The Effects of Mergers and Acquisitions on Firm-Specific Wage Premiums

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1. Introduction

The proposed project aims to enhance the data collected in a Title 13, Chapter 5 census (Criterion 7) as well as prepare estimates of populations and characteristics of populations as authorized under Title 13, Chapter 5 (Criterion 11). The project will match firms in the Longitudinal Employer-Household Dynamics (LEHD) and Longitudinal Business Database (LBD) to the Thomson Reuters database of Mergers and Acquisitions (SDC), a high-quality external dataset which measures merger and acquisitions (M&A) activity. Through this matching, we will evaluate how well tracking worker flows across firms can capture M&A activity in the LEHD (Criterion 7).

Additionally, we will document the characteristics of firms involved in M&A, the number of workers affected by M&A activity, and how this has changed over time. We will also estimate the effect of M&A activity on wages and employment. At least in the popular media, M&A is often associated with mass firings. We intend to determine whether this is due to a few well-publicized deals, or if firings are common to most M&A events. Additionally, we will estimate how wages change around M&A events. Theoretically, the answer is not clear. If M&A increases profits and productivity of firms, then the increased profits may spillover to wages. Others argue that decreasing labor costs is itself a central motivation of M&A. Takeovers may allow firms to renege on either implicit or explicit contracts, effectively lowering wages for the workers in the firm.

The project will involve linking the SDC database of Mergers and Acquisitions to the LBD through the Compustat-SSEL Bridge. The SDC database is often linked to Compustat (for example, see Malmendier et al., 2012). For private firms which do not appear in Compustat, we can also link by firm name and address (which appear in both the Standard Statistical Establishment Listing Name and Address File (SSEL-NA) and the SDC database). In additional to the LBD, Compustat-SSEL Bridge, SSEL-NA, and LEHD, we also plan to utilize the Successor-Predecessor File (SPF) and the Quarterly Workforce Indicators (QWI).

Next, we outline our primary research questions and the corresponding main estimates of interest which contribute to preparing estimates of population and characteristics of population as authorized under Title 13, Chapter 5.

1. What does the time series of M&A (growth and number of workers affected) look like in the United States, and how has this changed by industry?

We will use the LEHD to provide new statistics concerning the prevalence and growth of M&A in the United States over time. For example, the number of firms engaged in M&A, the total employment of firms engaged in M&A, what percent of workers within a year are working for a firm engaged in M&A, and how do these statistics vary over time and by some broad industry

classifications (for example, manufacturing). These are policy-relevant statistics, as there is concern that M&A activity can lead to wage losses and mass firings. Documenting these changes in the LEHD will aid future researchers who are interested in the effects of M&A.

2. How does M&A impact workers' wages?

We will estimate the average change in wages around M&A while controlling for the quality composition of the workforce. The individual identifiers in the EHF allow us to control for worker quality. There is little academic work studying the effects of M&A on workers' wages, however, this is a policy-relevant statistic. The Department of Justice primarily considers consumer welfare when evaluating M&A. However, there may be important effects on workers as well. For example, a recent anti-trust lawsuit against the high-tech industry showed that firms in Silicon Valley were engaging in anti-competitive behavior in regards to their employees (specifically by agreeing not to poach employees). Similarly, consolidation could affect competition in the labor market by making it easier for firms to collude on employment compensation and recruiting efforts. Our basic goal is to determine whether wages on average rise or fall following M&A, while controlling for changes in worker quality. If wages systematically fall, then this could be cause for concern for anti-trust authorities.

3. Does M&A lead to employment losses, and how are the earnings of displaced workers affected?

We will compute the probability a worker in an M&A firm is displaced by M&A activity. To do so, we need the EHF so that we can track workers' employment histories. We will code quarters of no work or very low earnings as unemployment. A large public concern about M&A is that it displaces many workers. In this proposal, we aim to measure the volume of such displacements, as well as future consequences (for example, do future wages, on average, decrease due to M&A displacements).

