower in areas where employers have monopsony power ($\beta_2 < 0$). Specifically, within the same industry, plants in commuting zones that fall in the top quartile of the HHI (D_CONC) exhibit an average wage reduction of 1.5 - 1.7%. Plants operating in locally dominant industries (D_DOM) experience an even larger wage decrease, ranging from 4.2% to 6.3%.

However, the presence of unions appears to counteract the monopsony power of employers and alleviate the wage disparity ($\beta_3 > 0$). On average, unionization is associated with an additional 3% wage premium in top-quartile-HHI commuting zones, independent from the 8% union wage premium in general. Moreover, the union premium is 4% higher in locally dominant industries. As a result, we do not observe lower wages in unionized plants in concentrated markets where employers hold monopsony power. Using plant-level unionization rate, our wage results align with findings of Benmelech et al. (2022).

Table 12: [INSERT TABLE HERE]

We extend the existing literature by examining the interaction between employer concentration and unionization regarding incentives. Following the framework outlined in Section 4.1.2, we include incentive measures based on performance-based measures for bonuses, promotion, and dismissal, separately for managers and non-managers. For brevity, we only present results using the indicator variable, D_Conc, and results are qualitatively consistent when we use the other two variables (HHI and D_Dom). We use a similar specification as that in Equation (7).

Our results are presented in Table 12 Panel B. In contrast to the observed negative association between monopsony power and wages, we do not find any significant effect of monopsony power on incentives ($\beta_2 \approx 0$). However, there is some evidence that unionized plants adopt even fewer incentives in areas where employers are concentrated ($\beta_3 < 0$), especially in performance-based promotion and dismissals. Notably, this effect is more pronounced for non-managers. Unionized plants are less likely to promote or dismiss non-managers based on their performance, and the likelihood is even lower in concentrated areas.

7.2 Union and Capital Labor Ratio

We show that both capital expenditures and employment growth are lower in unionized plants, and the differential effect is associated with higher wages and weaker incentives. Higher wages raise labor costs, while the lack of incentives may result in lower labor productivity. Given that labor becomes more expensive and less efficient in unionized plants, do firms adapt by changing the composition of capital and labor? On the one hand, firms may substitute labor with capital and adopt more capital-intensive production technology (Arrow, Chenery, Minhas, and Solow (1961)). On the other hand, in industries with long-lived plants and equipment, investors may strategically choose to invest less to discourage wage demands from unions (Baldwin (1983)). In this section, we examine Hypothesis 7 that unionized plants have higher capital-labor ratios.

We examine the effect of unionization on the capital-labor ratio in two ways. First, we look at the level effect by regressing the capital-labor ratio on a union indicator, controlling for wages, incentives, plant characteristics, and industry and location fixed effects. Table 13 reports the estimates.

Table 13: [INSERT TABLE HERE]

Column 1 shows that unionized plants have consistently higher capital-labor ratios. This is consistent with the hypothesis that firms substitute capital-intensive production technology in the presence of unions. We also find that larger, older plants have higher capital-labor ratios, possibly due to their advantage in financial slacks. Plants with more educated managers but less educated workers also tend to have higher capital-labor ratios. We include wages and incentives in Column 2. Higher wages are related to a lower capital-labor ratio, consistent with findings in Bena, Ortiz-Molina, and Simintzi (2022) who show that plants faced with rising labor costs substitute labor with capital. On the incentives, we find that lower non-managerial incentives are associated with higher capital-labor ratios, suggesting that firms substitute labor with capital when workers are not

well motivated. In contrast, we do not find any significant effect of managerial incentives on capital-labor ratios. Including wages and incentives explains about half of the impact of unionization on capital-labor ratios.

One potential concern with using the plant's own wage level as an explanatory variable is that wages can be driven by omitted variables that correlate with the technology employed or plant productivity. So, in Column 3, we replace the plant-level wage with the average wage of other plants in the same 4-digit NAICS industry and the same commuting zone (Local Wage). We find qualitatively similar results.

Since structures and equipment in manufacturing are likely to have a long life span, it is possible that omitted variables can drive both the unionization status and the level of capital stock. In our second approach, we compare changes in the capital-labor ratio during our sample period (from 2010 to 2017) by unionization status, controlling for changes in labor costs. Despite a higher capital-labor ratio at the beginning of this period, shown in Column 1, unionized plants continued to increase capital-labor ratios, resulting in an even higher capital-labor ratio at the end of the period. Consistent with the substitution explanation, we find that plants with rising wages also tend to increase the capital-labor ratio. The result is robust when we use the increase in local wages rather than the actual wages offered at the plant.

8 Conclusion

Unions affect the distribution of a firm's cash flow by increasing wages to above-market rates and by bargaining over the incentives that firms provide for their non-managerial employees. The first channel has been explored in the literature. The second is mostly unexplored.

Using a large sample and granular plant-level data on unionization, incentives, wages, investment, and other metrics, we show that unionized plants have fewer incentives and pay higher wages and benefits. Both are associated with lower productivity, less investment, less employment growth, and higher plant exit rates. Low incentives are associated with higher capital-labor ratios, consistent with the hypothesis that higher incentives increase labor effectiveness. Moreover, even when a unionized plant reports that it has incentives for non-managerial employees, these incentives are not associated with higher productivity. This is in sharp contradiction with the case of non-unionized plants, where incentives are associated with higher productivity.

We also examine how unions indirectly impact non-unionized plants within the same firm. Such spillovers might emerge if employers increase wages and adjust incentives in non-unionized plants to

make union representation less appealing to workers. We discover that these spillover effects are real and significant for both incentives and wages. Incentives are reduced most (and wages increased) in non-unionized plants that share the same industry or commuting zone with unionized plants. Additionally, we observe a similar, albeit lesser, reduction in managerial incentives in unionized plants and a corresponding decrease in incentives in non-unionized plants. We hypothesize that these diminished incentives could be a reaction to changes in managerial roles, considering the lessened effectiveness of incentives for non-managerial workers in unionized plants.

The observation that firms reduce incentives in order to reduce unionization implies that the median non-management employee in a non-union plant prefers, all other things equal, a lower level of incentives. The magnitudes are consistent with the conjecture that much of the reduction in incentives can be explained by unions catering to the preferences of the median worker. Our estimates suggest that the upper bound on the extent to which unions might reduce incentives to build solidarity and increase bargaining power is under 60%.

