Uncovering Organizational Strategies Behind Employee Downsizing: Evidence from Product Turnover in Manufacturing Plants *

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Abstract

Workforce downsizing is an important management decision for firms to recover from business downturns. Using administrative data on the population of manufacturing plants and their products in Japan, we investigate the strategies adopted by firms that secure productivity gains after downsizing. By accounting for the staggered timings of layoff events, we found that managing product turnover is key to securing productivity gains. In particular, successful plants were less likely to introduce new products and replace existing products, and they reduced their new investment while maintaining performance levels after downsizing. Importantly, these effects were only observed in capital-intensive plants. We argue that a relatively high replacement cost per new product leads capital-intensive plants to focus on process innovation for their existing products, thereby improving their productivity.

Keywords: layoff, employee downsizing, resource allocation, productivity, product turnover, staggered difference-in-differences.

1 Introduction

Workforce downsizing is an important management decision for firms to recover from business downturns. By laying off workers, firms intend to allocate their internal resources efficiently in response to external changes to prepare for the next stage of organizational growth. However, whether downsizing leads firms to successful recovery and eventually secures productivity gains remain empirically controversial. Notwithstanding the large body of the empirical literature, studies have provided mixed evidence on the impacts of employee downsizing on firm performance and productivity (Chen et al., 2001; Chalos and Chen, 2002; Dong and Xu, 2008; Datta et al., 2010; Chhinzer and Currie, 2014; Kawai, 2014; Goesaert et al., 2015, etc.). Identifying the factors underlying the mixed evidence is key to designing successful downsizing strategies.

This study aims to uncover the organizational behaviors behind employee downsizing and investigate the strategies adopted by firms that secure productivity gains after employee downsizing. To reveal the new mechanisms behind successful cases, we revisited the moderating role played by capital intensity (Datta et al., 2005; Guthrie and Datta, 2008) and examined whether capital intensity moderated the impact of employee downsizing on not only performance and productivity but also resource allocation and product turnover. To serve this purpose, this study draws on administrative data on the population of manufacturing plants and their 6-digit product information in Japan. We extracted layoff announcement information for firms listed on Japanese stock exchanges. We then compared the performance trajectories of plants whose headquarters announced layoffs to those of their similar counterparts without any layoff announcements. Plants with layoff announcements may be systematically different from other plants in terms of managerial traits or production technologies, thus raising concerns regarding their causal interpretations. To address this issue, we carefully constructed appropriate comparison groups by following recent advancements in the staggered difference-in-difference (DID) literature (Baker et al., 2021; Borusyak et al., 2021; Callaway and Sant'Anna, 2021; de Chaisemartin and DHaultfuille, 2020; Goodman-Bacon, 2021; Imai and Kim, 2021; Sun and Abraham, 2021; Athey and Imbens, 2022). We then investigate whether the impacts on plant performance, productivity, product turnover, and resource allocation are characterized by the extent of capital intensity prior to the layoff announcement.

Based on the large-scale layoffs announced between 2008 and 2012, we found that managing product turnover was key to the success of capital-intensive plants. In particular, capital-intensive plants were less likely to introduce new products to replace existing ones after downsizing. They also reduced their capital inputs substantially, while increasing their productivity levels. We argue that a relatively high replacement cost per new product leads capital-intensive plants to focus on process innovation for their existing products, rather than introducing new products, which contributes toward improving their productivity. Our estimates suggest that capital-intensive plants reduced their product turnover in the first year after the layoff announcement. Their total factor productivity (TFP) started to increase in the second year, and by the fourth year, the capital-intensive plants had 20% higher TFP than comparable plants without layoff announcements. Taken together, the findings of this study highlight the importance of product management strategies during employee downsizing.

Our study contributes to the downsizing literature in two ways. First, it provides the first direct evidence of downsizing effects on product turnover and its moderating effect by capital intensity. To develop our conceptual framework, we apply strategic rigidities arising from high capital intensity (Datta and Rajagopalan, 1998; Hambrick and Lei, 1985) to product turnover. Although this strategic rigidity framework has already been adopted to conceptualize the moderating effect of capital intensity on firm profitability (Guthrie and Datta, 2008), to the best of our knowledge, no studies have applied it to internal resource allocation and product turnover. We argue that organizational strategies are complementary to each other in the sense that a downsizing strategy should be simultaneously determined with resource allocation strategies, in addition to product management.

Second, we also contribute to the downsizing literature by carefully accounting for the staggered timings of layoff events. Some recent studies have raised serious concerns vis-à-vis applying the event study approach when the treatment has multiple timings and heterogeneous effects over time (Baker et al., 2021; Borusyak et al., 2021; Callaway and Sant'Anna, 2021; de Chaisemartin and DHaultfuille, 2020; Goodman-Bacon, 2021; Imai and Kim, 2021; Sun and Abraham, 2021; Athey and Imbens, 2022). Intuitively, the bias arises owing to the inclusion of early-treated groups in the control group when estimating the treatment effect for later-treated groups. After accounting for this bias, some prominent findings in finance and accounting publications failed to survive (Baker et al., 2021). Because layoffs occur at different points in time for each firm, it is essential to follow the proposed methods in the context of our study. To the best of our knowledge, our study is one of the first to apply a staggered DID framework in the downsizing literature and provide a causal interpretation of the strategic consequences of employee downsizing.

The remainder of this paper is organized as follows: Section 2 presents our conceptual framework by drawing on previous studies and lays out the main hypotheses. Section 3 introduces the datasets used in the analyses and illustrates the institutional background of the layoff announcements analyzed in this study. Section 4 describes the identification strategies employed in this study. Section 5 presents the results. Section 6 discusses the managerial implications and limitations and concludes the study.

2 Conceptual Framework

This section illustrates our conceptual framework by drawing on existing studies and lays out the main hypotheses. In this study, we consider employee downsizing as a set of organizational strategies and its announcement to cut back on employees in response to an unexpected negative shock with the aim of improving performance and efficiency. Our definition of employee downsizing is very similar to those of previous management studies (Cameron, 1994; Cameron et al., 1993, etc.) in that we aim to study intentional organizational actions. However, our definition slightly differs from previous works in that we study immediate organizational strategic responses to relatively large and unexpected shocks rather than strategies planned over a relatively longer period of time in advance. We follow this definition because it is in line with the nature of shocks at the time of the Great Recession, our sampling period (see Section 5.1), and also because it has a methodological advantage in providing causal interpretations for the strategic consequence of employee downsizing (see Section 4).

Notwithstanding the expansiveness of the empirical literature, studies have reported mixed effects of employee downsizing on firm performance and labor productivity, and no positive effects on TFP.[1] Identifying the factors underlying the mixed evidence is key to finding successful downsizing strategies. Therefore, over the past two decades, studies have sought to clarify the moderating factors that have led firms to successful downsizing strategies. These moderating factors range from controllable internal policies (Zatzick and Iverson, 2006; Chadwick et al., 2004; Cspedes-Lorente et al., 2019) to preexisting corporate conditions (Love and Nohria, 2005; Yu and Park, 2006; Guthrie and Datta, 2008; Goesaert et al., 2015; Ramdani et al., 2020).[2]

We adopt our baseline conceptual framework from one strand of these studies, Guthrie and Datta (2008), wherein the authors argue that industry conditions, such as capital in-

[1]Studies reported no significant positive effect of downsizing on TFP (Goesaert et al., 2015; Dong and Xu, 2008). One exception is the case in which firms downsize after mergers and acquisitions (M&A). Siegel and Simons (2010) investigated employer–employee matched panel datasets in the Swedish manufacturing sector and found that M&A enhanced plant productivity, while simultaneously engendering a recovery in TFP and plant downsizing. In terms of labor productivity, the evidence is mixed. Chhinzer and Currie (2014) found no recovery in labor productivity two years after the layoff among Canadian firms, while some found an improved labor productivity after downsizing (Chen et al., 2001; Chalos and Chen, 2002).Datta et al. (2010) provides a comprehensive overview of empirical studies up to year 2008. According to Datta et al. (2010), evidence on firm performance or profitability is also mixed. More recently, Kawai (2014) established a negative correlation between downsizing and subsequent sales growth among Japanese multinational firms.