4. Do spinoffs decrease wages?

We will estimate the average change in wages for workers who are spun off from a parent firm. The individual identifiers in the EHF allow us to control for worker quality. This is a policy-relevant statistic as it relates to the possibly large negative consequences for workers due to off-shoring and outsourcing.

To answer the wage-related questions, we will study the effect of M&A on firm-specific wage premiums. The firm-specific wage premium captures the generosity of a firm's compensation while controlling for worker quality. Controlling for worker quality is integral for determining causal effects, as the composition of the workforce may change due to M&A.

Our primary empirical approach will be to estimate two-way fixed effects models with worker and firm fixed effects, as in Abowd, Kramarz, and Margolis (1999). Because this model conditions on individual workers, the coefficient on the firm fixed effects captures the firm-specific wage premium. Intuitively, this parameter captures the generosity of a firm's compensation policies relative to all other firms, while controlling for the fact that firms hire

differently skilled workers. By allowing the firm-specific wage premium to change after M&A, we can capture the change in the generosity of a firm's compensation, while controlling for changes in worker quality. In addition to two-way fixed effects models, we will perform propensity score matching methods, which intuitively, compare wages and employment growth in firms which undergo M&A events to a set of similar firms.

The above analyses cannot be completed without the restricted-access data of Census Bureau. We rely on matched employee-employer data in order to (1) identify M&A in the data and (2) to estimate firm-specific wage premiums. Notably, we have been informed that LEHD data for some states are not immediately available and require state-by-state approval. Starting with a subset of states will not impede our study. Below we list all the internal data required to accomplish this project:

Employer Characteristics File (ECF-T26 and ECF)
We request the ECF dataset, which includes employer's attributes such as location and industry classification at the firm level and at the establishment level.

Employment History File (EHF)
The EHF is designed to store the in-state history of employment. The core file contains one record for each employee-employer combination in each year, enabling us to retrieve the annual and quarterly earnings for the jobs. The EHF and the ECF will be jointly used to track the job changes.

Individual Characteristics File (ICF-T26 and ICF)
The ICF contains biographical information at the individual level and place-of-residence at the person-year level.

Quarterly Workforce Indicators (QWI)
The QWI provides quarterly measures of workforce composition and worker turnover at the establishment level. It supplements the firm-level data allowing us to include firm-level covariates in the analysis.

Successor-Predecessor File (SPF)
The Successor-Predecessor File will serve as a benchmark for identifying changes in ownership.

Longitudinal Business Database (LBD)
The LBD provides establishment age, industry classification, establishment-level employment and payroll information.

Standard Statistical Establishment List/Business Register Name and Address File (SSEL-NA)
The access to SSEL-NA allows us to merge the LEHD and LBD at the firm level to the SDC database of Mergers and Acquisitions.

Compustat-SSEL Bridge

Access to the Compustat-SSEL makes it possible to connect the LBD to Compustat, through which firms can be linked to the SDC database of Mergers and Acquisitions.

2. Methodology

As discussed previously, the first step in our project is to identify M&A in the data. To do so, we will use the analysis of Benedetto. et al. (2007), which tracks clusters of workers as they move across firms in order to identify changes in firm ownership. This method was proposed to capture changes in firm boundaries in the LEHD.

A key benefit to the Census is evaluating the accuracy of using worker flows to detect changes in firm ownership. To do so, we will use the SSEL-NA and Compustat-SSEL Bridge to match the LBD to Compustat, through which firms can be linked to the SDC database of Mergers and Acquisitions. We will assess the accuracy of using worker flows to identify M&A by comparing the identified set of M&A against a dataset of known mergers and acquisitions. For example, we will produce statistics such as what percent of M&A listed in the SDC database of Mergers and Acquisitions are identified by the worker flows methodology. We expect that both hand-collected data and the SDC database may have trouble identifying mergers and acquisitions for small and private firms. Therefore, we will explore whether the LEHD can be used to better track firm dynamics of small businesses. This will allow researchers a better understanding of the merits of using linked employee-employer data to identify firm dynamics as opposed to more traditional sources, like the SDC database. For the M&A activities we can match between datasets, we can also provide a variable which codes the reason for the change in firm identifiers (for example, domestic acquisition, merger, or foreign acquisition). See the appendix for additional details about the SDC database including years covered, firm identifiers, and additional variables.