The existence of spillover effects has implications for the firm's participation in the market for acquisitions. A unionized firm is worth less, net of spillovers, to a non-unionized acquirer. Similarly, a non-unionized target is worth less to a unionized acquirer than to a non-unionized acquirer. Thus, spillovers can partition the marker for acquisition, reducing the efficient reallocation of assets. The unionization of a firm makes it more costly for the firm to participate in a very large segment of the market for assets. This affects the firm's value directly. Moreover, to the extent that the possibility of being acquired acts as an incentive for the firm's senior managers, the reduction in the number of potential acquirers may have an additional effect on the incentives of top managers.

Non-unionized plants in concentrated markets pay lower wages than in competitive labor markets. Unions remove this differential. Compared to wages, the level of incentives in non-unionized plants is less sensitive to labor market concentration. However, unionized plants in concentrated markets have lower incentives than unionized in more competitive markets.

Overall, the effect of unions on incentives and wages is of large economic importance. The lower incentives in unionized plants and the loss of association between the incentives that exist in unionized plants and productivity are related to reduced investment, growth, employment, and productivity, as well as the substitution of capital for labor. Evidence of spillovers suggests that higher suggests that partial unionization affects the whole firm, both directly and by altering its participation in market acquisitions.

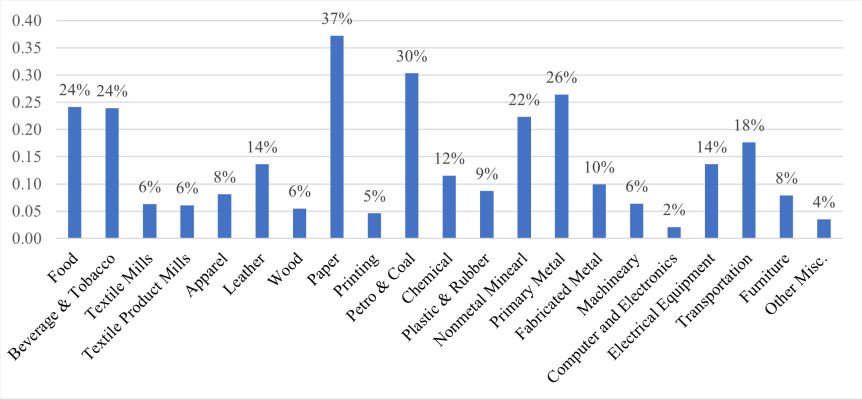
Appendix: Transferring Answers to Scores for MOPS Questions

Question	Response	Monotonic Score	Question	Var Name
Section 1: Union Status				
36	0%	0	What percent of all employees at this establishment were members of a labor union?	union, D_Union
36	1-20%	0.1		
36	21-40%	0.3		
36	41-60%	0.5		
36	61% - 80%	0.7		
36	More than 80%	0.9		
Section 2: Worker Characteristics				
34	20% or less	0.1	What was the percent of managers at this establishment with a bachelors degree?	BA_M
34	21- 40%	0.3		
34	41 - 60%	0.5		
34	61 - 80%	0.7		
34	More than \80%	0.9		
35	See question 34	See question 34	What was the percent of managers at this establishment with a bachelors degree?	BA_NM
Section 3: Incentives				
9	Their own performance as measured by production targets	1	What were non-mangers' performance bonuses usually based on?	Bonus_NM
9	Their team or shift performance as measured by production targets	3/4		
9	Their establishment's performance as measured by production targets	1/2		
9	Their company's performance as measured by production targets	1/4		
9	No performance bonuses	0		
10	0%	1/5	What percent of non-managers at this establishment received performance bonuses?	
10	1-33%	2/5		
10	34-66%	3/5		
10	67-99%	4/5		
10	100%	1		

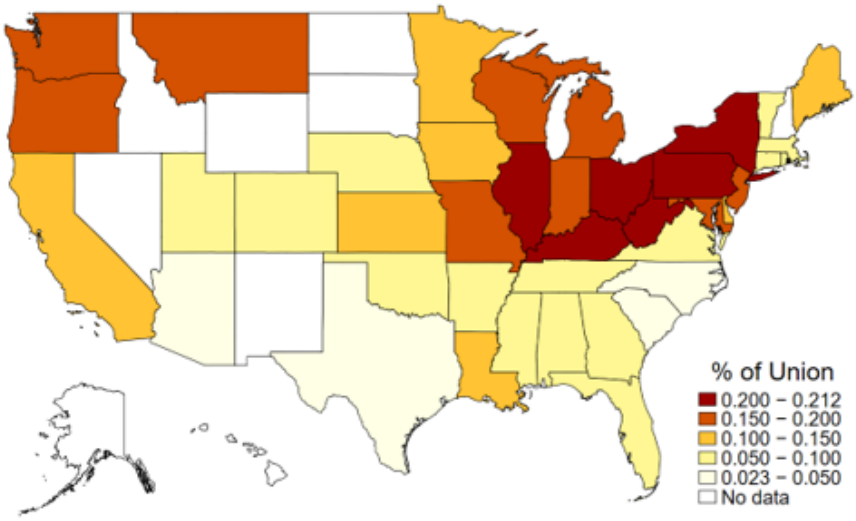
Appendix: Transferring Answers to Scores for MOPS Questions

Question	**Response**	**Monotonic Score**	**Question**	**Var Name**
10	Production targets not met	0		
11	See question 9	See question 9	What were managers' performance bonuses usually based on?	Bonus_M
12	See question 10	See question 10	What percent of -managers at this establishment received performance bonuses?	
13	Promotions were based solely on performance and ability	1	What was the primary way non-mangers were promoted at this establishment?	Promotion_NM
13	Promotions were based partly on performance and ability, and partly on other factors (for example, tenure or family connections)	2/3		
13	Promotions were based mainly on factors other than performance and ability (for example, tenure or family connections)	1/3		
13	Non-managers are normally not promoted	0		
14	See question 13	See question 13	What was the primary way managers were promoted at this establishment?	Promotion_M
15	Within 6 months of identifying under-performance	1	When was an under-performing non-manager reassigned or dismissed?	Dismissal_NM
15	After 6 months of identifying under-performance	1/2		
15	Rarely or never	0		
16	See question 15	See question 15	When was an under-performing manager reassigned or dismissed?	Dismissal_M

Figure 1: **Sample Distribution**. The figure below shows the percentage of labor union membership by industry (Panel A) and state (Panel B).