[2]For instance, Zatzick and Iverson (2006) found that the negative impact of workforce downsizing on productivity was mitigated among firms that adopted high-involvement workplace practices. Similarly, Chadwick et al. (2004) reported that human resource (HR) policies such as extensive communication influence the perceived success of workforce downsizing in hospitals. According to Cspedes-Lorente et al. (2019), information technology implementation moderates the negative effect of employee downsizing on economic performance. Conversely, studies have also pointed out that the benefits of downsizing on firm profitability are greater if firms have experienced high levels of slack and downsizing involved organizational redesigns etc., (Love and Nohria, 2005), as well as if firms have had no losses in the past three years (Yu and Park, 2006). Similarly, the negative impact on productivity is also mitigated by firms restructuring to increase efficiency in contrast to firms restructuring due to business downturns (Goesaert et al., 2015). It was also established that employee downsizing had a positive effect on innovation for firms with resource slack, while it had an opposing effect for firms with resource constraints (Ramdani et al., 2020).

tensity and research and development intensity, have moderating effects on the impact of employee downsizing on firm performance. Their conceptual framework was built upon a contingency perspective of the resource-based view of the firm. Essentially, the effectiveness of HR policies, including employee downsizing, depends on the structure of the firm's industry (Datta et al., 2005; Guthrie and Datta, 2008). A prominent example of such a structure is the extent of capital intensity in the industry. Because firms in a capital-intensive industry face a relatively high fixed cost of capital, their management faces strategic rigidity in the sense that their decision is constrained by the high replacement or adjustment cost of their capital (Datta and Rajagopalan, 1998; Hambrick and Lei, 1985). To compensate for the high adjustment cost, capital-intensive firms would be disproportionately concerned about leveraging sufficient returns per unit of their investment, thereby adopting production processes and technologies accordingly. Given the relatively high contribution of capital to firm performance, the role of labor tends to be smaller in capital-intensive industries. The effects of HR policies on firm performance and productivity are then reduced or moderated in more capital-intensive industries (Datta et al., 2005; Guthrie and Datta, 2008).[3]

We modify the baseline conceptual framework in two ways. First, we extend the context of the framework from industry structure to the conditions faced by individual plants. We argue that individual plants develop their own production processes and technologies differently, even within the same industry. Because of the divergent levels of production technologies, individual plants are likely to face different fixed and replacement costs of capital, and therefore, different extents of capital intensity both within and across industries. Thus,

[3] Datta et al. (2005) and Guthrie and Datta (2008) also draw their arguments from degrees of task structure conceptualized in the strategic HR management literature, suggesting that "human elements becomes more integral to the production process as capital intensity decreases"(Guthrie and Datta, 2008, p.137). While we agree with the rationale of their argument, we also consider that the human element plays an increasingly interactive or enforcing role in the production process in capital-intensive industries. In fact, a recent empirical research has found a stronger complementarity between capital and labor after the Great Recession (Hershbein and Kahn, 2018). Based on skill requirement information in job vacancy postings, Hershbein and Kahn (2018) show that recessions lead firms to restructure their production toward routine-biased technologies and, therefore, increase job postings for skilled labor who can complement the newly adopted technologies. Thus, specific types of labor are becoming more integral, even in capital-intensive industries. In the following, we focus on a conceptual framework based on the rigidity arguments raised in Datta et al. (2005) and Guthrie and Datta (2008).

it is consistent to consider that the effect of employee downsizing is also contingent on the capital intensity of individual plants. We hypothesize that the capital intensity of each plant moderates the effect of employee downsizing on plant performance and productivity (**hypothesis 1**).[4]

Second, we extend the original framework to plants' resource allocation and product turnover to elucidate further mechanisms behind the moderated effect on plant performance and productivity, if any. In particular, we argue that the moderating effect of capital intensity is also present in the plant's resource allocation behavior and product replacement decision. Consider a plant that has announced large-scale layoffs. Given the original aim of employee downsizing, the plant now tries to determine a combination of products that would yield the highest return among a potential set of product mixes and allocate their internal resources accordingly. The plant faces two main options: replacing some existing products with new ones or maintaining the current combination of products. As in Datta and Rajagopalan (1998) and Hambrick and Lei (1985), high fixed and replacement costs of capital generate strategic rigidities among capital-intensive plants. Because of the higher contribution of capital in capital-intensive plants, the implicit cost arising from the uncertainty in making new investments is also higher. Thus, capital-intensive plants are less likely to opt to replace existing products, in concurrence with employee downsizing. Because additional replacement cost per product is more expensive than it is for less capital-intensive plants, they are more likely to maintain the current product combination. We hypothesize that capital intensity at each plant moderates the effect of employee downsizing on product creation and destruction, and therefore, product turnover (**hypothesis 2**). Because they are less likely to make a new investment to replace existing products, we also hypothesize that capital intensity slows down renewal investments (**hypothesis 3**).

[4] In the following estimations, we purge out industry impact by including industry-specific trends in a model, thereby exclusively focusing on the moderating effect of capital intensity at the plant level.

3 Data

3.1 Main Data

Our main analysis draws on plant-level panel data from the Census of Manufacture, which is conducted annually by the Japanese Ministry of Economy, Trade, and Industry. The Census of Manufacture covers nearly the entire population of plants in Japans manufacturing sector. It contains detailed information on the factor inputs and outputs produced by each plant. Using this information, we calculated the plants' productivity measurements and the extent of capital intensity, in addition to product turnover. We start our analysis with the annual files from 2005 to 2016 that cover all plants with 30 or more employees (*Kou Hyou* panel).[5] We use plant-level panel data rather than firm-level data, as firms can allocate their resources across plants in response to employee downsizing. We take this approach mainly because of the limited nature of our sample (i.e., manufacturing plants only)[6], as well as because we adopt a lower-bound approach: since plant-level resource adjustments would be negatively correlated between plants within the same firm, the estimates of the impact of layoff announcement would be larger in absolute terms if we were to account for this possibility.[7] Thus, the estimates shown in this study should be considered as the lower bounds of the impact of layoff announcements.

Performance, Productivity, and Resource Allocation: We first examine how layoff announcements affect plants' performance and productivity levels. Thereafter, we investigate the internal mechanism to explain the results on performance and productivity by exam-

[5]The survey also has other types of annual files that contain information on all plants with 29 or fewer employees (*Otsu Hyou* panel). Because these files lack information on fixed assets, we decide not to use them in this study.

[6]We matched the layoff information by the telephone numbers of the headquarters; however, the phone numbers of some headquarters are unavailable in the Census of Manufacture. It is also possible that branches targeted at the firms' layoff announcements are not registered as manufacturing establishments; the firms do not target the manufacturing branches for the layoff.

[7]Intuitively speaking, if a firm reduced its workforce and fixed assets at one plant after the layoff announcement but strategically reallocated more resources to the other plant (e.g., invested more in their capital), the negative effect of layoff announcements on fixed asset at one plant would attenuate the positive effect on fixed asset at the other plant.

ining the impact of layoff announcements on the extent of plants' resource allocation in a broad sense, namely, the impact on the number of regular employees and fixed assets. We measure plant performance by their value added. Value added is calculated by subtracting the material costs from the revenue from the product shipment of each plant. We take logarithms for all these outcome variables and report our results in terms of the layoff impact in %. To measure a plant's productivity level, we adopt two variables: labor productivity and TFP. Labor productivity is calculated by dividing the value added by the number of regular employees and taking the logarithm. To calculate TFP, we first take the average labor share of each industry (α_s for industry s). The TFP of plant i at time t is then calculated as $lnTFP_{it} = lnVA_{it} - \alpha_s lnL_{it} - (1 - \alpha_s)lnK_{it}$, where VA, L, and K denote value added, number of regular workers, and fixed assets, respectively. According to economic theory, TFP measures anything that is left in value added after accounting for the direct contributions of input factors of production, labor (number of regular workers), and capital (fixed assets) (Mankiw, 2015). Thus, TFP reflects the technological level of the plant, skills, and knowledge of workers, in addition to the efficiency of resource allocation within a plant.[8]

Product Creation and Destruction: One advantage of using the Census of Manufacture is that we can proxy the extent of product creation and destruction by relying on the 6-digit level records of products manufactured at each plant. The 6-digit level of product information is sufficiently detailed to reflect major product turnover. For example, batteries are broken down into "lead battery (309111)," "alkaline battery (309112)," and "lithium-ion battery (309113)," among others.[9] We aggregated the product information for each plant in each time period by counting the number of products produced. More specifically, a new product is defined as a product produced in the survey year but not in the previous year. Similarly, an abolished product is the product produced in the survey year but not in the next year. The net increase in the number of products is calculated as the number of new

[8] It can also be proved that labor productivity is divided into two components—TFP and capital to labor ratio—under reasonable assumptions on plants' production functions (Mankiw, 2015).