As discussed previously, our primary empirical approach will be to estimate two-way fixed effects models as in Abowd, Kramarz, and Margolis (1999). We will also implement propensity score matching methods to find a set of firms with characteristics similar to those engaged in M&A activity.

2.1 Hypotheses

A recent literature studying wage inequality has shown that wages vary dramatically across firms, even while controlling for the quality of the workers. Factors such as collective bargaining agreements (Card et al., 2004) and fairness considerations[1] (Akerlof and Yellen 1990) have been posed as reasons for wage compression within firms and rent sharing of firm profits. Rent sharing increases wages above and beyond the outside opportunity of workers. Changing firm boundaries may be a way for high-wage employers to decrease the wages of their workers. If the workers no longer work at the same firm, then fairness considerations and profit-sharing may become less important components of wage determination.

1 A firm may need to retain or recruit a certain subset of workers (say engineers) by paying high wages to this group. In this case, they may choose to raise wages for all workers (for example janitorial staff), and not just engineers, in order to combat morale problems which may arise due to large inequities in pay within the firm. For example, if workers feel they are not being paid adequately in comparison to some other group, they may decide to shirk.

In the first part of the proposal, we plan to focus on the effects of mergers and acquisitions on firm-specific wage premiums. Theoretically, the effect of mergers and acquisitions on workers' wages is ambiguous. If rent-sharing is an important component of the firm-specific wage premium, then M&A activity may increase wages through increased profits and productivity.

Another strand of literature, however, argues that savings on labor costs are a direct motivation for M&A activity (Shleifer and Summers, 1988). Takeovers may allow the new owners to renege on both implicit and explicit contracts, resulting in falling wages following M&A. Another concern is that M&A activity results in decreases in employment. If workers can easily find another, equally-well paying job, then displacement due to changing firm ownership may not cause long-run earnings losses for workers. If workers cannot find jobs quickly, or find jobs at lower-paying firms, then changing firm ownership could result in large losses in lifetime earnings for the workers impacted. This analysis relies on detailed worker-level data, so that it is possible to follow workers after a merger or acquisition.

The previous two hypotheses relate to level shifts in wage premiums, however, many interesting hypotheses (for acquisitions in particular) actually relate to how the firm-specific wage premiums of the target firm (i.e. the firm which is acquired) moves relative to the acquiring firm. For example, does the firm-specific wage premium of the target firm converge to the firm-specific wage premium of the acquiring firm? If not, then acquisitions may be a low-cost way for high-wage firms to expand without having to pay high wages to new employees. While spinoffs have been shown to decrease wages for contracted-out work, acquisitions may serve a similar purpose. Both actions may allow high-wage firms to exclude a set of workers from the rent at the parent firm.

Although not the main focus of the proposal, we will also consider the effects of spinoffs on workers' wages. In the last few decades, firms have become increasingly specialized in production, contracting-out to other firms to perform non-core tasks. A recent paper by Goldschmidt and Schmieder (forthcoming) shows that outsourcing jobs leads to large decreases in wages. They argue that outsourcing services, such as janitorial or cafeteria services, allows firms to pay workers lower wages by changing the boundary of the firm. It is unclear how these effects vary by industry. This "fissuring" of the workplace has been on the rise in many industries, but the effects on workers has been well-studied in only a few narrow industries. In particular, one primary driver of wage inequality is increased assortative matching (that is, high productivity workers are increasingly more likely to work at high-wage firms). The fissuring of the workplace may be one channel through which high productivity workers have become increasingly concentrated in high-wage firms.