Panel A: Unionization Rate by Industry (3-digit NAICS)



Panel B: Unionization Rate by State

Table 1: **Summary Statistics**

This table compares characteristics between unionized and nonunionized establishments. D_Union is an indicator variable that equals zero for establishments without any labor union membership and one otherwise. *, **, and *** represent significance at 10%, 5%, and 1%, respectively. Numbers are rounded to comply with Census's disclosure policy.

VARIABLE	D_Union = 0	D_Union = 1	Diff (1 vs. 0)
Total Value of Shipments (in $000's)	81500	209700	128200
Employment	151.2	258.6	107.4
Avg Wage (in $000's)	47.65	52.98	5.33
Hourly Wage	20.01	23.76	3.75
Benefits (Pension) per worker (in $000's)	1.842	3.645	1.803
Benefits (Health) per worker (in $000's)	5.802	8.268	2.466
Benefits (Other) per worker (in $000's)	6.031	7.794	1.763
Benefits (Total) per worker (in $000's)	13.75	19.97	6.22
Bonus_NM	0.353	0.316	-0.037
Bonus_M	0.456	0.526	0.07
Promotion_NM	0.851	0.8	-0.051
Promotion_M	0.813	0.883	0.07
Dismissal_NM	0.667	0.591	-0.076
Dismissal_M	0.566	0.573	0.007
Decision	0.318	0.243	-0.075
Number of Obs	24000	6000	

Table 2: **Union and Labor Costs**

This table reports regression results to examine the association between union membership and labor costs using the 2010 ASM. The dependent variables are the logarithm of hourly wage (in columns 1 and 4), the logarithm of average wage (in columns 2 and 5), and the logarithm of total benefits per worker (in columns 3 and 6). D_Union is an indicator variable that equals one if workers at the establishment have membership in labor unions and zero otherwise. Standard errors clustered at the industry (3-digit NAICS) x commuting zone level and are reported in parentheses. *, **, and *** represent significance at 10%, 5%, and 1%, respectively. Numbers are rounded to comply with Census's disclosure policy.

DEP VAR	(1) Hourly_Wage	(2) Avg. Wage	(3) Benefits	(4) Hourly_Wage	(5) Avg. Wage	(6) Benefits
D_Union	0.0750***	0.0248***	0.1780***	0.0421***	0.0135*	0.0992***
	(0.008)	(0.007)	(0.010)	(0.010)	(0.008)	(0.011)
Log(TVS)	0.0364***	0.0677***	0.0700***	0.0305***	0.0448***	0.0511***
	(0.002)	(0.002)	(0.003)	(0.004)	(0.003)	(0.004)
Log(Age)	0.0115***	0.0153***	0.0333***	0.00346	0.00206	0.0258***
	(0.003)	(0.003)	(0.004)	(0.005)	(0.004)	(0.006)
Log(Firm Emp)	0.0086***	-0.0065***	0.0231***			
	(0.001)	(0.001)	(0.002)			
TFP	0.0851***	0.0340***	0.0521***	0.0445***	0.004	0.0098
	(0.005)	(0.005)	(0.006)	(0.009)	(0.007)	(0.009)
Pct of BA_Non-Manager	0.339***	0.416***	0.254***	0.244***	0.323***	0.191***
	(0.009)	(0.008)	(0.011)	(0.014)	(0.011)	(0.015)
Pct of BA_Manager	0.0390***	0.0814***	0.123***	0.0187	0.0448***	0.0576***
	(0.009)	(0.008)	(0.011)	(0.014)	(0.011)	(0.015)
Constant	2.292***	3.005***	1.499***	2.525***	3.313***	1.978***
	(0.024)	(0.022)	(0.029)	(0.040)	(0.033)	(0.045)
Number of Obs. (rounded)	30000	30000	30000	30000	30000	30000
R-Square	0.591	0.655	0.64	0.802	0.854	0.871
Ind FE	No	No	No	Yes	Yes	Yes
Czone FE	No	No	No	Yes	Yes	Yes
Ind x Czone FE	Yes	Yes	Yes	No	No	No
Firm FE	No	No	No	Yes	Yes	Yes

Table 3: **Union and Productivity**

This table reports regression results to examine the association between union membership and pay-for-performance sensitivity using the 2010 ASM. The dependent variables are indicated in the header row. D_Union is an indicator variable that equals one if workers at the establishment have membership in labor unions and zero otherwise. TFP is the total factor productivity estimated based on input shares. VA/TH is the logarithm of value added divided by total production hours. Standard errors clustered at the industry (3-digit NAICS) x commuting zone level and are reported in parentheses. *, **, and *** represent significance at 10%, 5%, and 1%, respectively. Numbers are rounded to comply with Census's disclosure policy.

	(1)	(2)	(3)	(4)
DEP VAR	TFP	TFP	VA_PH	VA_PH
D_Union	-0.0334***	-0.0295*	-0.0511***	-0.0814***
	(0.009)	(0.016)	(0.014)	(0.027)
Log(TVS)	-0.00780**	0.0148**	0.233***	0.232***
	(0.003)	(0.007)	(0.005)	(0.011)
Log(Age)	-0.0290***	-0.0289***	-0.0788***	-0.119***
	(0.004)	(0.009)	(0.006)	(0.015)
Log(Firm Emp)	0.00473**		-0.0110***	
	(0.002)		(0.003)	
Pct of BA (non-manager)	0.0946*	-0.0327	0.522***	0.119
	(0.055)	(0.108)	(0.088)	(0.170)
Pct of BA (manager)	0.0232**	0.00869	0.134***	-0.00636
	(0.012)	(0.024)	(0.018)	(0.038)
Constant	1.988***	1.805***	2.476***	2.628***
	(0.029)	(0.068)	(0.040)	(0.105)
Number of Obs. (rounded)	30000	30000	30000	30000
R-Square	0.369	0.798	0.373	0.771
Ind FE	Yes	Yes	Yes	Yes
Czone FE	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes

Table 4: **Union and Performance-Based Incentive Measures (MOPS)**

This table reports regression results to examine the association between union membership and performance-based measures using the 2010 MOPS. The dependent variables are indicated in the header row. D_Union is an indicator variable that equals one if workers at the establishment have membership in labor unions and zero otherwise. Standard errors clustered at the industry (3-digit NAICS) x commuting zone level and are reported in parentheses. *, **, and *** represent significance at 10%, 5%, and 1%, respectively. Numbers are rounded to comply with Census's disclosure policy.