[9] Dekle et al. (2021) used the same 6-digit product data to examine product dynamics over business cycles.

products minus the number of abolished products. We then merge this information with layoff announcement records to examine the impact of large-scale layoffs on firms' product dynamics. Table 1 presents the summary statistics of the main data. On average, the plants in our sample produced 2.3 products, abolished 0.14 products, and added 0.15 products per year.

Capital-Intensive Plants: Capital intensity is calculated as the ratio of fixed assets to revenue from product shipments at each plant. The bottom line of Table 1 presents the summary statistics of plant-level capital intensity in each year. We classify plants into "high capital-intensive plants" based on their three-year average of the capital intensity prior to the layoff announcement. More specifically, we define plants as capital-intensive if the three year average is higher than the median value of the capital intensity of all plants. We take an average in years prior to the announcement event to prevent the capital intensity measurement itself from being affected by the layoff announcement, thereby contaminating our categorization.

Control Variables: In the main estimations, we control for individual plant and year fixed effects. By including plant fixed effects, we eliminate time-invariant plant characteristics and, therefore, estimate the impact of layoff announcements based on variations in the outcome variable within the same plant before and after the layoff announcement. The model also controls for industry-specific and region-specific year effects. These control variables absorb annual business shocks specific to the industry or region to which each plant belongs.

3.2 Layoff Announcement

Our data on layoff announcements were obtained from a survey compiled by Tokyo Shoko Research Ltd. (TSR).[10] The survey collects information on large-scale layoffs announced by major listed companies and OTC-registered companies.[11] It contains the layoff announcements of well-known global corporations. We merged the firm-level layoff announcements provided by TSR with plant-level observations of the Census of Manufacture by the telephone number of the plant's headquarters. As explained in more detail in Section 4, we constructed a dummy variable to indicate the timing at which the headquarters announced layoffs. Figure 1 shows the number of plants whose headquarters announces layoffs in the merged dataset. Unsurprisingly, the number of layoffs surged during the Great Recession.

3.3 Institutional Background

To draw implications from our results, it is important to clarify the institutional background behind the layoff announcement concept analyzed in this study. First, this study focused on the time period surrounding the Great Recession in 2009. As we will show later, this choice of the time period has a methodological advantage because we can exploit the relatively unexpected nature of the economic shock to identify the impacts of strategic responses. While the literature has also examined antecedents of employee downsizing (Datta et al., 2010, for a comprehensive review), we do not focus on such driving factors because the divergent prior factors would contaminate the estimates of post-layoff effects. Second, layoffs in our dataset were announced as buyout offers to employees, in some cases targeting specific age groups by setting a minimum age requirement (e.g., early retirement program). Although some of our layoff announcement data contain age requirement information, we do not use this information in our estimations, owing to the small sample size or the

[10] TSR is a major credit research company in Japan, mainly engaged in the credit research of domestic and overseas companies as well as the development of databases based on corporate information. We thank TSR for providing us with layoff announcement data.

[11] The survey is based on "the Disclosure of Corporate Information" section of Timely Disclosure of Corporate Information.

lack of statistical power. Finally, Japan is still a country characterized by lifetime employment practices (Kambayashi and Kato, 2016). Such long-term employment is concurrent with firm-specific skill investment (Hashimoto, 1979; Hashimoto and Raisian, 1985). Layoff announcements in the context of this study, therefore, may potentially breach long-run commitment to relation-specific investments and hamper workers' motivation and skill investment, especially among young employees. Okudaira et al. (2022) studied the impact of layoff announcements on firm-specific investment by combining the age composition information available in the Basic Survey on Wage Structure in Japan. They reported that layoff announcements decreased the proportion of young employees. Although firm-specific investment is not the main focus of the current and extended version of the paper, the results presented in this study should be interpreted along with this possibility.

4 Methodology

The causal relationship between layoff announcement and firm performance is not necessarily straightforward when interpreting data. For instance, firms announce layoffs because of downturns in their businesses, but they may not recover even many years after the layoff due to prolonged business slump. In this case, the decline in performance after the layoff reflects not only a preexisting declining market trend but also a strategic consequence of their decision to downsize. Similarly, firms may suffer from plummeting performance, and thus announce layoffs, essentially because of their HR malmanagement. Then, these firms might not reallocate their resources effectively, even after downsizing; therefore, they might continue to fall behind other firms. If this is the case, it is a lack of managerial ability, rather than employee downsizing, that drives down firm performance. Therefore, to evaluate the strategic consequences of layoff decisions, it would be ideal to know what would have happened to a layoff firm had it not announced the layoff.

Difference-in-differences (DID) is a useful approach for addressing this issue. It estimates the differences in outcomes between a layoff plant (i.e., treatment group) and those of its potentially similar counterpart (i.e., control group). We begin our specification using the standard DID regression model:

$$Y_{it} = \sum_{s=-w}^{w} \gamma^s I(event_{it}^s) + x_{it}\beta + \delta_t + \theta_i + \epsilon_{it}, \tag{1}$$

where Y_{it} is an outcome variable for plant i in year t, such as valued added, productivity measurements, or the number of new products; w is an arbitrary event window (e.g., three years or $w = 3$); and ϵ_{it} is an error term representing idiosyncratic shock to the plant i at year t. The model controls for year effects (δ_t) and plant fixed effects (θ_i). These variables are intended to remove annual business shocks common to all plants as well as unobserved plant traits at each plant, including management quality, which are fixed over time. We also include a vector of control variables, industry and region-specific year effects (x_{it}). The treatment indicator $I(event_{it}^s)$ takes a value of one if plant i announces layoffs at s years from period t and zero otherwise. Thus, our model adopts an event study framework. By examining the significance of estimates for γ^s, we can test the differences in performance trajectories between plants with layoff announcements and their similar counterparts without any layoff announcements before and after the layoff.

One advantage of the DID approach is that it allows us to examine whether layoff plants are very similar to control plants in terms of preexisting trends in the outcome variable. In econometric terms, we can indirectly test the common trend assumption, that is, whether the treated plants would have followed the same outcome path as the control plants, had the treated plants not been affected by the layoff announcement. Researchers typically test the validity of this assumption by examining the magnitude of the estimates of γ^s prior to the layoff announcement (for $s \leq -1$). If these estimates are not statistically different from zero, it indicates that layoff plants and control plants are very similar prior to the layoff announcement in that they follow the same outcome trends. The layoff announcement is thus considered quasi-random: conditional on control variables, layoff and control plants are almost the same except that the former adopts the layoff strategy, while the latter does not. Such a DID specification has been adopted across a wide range of studies, including prominent works in finance and accounting (Beck et al., 2010; Fauver et al., 2017; Wang et al., 2021), in addition to strategic management.[12]

However, recent advancements in the econometric literature have raised serious concerns about estimating DID models when the timings of treatments are staggered (Baker et al., 2021; Borusyak et al., 2021; Callaway and Sant'Anna, 2021; de Chaisemartin and DHaultfuille, 2020; Goodman-Bacon, 2021; Imai and Kim, 2021; Sun and Abraham, 2021; Athey and Imbens, 2022). This issue arises essentially because the standard DID model, such as equation (1), automatically treats early adopters (i.e., those plants that announce layoffs at an earlier stage during the sample period, say in 2008) as control plants when estimating the treatment effect of late adopters (i.e., those plants that announce layoffs at a later stage, say in 2013).[13] In fact, the DID estimate can even provide the opposite sign to the true effect of the layoff strategy. In his replications of the earlier studies that had employed a standard DID approach in finance and accounting journals, Baker et al. (2021) showed that some important findings in these studies failed to hold after correcting for the bias arising from the inclusion of early adopters in the control group.[14] To identify the true layoff effects of staggered events, we must construct appropriate control groups for each of the event years and ensure the validity of the common trend assumption for each of these event years.

To overcome the issues arising from staggered DID, this study adopted a strategy suggested in the recent literature—the stacked event-by-event approach proposed by Cengiz

[12]As a recent example of the application, Flammer and Ioannou (2021) adopted a similar DID specification to study the impact of a substantial increase in the cost of credit on their resources. It should be noted that their DID specification relies on one treatment timing (i.e., financial crisis); therefore, it is free from the concern arising from staggered treatment timings, which we describe below.

[13]More specifically, when the treatment has multiple timings and heterogeneous effects across time, the dynamic evolution of the treatment effect has a bias on the DID estimate owing to the inclusion of early adopters in the comparison group.