2.2 Identifying M&A using Worker Flows

To test the above hypotheses, we first need to identify changes in firm boundaries using worker flows. In this proposal, we refer to a firm as an EIN. Firm identifiers in the LEHD, however, are state employment identification numbers (SEINs), which reflect an entity reporting unemployment insurance to a state tax authority. We will primarily use EINs, which allow for links in firms across states, to identify changes in firm boundaries using worker flows. The

overview of the 2011 snapshot of the LEHD (Vilhuber and McKinney, 2014) states, "…the federal Employer Identification Number (EIN) is available and can be used to link SEINs within and across states." Therefore, we use EINs as our primary measure of a firm. However, we do recognize that some firms may use multiple EINs, and so changes in EINs may not reflect true M&A activity. For this reason, we believe it is beneficial to link firms to the SDC database of Mergers and Acquisitions. Essentially, this will allow us to check whether the definition of changes in firm boundaries given below are sensible in practice.

We first consider acquisitions. We refer to the target as the firm being acquired (and whose corresponding EIN disappears from the sample) and the acquiring firm as the firm which acquires the target. Following Benedetto et al. (2007), we propose the following definition for an acquisition:

1. More than 80% of the target firm workers move to the acquiring firm.
2. The target firm exits the sample.
3. The acquiring firm existed in the sample in the years prior to the acquisition.

Similarly, we define a merger as:

1. 80% percent of the workers from both firms move to the same firm.
2. Both firms exit the sample.
3. The merged firm did not exist in the years prior to the merger.

Lastly, we define a spinoff as:

1. 80 percent of the spinoff firm workers come from the same origin firm
2. The spinoff firm did not exist in the year prior to the spinoff

As a benefit to the Census, we will document cases in which the EIN may change while the SEIN does not, and vice versa. For example, for firms matched to the SDC database of Mergers and Acquisitions, we can observe which identifiers generally change following M&A activity. This will give us a better sense what firm identifier is most appropriate for classifying M&A activity, and what firm identifiers may remain stable even if the firms undergo ownership changes.

While we provide separate definitions for a merger and acquisition, we will primarily consider mergers and acquisitions together and most analysis will not consider these events separately. However, the SDC database does include information on whether the M&A event is a merger or an acquisition. In the case of an acquisition, it also identifies the target firm. Therefore, we can directly observe whether the definitions of mergers and acquisitions proposed above hold in practice. There are potentially many reasons why a firm may apply for a new EIN or retain an old EIN, so it is unclear without access to an external dataset whether the definitions above will accurately capture M&A.

By linking the LEHD to the SDC database of mergers and acquisitions, we can test the accuracy of using worker flows to identify changes in firm ownership, a high-quality database of M&A activity. As discussed previously, we suspect that the database may fail to capture some small acquisitions, which may not be reported by the banking and legal contributors and may be difficult to detect using available reports, but can be potentially detected using the worker flows

methodology. The SDC database has information on target and acquirer name, CUSIP, ticker symbol, and firm location, through which we can link firms in the SDC database to Compustat.

This work is key in delivering in the delivery of Criterion 7, specifically by allowing us to gauge how well worker flows can capture firm dynamics in the LEHD. While using worker flows has been suggested as a promising avenue to form better links in firms across time, there is little external validation on how well this method performs in practice. This benefit is related to the ongoing effort to integrate firm age and size information into LEHD data. By matching the SDC database of mergers and acquisitions to the LEHD, we can also include the reasons why firms changed ownership. For example, we can create a dataset of foreign acquisitions, which could be helpful in studying how foreign investment has changed over time and how these changes have affected workers. In this way, identifying the reason for ownership change also benefits the Census according to criterion 11.