DEP VAR	(1) Bonus_M	(2) Bonus_NM	(3) Promotion_M	(4) Promotion_NM	(5) Dismissal_M	(6) Dismissal_NM	(7) Incentives_M	(8) Incentives_NM
D_Union	-0.0177***	-0.0896***	-0.0133**	-0.0911***	-0.0238***	-0.0832***	-0.0548***	-0.264***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.012)	(0.013)
Log(TVS)	0.0305***	0.0312***	0.0368***	0.0306***	0.0269***	0.0253***	0.0942***	0.0872***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)
Log(Age)	-0.0104***	-0.0113***	-0.0142***	-0.0161***	-0.0259***	-0.0290***	-0.0505***	-0.0564***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.006)	(0.005)
Log(Firm Emp)	0.0126***	0.00739*	-0.00804**	-0.00473	-0.0178***	-0.0209***	-0.0132	-0.0182**
	(0.004)	(0.004)	(0.004)	(0.003)	(0.005)	(0.005)	(0.008)	(0.008)
TFP	0.0261***	0.00862***	0.0317***	0.0163***	0.0155***	0.00627***	0.0733***	0.0312***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Pct of BA_Non-Manager	0.163***	0.235***	0.256***	0.276***	0.267***	0.137***	0.686***	0.648***
	(0.035)	(0.037)	(0.035)	(0.033)	(0.042)	(0.042)	(0.074)	(0.072)
Pct of BA_Manager	0.0870***	0.0822***	0.0186**	-0.00584	0.0447***	0.0335***	0.150***	0.110***
	(0.007)	(0.008)	(0.008)	(0.007)	(0.009)	(0.009)	(0.016)	(0.015)
Constant	-0.0447***	-0.0407**	0.286***	0.486***	0.274***	0.474***	0.515***	0.920***
	(0.017)	(0.018)	(0.018)	(0.017)	(0.021)	(0.021)	(0.037)	(0.036)
Number of Obs. (rounded)	30000	30000	30000	30000	30000	30000	30000	30000
R-Square	0.165	0.0996	0.16	0.103	0.0699	0.0597	0.209	0.134
Ind FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Czone FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: **Union and Pay-for-Performance Sensitivity**

This table reports regression results to examine the association between union membership and pay-for-performance sensitivity using the 2010 ASM and 2017 CMF. We include a subsample of establishments that survived to 2017, and each establishment has two observations, one in 2010 and one in 2017. The dependent variables are indicated in the header row. D_Union is an indicator variable that equals one if workers at the establishment have membership in labor unions and zero otherwise. VA/TH is the logarithm of value added divided by total production hours, and VA/TE is the logarithm of value added divided by total employment. Standard errors clustered at the industry (3-digit NAICS) x commuting zone level and are reported in parentheses.*, **, and *** represent significance at 10%, 5%, and 1%, respectively. Numbers are rounded to comply with Census's disclosure policy.

	(1)	(2)	(3)	(4)
DEP VAR =	Hourly Wage		Average Wage	
VA/TH	0.129***		0.0708***	
	(0.004)		(0.003)	
VA/TH x D_Union	-0.0392***		-0.0273***	
	(0.010)		(0.008)	0
VA/TE		0.0861***		0.114***
		(0.004)		(0.004)
VATE x D_Union		-0.0312***		-0.0324***
		(0.010)		(0.009)
Constant	2.471***	2.640***	3.584***	3.351***
	(0.017)	(0.019)	(0.014)	(0.017)
Number of Obs. (rounded)	50000	50000	50000	50000
R-Square	0.747	0.734	0.816	0.823
Ind FE	Yes	Yes	Yes	Yes
Czone FE	Yes	Yes	Yes	Yes
Estab FE	Yes	Yes	Yes	Yes

Table 6: **Union and Investments**

This table reports regression results to examine the association between unionization and capital expenditures using the 2010 ASM and the 2017 CMF. The dependent variables are Capex, Capex(Equipment), and Capex(Structure), which are calculated as the change in total capital stock, change in equipment, and change in structures between 2010 and 2017, respectively. D_Union is an indicator variable that equals one if workers at the establishment have membership in labor unions and zero otherwise. Incentive_M and Incentive_NM are scores for incentives of managers and incentives of non-managers, respectively. Standard errors clustered at the industry (3-digit NAICS) x commuting zone level and are reported in parentheses. *, **, and *** represent significance at 10%, 5%, and 1%, respectively. Numbers are rounded to comply with Census's disclosure policy.

	(1)	(2)	(3)	(4)	(5)	(6)
DEP VAR =	Capital Expenditure		Capex (Equipment)		Capex (Structure)	
D_Union	-0.0301***	0.0414	-0.0314***	0.0269	-0.0331***	0.0576
	(0.010)	(0.099)	(0.011)	(0.110)	(0.009)	(0.085)
Wage		-0.0573***		-0.0539***		-0.0538***
		(0.014)		(0.016)		(0.013)
Incentives_M		0.0105		0.0146		-0.00053
		(0.009)		(0.010)		(0.008)
Incentives_NM		0.0397***		0.0403***		0.0413***
		(0.009)		(0.010)		(0.008)
TFP		0.0731***		0.0864***		0.0455***
		(0.009)		(0.010)		(0.008)
D_Union x Wage		0.00426		0.00474		-0.00303
		(0.029)		(0.032)		(0.025)
D_Union x Incentives_M		0.014		0.0194		0.00925
		(0.018)		(0.021)		(0.016)
D_Union x Incentives_NM		-0.0379**		-0.0359*		-0.0488***
		(0.016)		(0.019)		(0.015)
D_Union x TFP		-0.0173		-0.0184		0.000389
		(0.015)		(0.018)		(0.013)
Log(TVS)	0.0709***	0.0700***	0.0692***	0.0677***	0.0675***	0.0672***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)
Log(Age)	-0.0635***	-0.0590***	-0.0669***	-0.0619***	-0.0461***	-0.0428***
	(0.006)	(0.006)	(0.007)	(0.007)	(0.005)	(0.005)
Pct of BA (non-manager)	0.0811	0.0699	0.135*	0.117	-0.0024	-0.00235
	(0.070)	(0.070)	(0.078)	(0.078)	(0.062)	(0.062)
Pct of BA (manager)	0.00681	0.00183	0.00838	0.00193	0.00375	0.00126
	(0.014)	(0.014)	(0.016)	(0.016)	(0.013)	(0.013)
Log(Firm Emp)	-0.0138***	-0.0155***	-0.0196***	-0.0218***	-0.00159	-0.00243
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	-0.473***	-0.525***	-0.403***	-0.491***	-0.604***	-0.608***
	(0.041)	(0.055)	(0.044)	(0.060)	(0.039)	(0.050)
Number of Obs. (rounded)	25000	25000	25000	25000	25000	25000
R-Square	0.0836	0.0899	0.0874	0.0937	0.0749	0.0796
Ind FE	Yes	Yes	Yes	Yes	Yes	Yes
Czone FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: **Union and Investment: Wage, Incentives, and Productivity**