[14]By applying a standard DID specification to bank branching deregulations that occurred at different points in time across the US, Beck et al. (2010) found that the deregulation reduced state-level income inequality. However, this result no longer holds in specifications correcting for the inclusion of early adopters in a comparison group (Baker et al., 2021). Baker et al. (2021) also presented similar replication failures for Fauver et al. (2017), which showed the positive impact of corporate board reforms on firm values, and for Wang et al. (2021), which found a negative impact of the staggered legalization of stock repurchases on firm investments.

et al. (2019). In particular, we first define "event" by the timing of firms' announcement of layoffs. We then created an event-specific dataset by stacking the treated and "clean" control plants. For the 2009 event, for example, we stacked all plants that announced layoffs in 2009 and control plants that never experienced layoffs during our sample period into one dataset.[15] Thereafter, we estimated equation (1) separately for each event-specific dataset.[16] By stacking event-specific data in this manner, we avoided including early adopters in the control group when estimating the DID model. This process yields different sets of DID estimates for γ for each event-specific dataset. To aggregate these DID estimates into one set of estimates, we followed the same strategy in Cengiz et al. (2019): we stacked all the event-specific datasets into one and estimated common estimates of the announcement effect.[17] In the main analyses, we present the estimation results for (a) all plants and (b) capital-intensive plants to investigate the mediating role played by capital intensity. We also present the estimates for less capital-intensive plants in the Appendix Figures.[18]

[15]Control plants in our sample includes those plants that receive employment adjustment subsidy. Thus, the estimated treatment effects reflect the difference between layoff plants and plants receiving the subsidy.

[16]Specifically, for each event-specific stacked dataset, h, we estimated the following equation:

$$Y_{ith} = \sum_{s=-w}^{w} \gamma^{sh} I(event^{s}_{ith}) + x_{it}\beta_h + \delta_{th} + \theta_{ih} + \epsilon_{ith}, \tag{2}$$

where Y_{ith} is an outcome variable for plant i in year t for dataset h. The estimated treatment effects, $\hat{\gamma}^{sh}$, compared the performance trajectories between the treated and control plants for $s > 0$. We tested the validity of the common trend assumption in dataset h by examining the magnitude of the estimates of γ^{sh} for $s \leq -1$.

[17]Specifically, to estimate a single set of average treatment effects γ^{s} across all event years and provide a comprehensive assessment, we stacked all the event-specific datasets:

$$Y_{ith} = \sum_{s=-w}^{w} \gamma^{s} I(event^{s}_{ith}) + t \cdot \tau_{ph} + t \cdot \tau_{jh} + \delta_{th} + \theta_{ih} + \epsilon_{ith}. \tag{3}$$

Inclusion of the term δ_{th} essentially allows us to separate the dynamic treatment effects from year effects specific to the event group.

[18]To exploit all announcement events in our estimations, we used the unbalanced panel data of plants. Thus, our estimate measures the aggregate treatment effect, including the effects of compositional changes arising from a plant's entry or exit. To understand how the compositional effect affects the aggregate treatment effect, we also examined the impact of layoff announcements on the probability of long-term selective attrition. Summarily, our findings therein suggest that compositional changes are less likely to affect our main results although results are not shown in the main text for the sake of brevity.

5 Results

5.1 Are Layoff Announcements Exogenous?

Firms announcing layoffs may be systematically different from other firms a priori in terms of unobserved managerial traits or technology to substitute labor with capital. As such differences can mask the true causal effect of layoff announcements, it is important to compare layoff plants with otherwise identical plants. To ensure the common trend assumption, we estimated the stacked event-by-event DID model (i.e., Equation 2 in Footnote 16) separately for each event year and examined whether there were any systematic differences in the outcomes between the layoff plants and their control plants prior to the layoff announcement. As our main data cover the years between 2005 and 2016, we fix our event window at three years before and after layoff announcements ($w = 3$) to enhance comparisons across event years. We also multiply our estimates by 100 to complement the interpretation of our results (i.e., the impact as % of the outcome variables).

Figure 2 presents the estimates of treatment effects (γ^{sh}) multiplied by 100 for each event year. Most of the event years show significant drops in the number of employees following the announcement. This is consistent with the original purpose of the layoff announcements. Except for 2010, plants experienced an approximately 15 to 30% reduction in their workforce at some point in the following years. Plants showed immediate declines in 2009, 2011, and 2012. However, this was not evident in 2008 and 2010, although most of their estimates still showed a negative impact. We consider such small impacts to arise from our lower-bound approach, as explained in Section 3.1. It should also be noted that the estimates for the 2008 and 2010 events had relatively large confidence intervals, implying a lack of statistical power owing to the smaller number of treated plants (see Figure 1).

Importantly, the estimates for the pre-announcement periods are insignificant and close to zero, except for the layoff announcements in 2013. Thus, besides the 2013 event, the treatment and control plants were comparable in that they followed the same outcome trends before the event year. We consider this to be evidence of the unexpectedness or exogeneity of the layoff shock between 2008 and 2012, conditional on industry- or region-specific linear trends: firms announced layoffs, presumably because of unexpected or idiosyncratic demand shocks during this period. In contrast, the 2013 layoff announcements predict the pre-treatment employment level of the treated plants, indicating a violation of the common trend assumption. It is likely that the 2013 layoff announcements were confounded, in that these plants had redundant employees even three years prior to the announcement. In the following estimations, we stacked event-by-event datasets between 2008 and 2012 but excluded the 2013 dataset and obtained aggregated estimates across event years. In doing so, we focus on the causal consequences of employee downsizing.

5.2 Impact on Performance and Productivity

Figure 3 tests hypothesis 1 by examining the impact of layoff announcements on valued added and productivity measurements. To focus on the causal interpretations of layoff announcements, we stacked event-by-event datasets between 2008 and 2012, and estimated common DID effects across all event years (i.e., Equation 3 in Footnote 17). In Column (b), we limited our estimation sample to those layoff and control plants which had higher capital intensity prior to the layoff announcements, while we included all plants to obtain the estimates in Column (a). Because the sample size is smaller in Column (b), standard errors are larger in Column (b). We present the results for less capital-intensive plants in Appendix Figures, which we briefly discuss in Section 5.3.

Figure 3 confirms that capital intensity moderates the effect of layoff announcements on plant performance and productivity. In the first row, we found that the layoff announcements reduced the value added by approximately 20% in subsequent years in Column (a), while the negative impacts were much smaller and insignificant in Column (b), except for the first year after the announcement. Because labor productivity is calculated by dividing the value added by the number of workers, capital intensity is also expected to moderate the impact on labor productivity, as long as the impact on the number of employees is similar. This was established in the second row. Although the estimates are insignificant overall, the estimated coefficients are negative in Column (a), whereas they are close to zero when we limit our observations to capital-intensive plants only in Column (b). Importantly, we also found an even stronger pattern for TFP, as shown in the third row. Although the plants' TFP plummeted and took four years to recover to a level comparable to that of the control plants in Column (a), capital-intensive plants experienced no negative effect on TFP in Column (b). In fact, their TFP becomes *higher* than that of control plants over time. In the fourth year after layoff announcements, capital-intensive plants had approximately 20% larger TFP than control plants did. Thus, employee downsizing improves the technological and allocative efficiency of capital-intensive plants. To summarize, we obtain clear evidence of the moderating effect of capital intensity on plant performance and productivity, providing strong support for hypothesis 1.

5.3 Impact on Resource Allocation and Product Turnover

This subsection examines why capital-intensive plants successfully mitigate the negative impact of layoff announcements on value added and even outperformed in terms of productivity. We examined whether a reduction in product turnover was key to their success. In particular, we tested whether the high replacement costs in capital-intensive plants prevented them from making renewal investments after layoff announcements (hypothesis 2), and whether it also resulted in a reduction in both product creation and destruction, thereby making capital-intensive plants to focus on their existing core products after employee downsizing (hypothesis 3).

Figure 4 shows the estimation results using the number of regular employees and fixed assets as dependent variables, separately for all plants (Column a) and capital-intensive plants (Column b). The results indicated that the plants reduced their internal resources. Consistent with Figure 2, layoff plants had approximately 10% lower employment levels after the firms' layoff announcement than control plants did in both Columns (a) and (b). This effect persists for at least four years following the announcement. Plants also significantly reduced their fixed assets. Changes in the input factors of production suggest that firms' primary reason for the layoff announcement was to reduce the scale of their production, which was most likely driven by a negative demand shock.

Importantly, the reduction was slightly greater in capital-intensive plants. A reduction in fixed assets can occur through two main channels. First, plants may divest their lands, buildings, and equipment. Second, plants may not make any renewal investments, thereby depreciating the book values of their existing fixed assets. Provided that divestment should occur discontinuously rather than gradually, we consider that the decline in fixed assets is driven mostly by the second channel, and particularly so for capital-intensive plants because of the relatively high adjustment or replacement cost of their capital inputs.