2.3 Preliminary Analysis – Propensity Score Matching Difference-in-Differences

The first set of results compares wages of workers in firms which go through changes in firm ownership to a set of matched firms, where firms are matched using a propensity score methodology. This method was used to study the effects of productivity on M&A in Blonigen and Pierce (2015), a paper which utilized Census data products. The propensity score methodology we implement first runs a logistic regression of M&A activity in a particular time period (for our study, we will use six-year intervals) on a list of firm covariates. In particular, the covariates will include 3-digit NAICS codes, firm age, average log wage, firm size, and state fixed effects, all of which are available in the LBD. From this regression, we will retrieve the predicted probability (i.e. the propensity score) that a firm engages in M&A activity in the interval. For each firm engaged in M&A, we choose the nearest propensity score (known as nearest-neighbor matching), which will serve as the matched firm. Then, to estimate the impact of M&A on wages we will run the following difference-in-differences specification:

$$\ln(w_{it}) = \alpha + \beta_1 Post_t \, x \, MA_i + \beta_2 Post_t + \theta_i + X_{it}\pi + \varepsilon_{it}$$

Where θ_i are firm fixed effects and X_{it} are a set of covariates, which will include a full set of year indicators, average age of workers within a firm, average age of workers squared, average education, as well as interactions between average age and year dummies and interactions between average education and year dummies (all of which are available in the ICF). The specification of controls follows Card, Heining, and Kline (2013) and Bloom et al. (2015). Our key dependent variable throughout the proposal is wages. In constructing wages for workers, we will follow Abowd et al. (2017) and Sorkin (2015), both of which utilize the LEHD in order to estimate firm-specific wage premiums. Specifically, to construct wages, we will find the annual dominant employer (i.e. the firm which pays the worker the most in a given year). We will restrict attention to workers 18-61 and require that annualized earnings be greater than $3,250 (in 2011 dollars). The time horizon in this regression spans the entire sample (1985-2011 depending on the state).

The term β_1 captures the change in wages for workers in firms which undergo ownership changes relative to workers in matched firms which do not undergo ownership changes in the

interval. The regression delivers a benefit to the Census under Criterion 11, by providing evidence on the wage effects of M&A on workers. If $\beta_1<0$, then M&A is correlated with lower wages for workers.

A limitation of the above analysis is that some of the hypotheses in the section above cannot be tested in such a framework. For example, it is informative to study whether the two firms engaged in M&A firm-specific wage premiums converge after an acquisition. If so, we expect low-paying firms to see rises in wages, while we expect high-paying firms to see a decrease in wages following M&A. To explore this hypothesis, we need to estimate which is the higher-paying firm in a merger or acquisition. Comparing average wages may be misleading, as firms may hire different quality workers. Therefore, we proceed to the main analysis which studies changes in firm-specific wage premiums, which capture the generosity of a firm's compensation while controlling for the quality of the workforce.

2.4 Main Analysis – Changes in Firm-Specific Wage Premiums

The main analysis is concerned with the changes in firm-specific wage premiums. For every year t, we will identify all M&A which occur in the year t. The following analysis will be done on a three-year window around the year of the M&A (so if the M&A occurred in 2004, the interval will include the years 2002-2007). The three-year window will give us enough power to identify firm-fixed effects both before and after the M&A. To proceed, we first need to estimate all firm-specific wage premiums in this six-year interval following Card, Heining, and Kline (2013). Specifically, we will run regressions of the following form:

$$\ln\left(w_{it}\right)=\alpha_i+\psi_{J(i,t)}+X_{it}\pi+\varepsilon_{it}$$

Where α_i are individual worker fixed effects, $\psi_{J(i,t)}$are firm fixed effects (i.e. the firm-specific wage premiums), $J\left(i,t\right)$ is the identity of the firm that worker$i$is employed at in time period t , and X_{it} are a set covariates, which will include a full set of year indicators, gender, quadratic and cubic terms in age, education, as well as interactions between age and year dummies and interactions between education and year dummies (all of which are available in the ICF). As discussed in Abowd, Kramarz, and Margolis (1999), this model is only identified within a connected set of firms, where firms are connected by labor mobility. In similar settings, authors find over 90 percent of firms are within the largest connected set. We have performed the analysis proposed using administrative data from a single state, and found the restriction to the largest connected set did not affect any of the results (all firms which engaged in M&A were found to be part of the largest connected set). In our prior research, most dropped firms were single-person firms (likely self-employed individuals).