This table reports regression results to examine the association between unionization and capital expenditures using the 2010 ASM and the 2017 CMF. The dependent variables are Capex, Capex(Equipment), and Capex(Structure), which are calculated as the change in total capital stock, change in equipment, and change in structures between 2010 and 2017, respectively. D_Union is an indicator variable that equals one if workers at the establishment have membership in labor unions and zero otherwise. Incentive_M and Incentive_NM are scores for incentives of managers and incentives of non-managers, respectively. Standard errors clustered at the industry (3-digit NAICS) x commuting zone level and are reported in parentheses. *, **, and *** represent significance at 10%, 5%, and 1%, respectively. Numbers are rounded to comply with Census's disclosure policy.

DEP VAR =	(1) Exit	(2) Exit	(3) Emp Growth	(4) Emp Growth
D_Union	0.0365***	-0.0277	-0.0548***	0.0482
	(0.007)	(0.063)	(0.010)	(0.106)
Wage		-0.0057		0.158***
		(0.008)		(0.013)
Incentives_M		0.0101**		0.000689
		(0.005)		(0.007)
Incentives_NM		-0.0199***		0.0323***
		(0.005)		(0.007)
TFP		0.00726		0.00656
		(0.005)		(0.008)
D_Union x Wage		0.0225		-0.0271
		(0.019)		(0.033)
D_Union x Incentives_M		-0.0167		0.0266
		(0.012)		(0.017)
D_Union x Incentives_NM		0.0117		-0.0407**
		(0.012)		(0.018)
D_Union x TFP		0.00206		-0.00342
		(0.011)		(0.016)
Log(TVS)	-0.0480***	-0.0471***	-0.00304	-0.0119***
	(0.002)	(0.002)	(0.003)	(0.004)
Log(Age)	-0.0255***	-0.0258***	-0.0465***	-0.0459***
	(0.003)	(0.003)	(0.005)	(0.005)
Pct of BA (non-manager)	0.015	0.0216	0.201***	0.119*
	(0.041)	(0.042)	(0.061)	(0.061)
Pct of BA (manager)	0.00996	0.0107	0.0453***	0.0352***
	(0.009)	(0.009)	(0.013)	(0.013)
Log(Firm Emp)	0.00568***	0.00568***	-0.0199***	-0.0227***
	(0.001)	(0.001)	(0.002)	(0.002)
Constant	0.680***	0.693***	0.327***	-0.0967**
	(0.019)	(0.028)	(0.031)	(0.045)
Number of Obs. (rounded)	30000	30000	25000	25000
R-Square	0.0768	0.0776	0.0772	0.0864
Ind FE	Yes	Yes	Yes	Yes
Czone FE	Yes	Yes	Yes	Yes

Table 8: **Spillover Effects: Wages and Incentives**

This table reports regression results to examine the association between unionization and wages and incentives using the 2010 MOPS. The dependent variables are indicated by the header row. D_Union is an indicator variable that equals one if workers at the establishment have membership in labor unions and zero otherwise. "Non-Union Plant in Union Firm" is an indicator variable for non-unionized plants in a firm with at least one unionized plant. "Non-Union Plant in Firm's Union Ind" ("Non-Union Plant outside Firm's Union Ind") is an indicator variable for non-unionized plants in a firm with at least one unionized plant in the same (outside of the) industry. "Non-Union Plant in Firm's Union CZ" ("Non-Union Plant outside Firm's Union CZ" is an indicator variable for non-unionized plants in a firm with at least one unionized plant in the same (a different) commuting zone. Standard errors clustered at the industry (3-digit NAICS) x commuting zone level and are reported in parentheses. *, **, and *** represent significance at 10%, 5%, and 1%, respectively. Numbers are rounded to comply with Census's disclosure policy.

DEP VAR	(1) Wage	(2) Incentives_M	(3) Incentives_NM	(4) Wage	(5) Incentives_M	(6) Incentives_NM
D_Union	0.130***	-0.0850***	-0.338***	0.128***	-0.0836***	-0.334***
	(0.007)	(0.015)	(0.014)	(0.007)	(0.015)	(0.014)
Non-Union Plant in Firm's Union Ind	0.0810***	-0.0524***	-0.145***			
	(0.006)	(0.013)	(0.012)			
Non-Union Plant outside Firm's Union Ind	0.0452***	-0.0611***	-0.0971***			
	(0.008)	(0.016)	(0.016)			
Non-Union Plant in Firm's Union CZ				0.0944***	-0.0869***	-0.217***
				(0.007)	(0.016)	(0.015)
Non-Union Plant outside Firm's Union CZ				0.0587***	-0.0348***	-0.0815***
				(0.006)	(0.013)	(0.013)
Log(TVS)	0.0417***	0.0926***	0.0839***	0.0414***	0.0935***	0.0857***
	(0.002)	(0.004)	(0.004)	(0.002)	(0.004)	(0.004)
Log(Age)	0.00399	-0.0493***	-0.0529***	0.00387	-0.0487***	-0.0519***
	(0.003)	(0.006)	(0.005)	(0.003)	(0.006)	(0.005)
Log(Firm Emp)	0.00142	0.0803***	0.0472***	0.00193	0.0787***	0.0440***
	(0.001)	(0.003)	(0.003)	(0.001)	(0.003)	(0.003)
TFP	0.0827***	-0.0128	-0.0174**	0.0828***	-0.0133	-0.0184**
	(0.004)	(0.008)	(0.008)	(0.004)	(0.008)	(0.008)
Pct of BA (non-manager)	0.389***	0.689***	0.656***	0.382***	0.700***	0.684***
	(0.033)	(0.074)	(0.071)	(0.033)	(0.074)	(0.072)
Pct of BA (manager)	0.0403***	0.153***	0.116***	0.0406***	0.152***	0.113***
	(0.007)	(0.016)	(0.015)	(0.007)	(0.016)	(0.015)
Constant	2.279***	0.500***	0.884***	2.280***	0.500***	0.881***
	(0.018)	(0.037)	(0.036)	(0.018)	(0.037)	(0.036)
Number of Obs. (rounded)	30000	30000	30000	30000	30000	30000
R-Square	0.342	0.21	0.138	0.342	0.21	0.14
Ind FE	Yes	Yes	Yes	Yes	Yes	Yes
Czone FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: **Spillover Effects: Survival, Capex, and Employment Growth**