Figure 5 repeats the similar estimation exercise by replacing the dependent variables with the product information available in the Census of Manufacture. In Column (a), we found that the layoff plants did not introduce more new products or abolish more existing products relative to their comparison group. In contrast, capital-intensive plants introduced significantly fewer products, and at the same time, abolished fewer products in the year after the layoff announcement compared to control plants. Thus, after layoff announcements, capital-intensive plants adopted strategies to focus on improving their existing core products or process innovation.

Appendix Figures 1 and 2 present the same estimation results by limiting the observations to plants with lower capital intensity prior to layoff announcements. We found taht less-capital-intensive plants adopted an opposing strategy after the layoff announcement. In particular, the layoff plants in this group abolished significantly more existing products, while also introducing more new products, albeit insignificantly. Interestingly, they also reduced fixed assets, but to a lesser extent than the results for capital-intensive plants. Given that replacement costs for capital are lower in less capital-intensive plants, it is less costly for less capital-intensive plants to make new investments to replace their products. However, the negative impact on value added and product measurements is also larger for layoff plants in this group. In particular, the TFP of the layoff plants did not recover to a level comparable to that of their control counterparts. Taken together, these results point to the possibility that a strategy to replace products at least three years after the layoff announcement is tricky, even if the reallocation of resources is less costly. Along with our results in Figure 5, the complementary analyses in Appendix Figures 1 and 2 enforce our support for Hypotheses 1 to 3.

We decide to relegate the results for less capital-intensive plants to the Appendix because we cannot rule out the possibility that the common trend assumption is violated in this group of observations. In Appendix Figure 1, layoff plants in this group introduced and abolished more products *prior to the layoff announcements*. Given that the estimates were relatively large and even significant in one case (at $t-3$ for the number of abolished products), it was possible that the layoff plants among less capital-intensive plants had a higher product turnover than control plants did, even prior to the layoff announcements. Owing to this endogeneity concern, we decided not to present these results in the main analysis. Therefore, the results for less capital-intensive plants should be handled with caution.

6 Discussion and Conclusion

This study aims to uncover the organizational behaviors behind employee downsizing and investigate which strategies were adopted by the firms that secured productivity gains post-downsizing. To reveal the new mechanisms used by successful firms, we revisited the moderating role played by capital intensity first raised by Guthrie and Datta (2008). We examined whether capital intensity moderates the impact of employee downsizing not only on the performance and productivity but also on the resource allocation and product turnover. As firms in a capital-intensive industry incur a relatively high fixed cost of capital, the management in these corporations is bound by a strategic rigidity in the sense that their decision is constrained by a high replacement or adjustment cost of their capital (Hambrick and Lei, 1985; Datta and Rajagopalan, 1998). We extended this framework to new product introduction or product replacement behavior of manufacturing plants. As the additional replacement cost per item is more expensive for capital-intensive plants than it is for less capital-intensive plants, firms are more likely to continue with the current product combination than replace them with new products concurrent with the employee downsizing.

We tested the implications from the conceptual framework by leveraging a unique data set which contains the entire population of manufacturing plants in Japan along with the records of their product creation and destruction. The findings indicate that managing product turnover was the key to the success of capital-intensive plants. In particular, such capital-intensive plants were less likely to introduce new items and replace the existing products after downsizing. Further, they reduced their capital inputs substantially while increasing the productivity level. Most notable was the improvement in the TFP that was driven by a recovery in the value added and reduced renewal investment than a reduction in the labor force. As Figure 3 shows, a TFP recovery was accompanied by an increase in the valued added (i.e., the revenue from the product shipment minus the material cost) along with a curtailment of fixed assets after the second year since the layoff announcements. The fact that capital-intensive plants recovered their value added while reducing both the product turnover and factor inputs implies improvements in the production technology and allocative efficiency. One example of this development is the process innovation carried out on their existing core products. According to the National Innovation Survey conducted by the National Institute of Science and Technology Policy in Japan, a substantial improvement in business process innovations among the manufacturing plants took place after the Great Recession: the realization rate of business process innovations was 20% in 2009 to 2011, which increased to 25% in 2012 to 2014, then to 35% in 2015 to 2017. The results of this study indicate that a relatively high replacement cost per new product enables capital-intensive plants to focus on the process innovation for the existing products rather than introducing new ones, thereby increasing their productivity levels.

An important contribution of this study is the identification of the causal consequence of employee downsizing. As researchers have been aware, the causal relationship between layoff announcements and organizational outcomes is not necessarily straightforward. For example, firms announce layoffs due to downturns in their business, but they may not recover for several years following the layoff owing to a prolonged business slump. In this case, the declined performance after the layoffs would then reflect the pre-existing declining market trend and would not simply be a strategic outcome of their decision to downsize. To disentangle the strategic consequence from the other confounding factors, we relied on recent developments in the econometrics literature in staggered DID and adopted the stacked event-by-event approach proposed by Cengiz et al. (2019). In essence, we compared the performance trajectories of plants that announced layoffs against those of similar plants without any layoff announcements. Previous studies have been ambiguous about the causal interpretation of their estimated effects (see section 2). Our study supports the findings in some of the previous studies in that employee downsizing overall had non-positive effects on organizational performance and productivity, even after we carefully addressed the identification concerns in the estimations (i.e., estimates for all plants in column (a), Figures 3 to 5).

Our study provides several managerial implications. First, the restructuring strategy should be designed in the middle-term span rather than aiming for a very short-term profitability gain. Even in the case of successful productivity gains in our analyses, the plants needed four years on average until their value added recovered to the level comparable to that of the non-layoff plants and to outperform them in terms of the TFP.

Second, employee downsizing should be designed in accordance with product management and resource allocation strategies. Our results suggest that it is important for firms to take a lean investment and product management approach. Rather than introducing new products, it is vital to focus on process innovation in the existing core products. Such process innovations include improving the supply chain management, introducing new marketing methods for promotion, packaging, pricing, and product placement after sales service, in addition to enhancing the strength of the core products by introducing renewal development procedures for the existing products.

It must be emphasized that taking the opposing approach may be costly. We found that replacing the existing products with new ones was not accompanied by a clear recovery in plant performance and productivity among the less capital-intensive plants, although the evidence is admittedly crude as mentioned in section 5.3. Nonetheless, the contrasting results between the capital-intensive and less capital-intensive plants reveal that investing in new products is a tricky option for management after the layoff announcement, even if the reallocation of resources is less costly.

Lastly, although we have elucidated the productivity gains of employee downsizing on a subset of plants, it is important to bear in mind that, overall, employee downsizing had non-positive effects on plant performance and productivity. An important context to consider in interpreting our results is that we analyzed the manufacturing plants in Japan, a country known for long-term employee-employer relationships. Such long-term employment is concurrent with firm-specific skill investment (Hashimoto, 1979; Hashimoto and Raisian, 1985). Therefore, the layoff announcements in the context of this study may potentially breach the long-run commitment to relation-specific investments and hamper the workers motivation and skill investment, especially among the younger employees. Although the current study does not provide any analyses on skill investments, the overall non-positive effects are possibly driven by the detrimental effect on relation-specific investment. At one time, AT&T took substantial efforts in transforming the skill sets of their long-tenured employees by offering various training programs, thereby avoiding large-scale layoffs (Donovan and Benko, 2016; Sucher and Gupta, 2018). An important takeaway for the management is that those firms pursuing long-term relationships with their employees may be able to better plan the reskilling or upskilling of the slack labor in advance as an alternative reallocation option before the emergence of a business crisis.

The current study has certain limitations. First, although we argue that an increase in the TFP was driven by an increased process innovation, this paper does not offer any direct evidence on this point. This is left for future research. Second, we took a lower-bound approach to estimate the consequence of employee downsizing by focusing on plant-level panel data. As firms could allocate their resources across their branches, plants, and subsidiaries concurrent with the employee downsizing, the estimates on the impact of the layoff announcement obtained in this study would be larger in absolute terms, if we were to account for this possibility. Thus, the results of this study should be interpreted as providing the lower bound of the estimates. Finally, the scope of the organizational strategies analyzed in this study are limited to product management and resource allocation in a broad sense. Research has indicated that employee downsizing resulted in detrimental effects on other important organizational outcomes including corporate reputation (Flanagan and O'shaughnessy, 2005; Zyglidopoulos, 2005; Love and Kraatz, 2009) in addition to the survivors' motivation, job performance, satisfaction, employee turnover, and burnout (Luthans and Sommer, 1999; Shah, 2000; Brockner et al., 2004; Quinlan and Bohle, 2009; Kawai, 2014, etc.). Although our findings suggest that managing the product turnover is an important element for plants to secure productivity gains, paying attention to the other negative side effects also determines the effectiveness of employee downsizing. Researchers have observed that such detrimental effects may be mitigated by introducing programs to bridge targeted employees to future opportunities (see Sucher and Gupta, 2018, for Nokia's case). Organizational strategies reported in this study are complementary to these transitional programs.