This table reports regression results to examine the association between unionization and wages and incentives using the 2010 MOPS. The dependent variables are indicated by the header row. D_Union is an indicator variable that equals one if workers at the establishment have membership in labor unions and zero otherwise. "Non-Union Plant in Union Firm" is an indicator variable for non-unionized plants in a firm with at least one unionized plant. "Non-Union Plant in Firm's Union Ind" ("Non-Union Plant outside Firm's Union Ind") is an indicator variable for non-unionized plants in a firm with at least one unionized plant in the same (outside of the) industry. "Non-Union Plant in Firm's Union CZ" ("Non-Union Plant outside Firm's Union CZ" is an indicator variable for non-unionized plants in a firm with at least one unionized plant in the same (a different) commuting zone. Standard errors clustered at the industry (3-digit NAICS) x commuting zone level and are reported in parentheses. *, **, and *** represent significance at 10%, 5%, and 1%, respectively. Numbers are rounded to comply with Census's disclosure policy.

DEP VAR	(1) Exit	(2) Capex	(3) Emp Growth	(4) Exit	(5) Capex	(6) Emp Growth
D_Union	0.0488***	-0.0623***	-0.0668***	0.0484***	-0.0631***	-0.0657***
	(0.008)	(0.012)	(0.012)	(0.008)	(0.012)	(0.012)
Non-Union Estab in Firm's Union Ind	0.0181***	-0.0619***	-0.0261**			
	(0.007)	(0.011)	(0.011)	(0.000)	(0.000)	(0.000)
Non-Union Estab outside Firm's Ind	0.0337***	-0.0606***	-0.01			
	(0.009)	(0.013)	(0.014)	(0.000)	(0.000)	(0.000)
Non-Union Estab in Firm's Union CZone				0.0326***	-0.0443***	-0.0423***
				(0.009)	(0.014)	(0.013)
Non-Union Estab outside Firm's Union CZone				0.0154**	-0.0719***	-0.0103
				(0.007)	(0.011)	(0.011)
Log(TVS)	-0.0473***	0.0701***	-0.00332	-0.0477***	0.0696***	-0.00293
	(0.002)	(0.004)	(0.004)	(0.002)	(0.004)	(0.004)
Log(Age)	-0.0257***	-0.0604***	-0.0454***	-0.0260***	-0.0607***	-0.0452***
	(0.003)	(0.006)	(0.005)	(0.003)	(0.006)	(0.005)
Pct of BA (non-manager)	0.0133	0.0792	0.201***	0.00941	0.0734	0.207***
	(0.041)	(0.070)	(0.061)	(0.041)	(0.070)	(0.061)
Pct of BA (manager)	0.00836	0.00809	0.0457***	0.00909	0.00868	0.0453***
	(0.009)	(0.014)	(0.013)	(0.009)	(0.014)	(0.013)
TFP	0.00722	0.0659***	0.0189***	0.00746	0.0662***	0.0187**
	(0.005)	(0.008)	(0.007)	(0.005)	(0.008)	(0.007)
Log(Firm Emp)	0.00266*	-0.00635**	-0.0174***	0.00337**	-0.00554**	-0.0181***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Constant	0.672***	-0.621***	0.284***	0.672***	-0.621***	0.283***
	(0.021)	(0.045)	(0.034)	(0.021)	(0.045)	(0.034)
Number of Obs. (rounded)	30000	25000	25000	30000	25000	25000
R-Square	0.0774	0.0877	0.0777	0.0774	0.0878	0.0779
Ind FE	Yes	Yes	Yes	Yes	Yes	Yes
Czone FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 10: **Change of RTW Status: Main Effects**

This table reports regression results to examine the effect of the RTW shock using the "Midwest Sample". The dependent variables are indicated on the header row. D_Union is an indicator variable that equals one if workers at the establishment have membership in labor unions and zero otherwise. Treated is an indicator variable for the treated states (IN and MI) and zero for control states (IL, KY, OH, and WI). Pseudo Treated is an indicator variable that equals one for KY and WI and zero for IL and OH. Employment is the logarithm of total employment. Wage is the logarithm of the hourly wage for production workers. Capex(Equipment) and Capex(Structure) are calculated as the change in equipment and change in structures between 2010 and 2017, respectively. Standard errors clustered at the industry (3-digit NAICS) x commuting zone level and are reported in parentheses. *, **, and *** represent significance at 10%, 5%, and 1%, respectively. Numbers are rounded to comply with Census's disclosure policy.

	Panel A: Pre-Period			Panel B: Post-Period		
DEP VAR	(1) ΔEmployment	(2) Capex (Equipment)	(3) Capex (Structure)	(4) ΔEmployment	(5) Capex (Equipment)	(6) Capex (Structure)
D_Union	0.000423	-0.00073	-0.0213**	-0.0411**	-0.0227***	-0.00721
	(0.019)	(0.005)	(0.005)	(0.012)	(0.005)	(0.007)
Treated x Union	-0.0126	0.00981	0.0336	0.0474**	0.0172**	0.0117
	(0.032)	(0.033)	(0.021)	(0.012)	(0.007)	(0.011)
Log(Age)	-0.0359**	-0.0493***	-0.0315**	-0.0192**	-0.0167**	-0.0120*
	(0.010)	(0.007)	(0.008)	(0.007)	(0.006)	(0.005)
Log(TVS) 2012				0.00229	0.0184***	0.00711**
	(0.000)	(0.000)	(0.000)	(0.003)	(0.003)	(0.002)
Log(TVS) 2007	-0.0241***	-0.0372***	-0.0302***			
	(0.004)	(0.008)	(0.006)	(0.000)	(0.000)	(0.000)
TFP 2012				0.0185*	0.0205	0.00609*
	(0.000)	(0.000)	(0.000)	(0.008)	(0.011)	(0.003)
TFP 2007	0.0349**	0.0862***	0.0614***			
	(0.012)	(0.015)	(0.012)	(0.000)	(0.000)	(0.000)
Constant	0.174**	0.428***	0.335***	0.0232	-0.169***	-0.0573***
	(0.065)	(0.065)	(0.077)	(0.041)	(0.041)	(0.008)
Number of Obs. (rounded)	5200	5200	5200	5200	5200	5200
R-Square	0.164	0.178	0.102	0.164	0.178	0.102
FE	Ind x State	Ind x State	Ind x State	Ind x State	Ind x State	Ind x State