Table 1: Summary Statistics

	N	Mean	SD	P25	P50	P75
$ln(N.of Employees)$	477023	4.37	.81	3.76	4.16	4.78
$ln(FixedAsset)$	477023	10.12	1.68	9.16	10.09	11.09
$ln(ValueAdded)$	477023	11.12	1.27	10.28	10.93	11.79
$ln(TotalFactorProductivity)$	477023	3.88	0.9	3.39	3.89	4.39
$ln(FixedAsset/NofEmployees)$	477023	5.75	1.34	5.1	5.87	6.56
$ln(LaborProductivity)$	477023	6.75	.83	6.28	6.72	7.19
N of New Products	477023	0.15	0.51	0	0	0
N of Abolished Products	477023	0.14	0.5	0	0	0
N of Total Products	477023	2.3	1.79	1	2	3
Capital Intensity	477023	0.27	3.41	0.09	0.17	0.31

Source: Plant-level observations in Census of Manufactures, from 2005 to 2016.

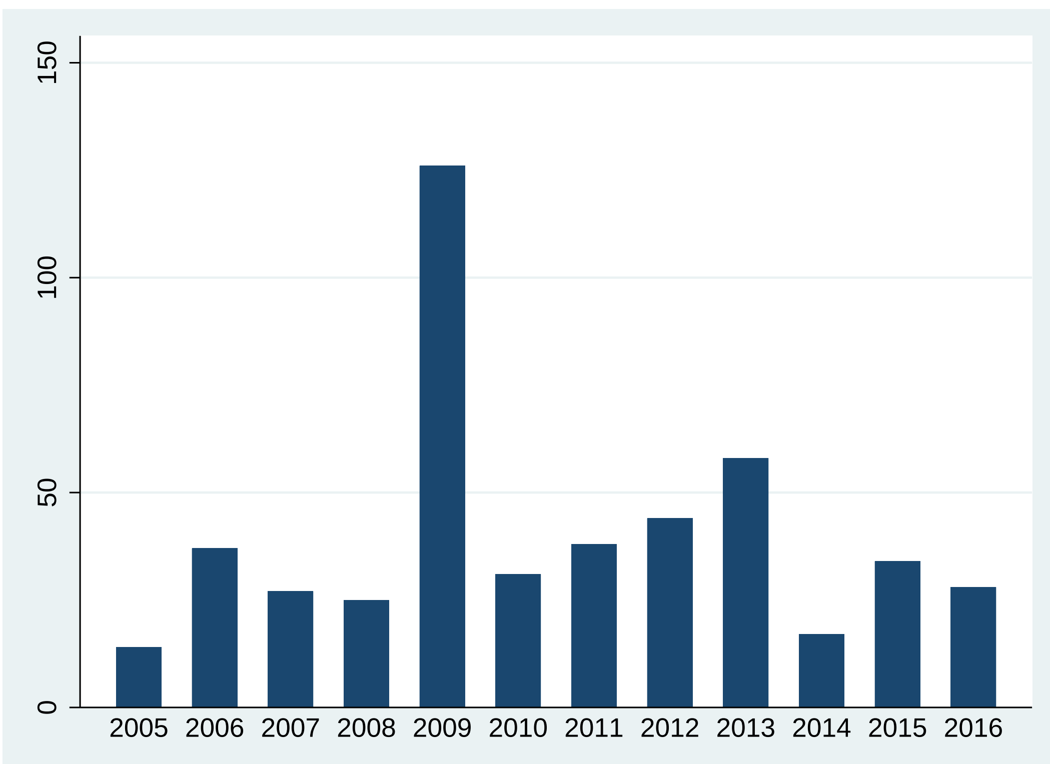


Figure 1: Number of Plants Affected by Layoff Announcement

Note: Bars indicate the numbers of plants whose headquarters announced buyout offers to layoff their employees in our main sample of Census of Manufacture (METI), 2005-2016. Layoff announcement information is taken from a survey conducted by TSR.

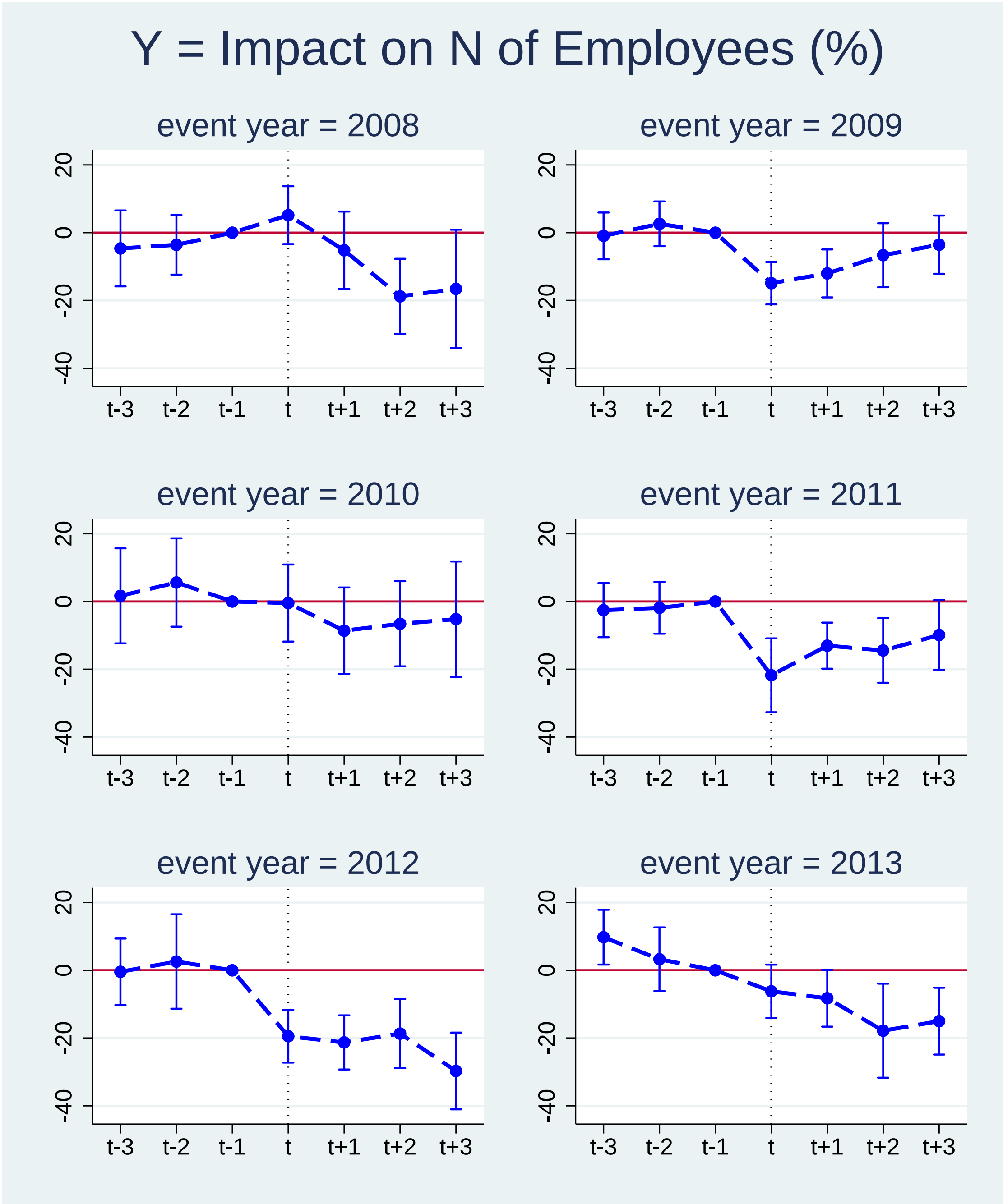


Figure 2: Exogeneity of Layoff Announcements by Event Year

Note: Each graph plots the estimated impact of layoff announcement at each time period (e.g., $\gamma_s \times 100$ in equation (2)). All models control for plant fixed effects and industry-specific and region-specific linear trends. The models are estimated on stacked event-by-event data sets, separately for each event year. Spikes indicate 95% confidence interval.

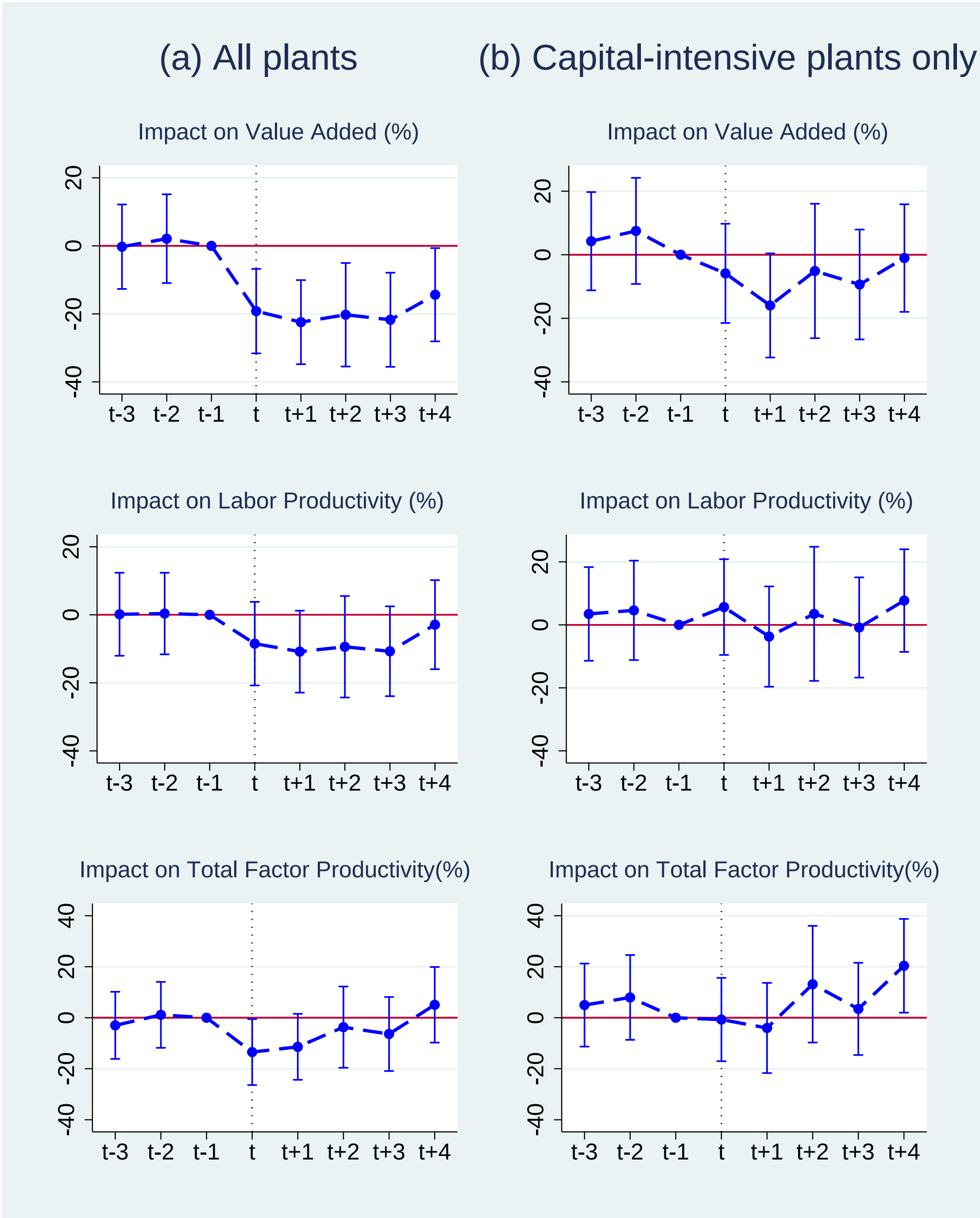


Figure 3: Impacts on Performance (Value Added) and Productivity

Note: Each graph plots the estimated impact of layoff announcement at each time period (e.g., $\gamma_s \times 100$ in equation (3)). All models control for plant fixed effects, event-specific dummies to indicate time periods, event-and-industry-specific linear trends, and event-and-region-specific linear trends. The models are estimated on stacked event-by-event data between 2008 and 2012 (N = 1,529,854 in column (a); N = 620,841 in column (b)). Column (b) limits their estimation sample to those plants with high capital intensity prior to t. Spikes indicate 95% confidence interval.

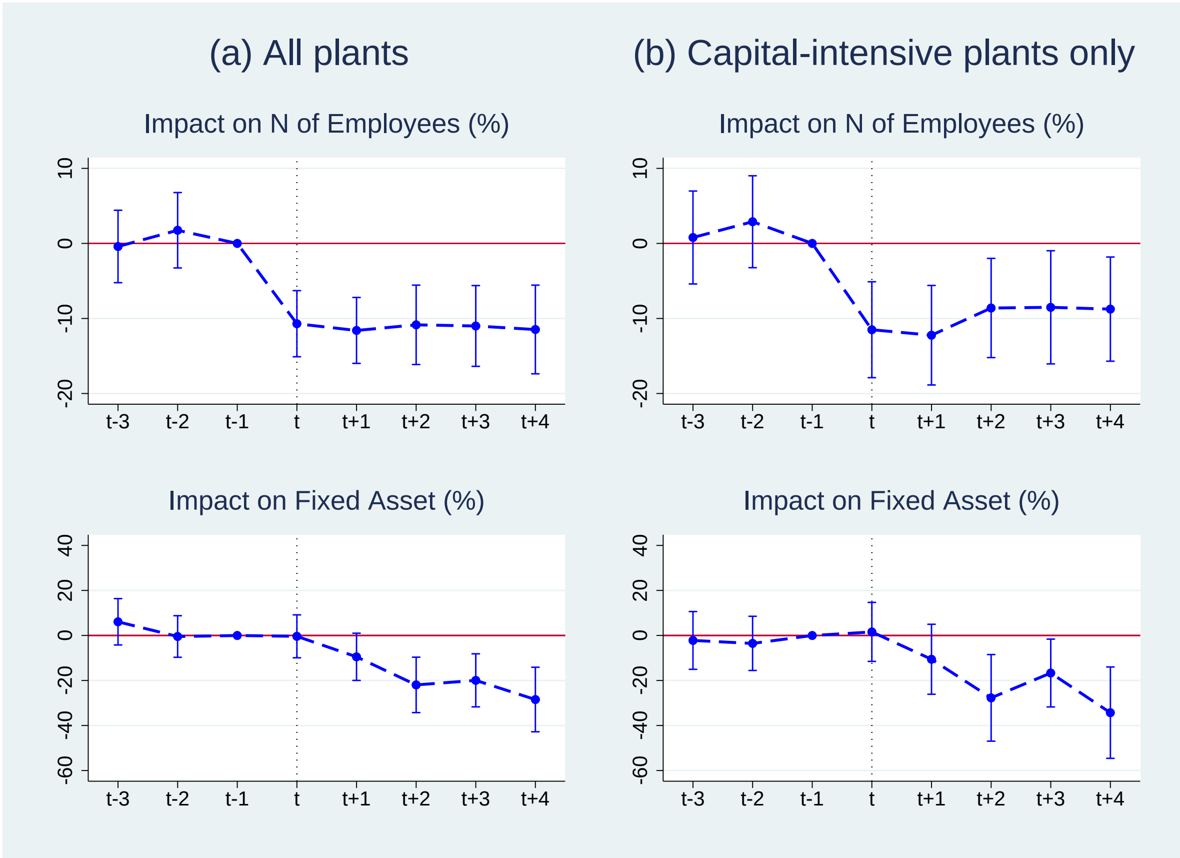


Figure 4: Impacts on Internal Resource Allocation

Note: Each graph plots the estimated impact of layoff announcement at each time period (e.g., $\gamma_s \times 100$ in equation (3)). All models control for plant fixed effects, event-specific dummies to indicate time periods, event-and-industry-specific linear trends, and event-and-region-specific linear trends. The models are estimated on stacked event-by-event data between 2008 and 2012 (N = 1,529,854 in column (a); N = 620,841 in column (b)). Column (b) limits their estimation sample to those plants with high capital intensity prior to t. Spikes indicate 95% confidence interval.