	Panel C: Post-Period (Pseudo-Treated)		
	(1)	(2)	(3)
DEP VAR	ΔEmployment	Capex (Equipment)	Capex (Structure)
D_Union	-0.0555***	-0.0228**	-0.0062
	(0.007)	(0.007)	(0.007)
Pseudo Treated x Union	0.036	0.0022	-0.0051
	(0.025)	(0.024)	(0.016)
Log(Age)	-0.0173	-0.0196*	-0.0081
	(0.009)	(0.008)	(0.005)
Log(TVS) 2012	0.0042	0.0182**	0.0063**
	(0.003)	(0.004)	(0.001)
TFP 2012	0.0201	0.0175	0.0038
	(0.013)	(0.014)	(0.003)
Constant	-0.0078	-0.153**	-0.0551**
	(0.045)	(0.040)	(0.012)
Number of Obs. (rounded)	3600	3600	3600
R-Square	0.115	0.122	0.102
FE	Ind x State	Ind x State	Ind x State

Table 11: **Change of RTW Status: Spill-over Effects**

This table reports regression results to examine the effect of the RTW shock on affiliated non-unionized plants owned by the same firm that owns unionized plants in the Midwest Sample (i.e., "Affiliated Non-Union Sample"). The dependent variables are indicated on the header row. ANU_Treated is an indicator variable that equals one if the union plant is in a treated state and zero otherwise. Employment is the logarithm of total employment. Capex(Equipment), and Capex(Structure) are calculated as the change in equipment and change in structures between 2010 and 2017, respectively. Standard errors clustered at the industry (3-digit NAICS) x commuting zone level and are reported in parentheses. *, **, *** represent significance at 10%, 5%, and 1%, respectively. Numbers are rounded to comply with Census's disclosure policy.

	Panel A: Pre-Period			Panel B: Post-Period		
DEP VAR	(1) ΔEmployment	(2) Capex (Equipment)	(3) Capex (Structure)	(4) ΔEmployment	(5) Capex (Equipment)	(6) Capex (Structure)
ANU_Treated	0.0308	-0.0000796	-0.00437	0.0429*	0.0203*	0.00799
	(0.032)	(0.034)	(0.023)	(0.022)	(0.011)	(0.009)
Log(Age)	-0.0354***	-0.0229	-0.0139	-0.00969	-0.0315***	-0.00157
	(0.010)	(0.016)	(0.010)	(0.015)	(0.008)	(0.003)
Log(TVS) 2007	0.0370***	-0.00977	-0.00713*			
	(0.012)	(0.008)	(0.004)			
Log(TVS) 2012				0.0122*	0.0106***	0.00987***
				(0.006)	(0.003)	(0.003)
TFP 2007	-0.0393**	-0.006	-0.0062			
	(0.015)	(0.025)	(0.008)			
TFP 2012				-0.0105	0.00639	-0.00326
				(0.013)	(0.016)	(0.005)
Log(Firm Emp)	-0.00247	-0.0170***	-0.00165	-0.0114	-0.0139**	-0.00395**
	(0.007)	(0.006)	(0.007)	(0.009)	(0.006)	(0.002)
Constant	-0.349**	0.355***	0.142***	-0.0288	0.0828	-0.0865*
	(0.133)	(0.092)	(0.030)	(0.089)	(0.060)	(0.047)
Number of Obs. (rounded)	2300	2300	2300	2300	2300	2300
R-Square	0.502	0.415	0.392	0.457	0.419	0.445
FE	Ind x State	Ind x State	Ind x State	Ind x State	Ind x State	Ind x State

Table 12: **Union and Concentration**

This table reports regression results to examine the association between unionization and compensation (Panel A) and incentives (Panel B) using the 2010 MOPS. In Panel A, the dependent variables are the logarithm of the hourly wage for production workers (columns 1 to 3) and the logarithm of average wages for all workers (columns 4 to 6), respectively. In Panel B, the dependent variables include performance-based measures as indicated by the header row. D_Union is an indicator variable that equals one if workers at the establishment have membership in labor unions and zero otherwise. HHI is the Herfindahl–Hirschman index (based on 3-digit NAICS). D_Conc is an indicator variable that equals one if the Herfindahl–Hirschman index (HHI) in the commuting zone is in the top quartile across all commuting zones in the U.S. and zero otherwise. D_Dom3 is an indicator variable that equals one if the establishment is in an industry (based on 3-digit NAICS) that employs more than 10% of the total employment in the commuting zone and zero otherwise. Standard errors clustered at the industry (3-digit NAICS) x commuting zone level and are reported in parentheses. *, **, and *** represent significance at 10%, 5%, and 1%, respectively. Numbers are rounded to comply with Census's disclosure policy.

Panel A : Compensation

	(1)	(2)	(3)	(4)	(5)	(6)
DEP VAR =		Hourly Wage			Average Wage	
D_Union	0.0787***	0.0813***	0.0769***	0.0251***	0.0290***	0.0234***
	(0.008)	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)
HHI3	-0.0237			-0.0515***		
	(0.016)			(0.014)		
D_Union x HHI3	0.0745***			0.0817***		
	(0.026)			(0.022)		
D_Conc		-0.0154**			-0.0172***	
		(0.006)			(0.006)	
D_Union x D_Conc		0.0325***			0.0310***	
		(0.012)			(0.010)	
D_Dom3			-0.0428***			-0.0633***
			(0.006)			(0.005)
D_Union x D_Dom3			0.0434***			0.0468***
			(0.011)			(0.009)
Log(TVS)	0.0401***	0.0401***	0.0429***	0.0677***	0.0677***	0.0721***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Log(Age)	0.0060**	0.0059**	0.00667***	0.0105***	0.0103***	0.0114***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Log(Firm Emp)	0.0100***	0.0100***	0.0102***	-0.00497***	-0.0050***	-0.00478***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
TFP	0.0830***	0.0829***	0.0826***	0.0349***	0.0348***	0.0343***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Pct of BA_Non-Manager	0.3920***	0.3920***	0.3930***	0.4520***	0.4520***	0.4540***
	(0.034)	(0.034)	(0.033)	(0.030)	(0.030)	(0.030)
Pct of BA_Manager	0.0432***	0.0433***	0.0439***	0.0819***	0.0820***	0.0830***
	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)
Constant	2.263***	2.263***	2.238***	3.010***	3.008***	2.971***
	(0.018)	(0.018)	(0.018)	(0.017)	(0.017)	(0.017)
Number of Obs. (rounded)	30000	30000	30000	30000	30000	30000
R-Square	0.338	0.338	0.339	0.438	0.438	0.44
Ind FE	Yes	Yes	Yes	Yes	Yes	Yes
Czone FE	Yes	Yes	Yes	Yes	Yes	Yes

Panel B : Incentives

DEP VAR	(1) Bonus_M	(2) Bonus_NM	(3) Promotion_M	(4) Promotion_NM	(5) Dismissal_M	(6) Dismissal_NM
D_Union	-0.0164**	-0.0869***	-0.0074	-0.0842***	-0.0197**	-0.0756***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.009)	(0.009)
D_Conc	0.00476	-0.0071	-0.0001	0.0072	0.0050	0.0054
	(0.007)	(0.007)	(0.006)	(0.006)	(0.008)	(0.008)
D_Union x D_Conc	-0.0055	-0.0105	-0.0233**	-0.0275**	-0.0163	-0.0301*
	(0.012)	(0.013)	(0.011)	(0.013)	(0.015)	(0.016)
Log(TVS)	0.0305***	0.0313***	0.0369***	0.0306***	0.0269***	0.0254***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Log(Age)	-0.0104***	-0.0113***	-0.0141***	-0.0161***	-0.0259***	-0.0290***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Log(Firm Emp)	0.0261***	0.0086***	0.0317***	0.0162***	0.0155***	0.0062***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
TFP	0.0126***	0.0074*	-0.0080**	-0.0046	-0.0177***	-0.0208***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.005)	(0.005)
Pct of BA_Non-Manager	0.163***	0.235***	0.257***	0.278***	0.268***	0.138***
	(0.035)	(0.037)	(0.035)	(0.033)	(0.042)	(0.042)
Pct of BA_Manager	0.0870***	0.0822***	0.0187**	-0.0057	0.0448***	0.0336***
	(0.007)	(0.008)	(0.008)	(0.007)	(0.009)	(0.009)
Constant	-0.0456***	-0.0401**	0.285***	0.484***	0.272***	0.472***
	(0.017)	(0.018)	(0.018)	(0.017)	(0.021)	(0.021)
Number of Obs. (rounded)	30000	30000	30000	30000	30000	30000
R-Square	0.165	0.0997	0.16	0.103	0.0699	0.0598
Ind FE	Yes	Yes	Yes	Yes	Yes	Yes
Czone FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 13: **Union and Capital-Labor Ratio**

This table reports regression results to examine the association between unionization and the capital-labor ratio using the 2010 ASM and the 2017 CMF. The dependent variables are capital-labor ratio (K/L) for columns 1-2 and changes in capital-labor ratio Δ(K/L) for columns 3-4. K/L is defined as the logarithm of capital stock over the number of employees in 2010, and Δ(K/L) is measured between 2010 and 2017. D_Union is an indicator variable that equals one if workers at the establishment have membership in labor unions and zero otherwise. Wage is the logarithm of the average wage at the establishment, and local wage is the logarithm of average wages across all other plants in the same industry (4-digit NAICS) and commuting zone. ΔWage andΔLocal Wage are measured between 2010 and 2017. Incentive_M and Incentive_NM are incentive scores of managers and non-managers, respectively, constructed from the 2010 MOPS. Standard errors clustered at the industry (3-digit NAICS) x commuting zone level and are reported in parentheses. *, **, and *** represent significance at 10%, 5%, and 1%, respectively. Numbers are rounded to comply with Census's disclosure policy.

DEP VAR:	(1) K/L	(2) K/L	(3) K/L	(4) Δ (K/L)	(5) Δ(K/L)
D_Union	0.0780***	0.0420***	0.0617***	0.0355***	0.0314**
	(0.016)	(0.015)	(0.016)	(0.013)	(0.013)
Wage		0.864***			
		(0.021)			
Local Wage			0.388***		
			(0.028)		
Δ Wage				0.411***	
				(0.021)	
Δ Local Wage					0.000667
					(0.019)
Incentives_M		0.00719	0.0207**	0.0105	0.00698
		(0.010)	(0.010)	(0.009)	(0.009)
Incentives_NM		-0.0213**	-0.0337***	0.0111	0.0117
		(0.010)	(0.010)	(0.009)	(0.009)
Log(TVS)	0.0981***	0.0411***	0.0873***	0.0772***	0.0757***
	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)
Log(Age)	0.0802***	0.0713***	0.0800***	-0.0178**	-0.0180**
	(0.008)	(0.007)	(0.008)	(0.007)	(0.007)
Pct of BA (non-manager)	-0.0385	-0.425***	-0.096	-0.165**	-0.133
	(0.094)	(0.091)	(0.094)	(0.082)	(0.083)
Pct of BA (manager)	0.189***	0.118***	0.179***	-0.0397**	-0.0424**
	(0.021)	(0.020)	(0.021)	(0.017)	(0.017)
Log(Firm Emp)	0.0374***	0.0418***	0.0382***	0.00254	0.00401
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	2.985***	0.345***	3.035***	-0.900***	-0.835***
	(0.048)	(0.080)	(0.049)	(0.047)	(0.048)
Number of Obs. (rounded)	30000	30000	30000	25000	25000
R-Square	0.35	0.396	0.356	0.114	0.0724
Ind FE	Yes	Yes	Yes	Yes	Yes
Czone FE	Yes	Yes	Yes	Yes	Yes

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