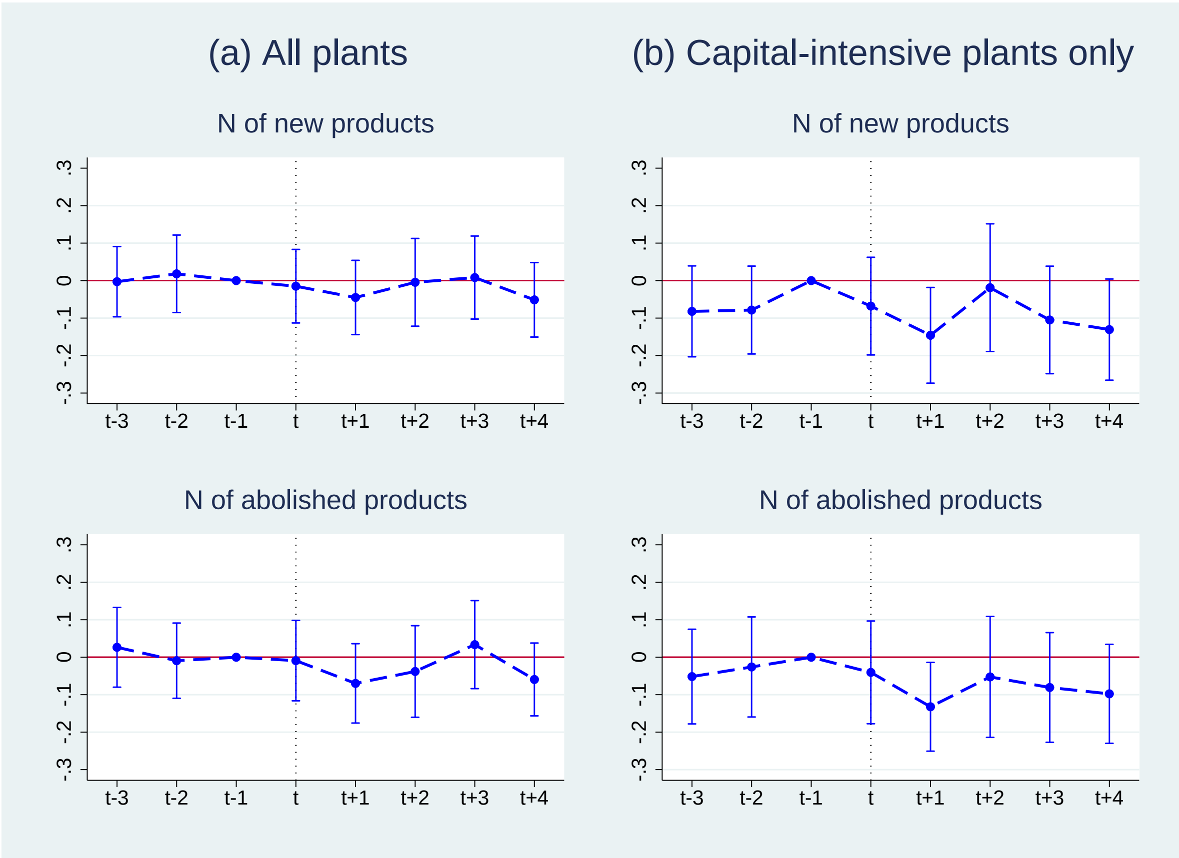
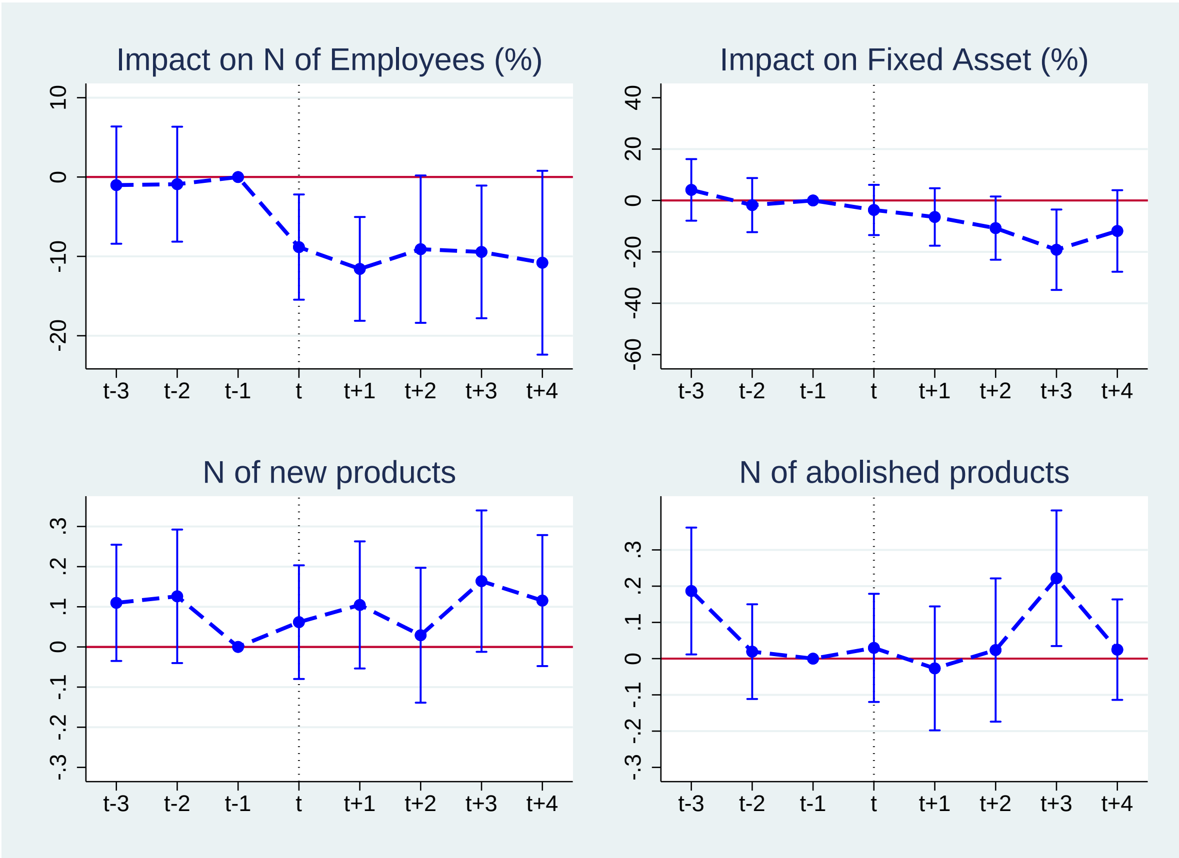


Figure 5: Impact on Product Creations and Destructions

Note:. Each graph plots the estimated impact of layoff announcement at each time period (e.g., $\gamma_s \times 100$ in equation (3)). All models control for plant fixed effects, event-specific dummies to indicate time periods, event-and-industry-specific linear trends, and event-and-region-specific linear trends.The models are estimated on stacked event-by-event data between 2008 and 2012 (N = 1,529,854 in column (a); N = 620,841 in column (b)). Column (b) limits their estimation sample to those plants with high capital intensity prior to t. Spikes indicate 95% confidence interval.



Appendix Figure 1: Impacts on Internal Resource Allocation and Product Turnover (low capital-intensive plants only)

Note: Each graph plots the estimated impact of layoff announcement at each time period (e.g., $\gamma_s \times 100$ in equation (3)). All models control for plant fixed effects, dummies to indicate time periods, industry-specific linear trends, and region-specific linear trends. The models are estimated on stacked event-by-event data between 2008 and 2012 (N = 613,220). The sample is limited to those plants with low capital intensity prior to t. Spikes indicate 95% confidence interval

Appendix Figure 2: Impacts on Performance and Productivity (less capital-intensive plants only)

Note: Each graph plots the estimated impact of layoff announcement at each time period (e.g., $\gamma_s \times 100$ in equation (3)). All models control for plant fixed effects, dummies to indicate time periods, industry-specific linear trends, and region-specific linear trends. The models are estimated on stacked event-by-event data between 2008 and 2012 (N = 613,220). The sample is limited to those plants with low capital intensity prior to t. Spikes indicate 95% confidence interval

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（日本語訳）
従業員のダウンサイジングと経営戦略：
プロダクトイノベーションに関するエビデンス

概要

人員削減は、企業が経営不振から回復するための重要な経営判断である。本研究では、日本の製造業事業所とその製品に関する政府統計調査票データを用いて、ダウンサイジング後に生産性向上を確保する企業がとる戦略を検証した。分析の結果、プロダクトイノベーションへの姿勢が生産性向上を確保する上で重要であることがわかった。生産性が回復した事業所では、新製品の導入や既存製品の入れ替えが有意に減少し、ダウンサイジング後の業績水準を維持したまま新規投資を減らしていた。興味深いことにこれらの効果は資本集約的な事業所でのみ確認された。資本集約的な事業所では、新製品の置換コストが比較的高いため、既存製品のプロセスイノベーションに注力し、生産性を向上させたと考えられる。

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