Given we are interested in changes to firm-specific wage premiums due to M&A, we must identify a separate firm fixed effect for firms before changes in ownership and firms after changes in ownership. When two firms become one, as in a merger or acquisition, it becomes difficult to identify a separate fixed effect for both of the original firms after the change in ownership, as workers are now listed as working at the same firm. We overcome this hurdle in two ways. First, as a baseline, we create synthetic firms which can be directly compared pre and post M&A activity. In the years before an M&A event, we create a synthetic firm composed of

all workers at the merging entities. We estimate the firm-specific wage premium for this synthetic firm and compare it to the merged entity in the years after the M&A event.

After retrieving the estimates of the firm-specific wage premiums, we study how the firm-specific wage premium before M&A compares to the firm-specific wage premium after M&A by adopting a simple event-study framework. Let Y_{jt} be the firm fixed effect of firm j in period t, where t is either equal to 0 (i.e. pre M&A) or t equals 1 (i.e. post M&A). We restrict the sample to firms engaged in M&A and run the following regression.

$$Y_{jt} = \alpha + \beta\, Post_t + \theta_j + \varepsilon_{jt}$$

Where $Post_t = 1$ indicates the post M&A period and θ_j are firm fixed effects (note we use a different notation for firm fixed effects in this regression to distinguish them from the estimates of the firm-specific wage premiums estimated in the regression on the previous page, which have a particular interpretation). Thus, β captures the average change in the firm-specific wage premium. If $\beta < 0$ then we conclude that the firm-specific wage premium generally falls after changes in ownership, while if $\beta > 0$ then the firm-specific wage premium generally rises after changes in ownership. This sign and magnitude of β provides a benefit to the Census under Criterion 11. In particular, β indicates the magnitude and the direction of changes in wages following M&A activity, while controlling for worker quality.

Note that in these regressions we indirectly control flexibly for time effects. The premiums themselves (Y_{jt}) are estimated conditional on year indicators. For example, assume on average, wages go up for all firms in the post M&A period (for example, if there is a boom period). These effects would be captured in the year indicators, not in the firm-specific wage premiums. The firm-specific wage premiums capture the generosity of a given firm's compensation policy, relative to all other firms. Therefore, if β is greater than zero, it means that on average, firms engaged in M&A saw faster increases in wages than firms not engaged in M&A. Therefore, while this regression is identified solely from firms that undergo M&A, the dependent variable (the firm-specific wage premium) is estimated by comparing the wages in M&A firms to all other firms.

Also, it is important to note this regression contains only two time periods, pre and post M&A. In theory, it would be ideal to estimate a firm-specific wage premium every year and see how this evolves around the time of acquisitions, which would allow us to see whether significant pre-trends exist. However, in practice, it generally takes at least a few years of data to estimate the firm-specific wage premium with precision (for example, Card, Heining, and Kline (2013) use six years of data to estimate firm-specific wage premiums). For this reason, we have opted to only estimate a pre-M&A firm-specific wage premium and a post-M&A firm-specific wage premium. However, we will also provide results for mergers and acquisitions which involve two "old" firms (where old is defined as both firms existed for at least six years before the M&A event). In this case, we can estimate multiple pre-M&A firm-specific wage premiums. In this subsequent analysis, we will also include time indicators to the regression above, given there will be more than two time periods.

There are important caveats to the analysis above. For example, in the case of an acquisition, if acquiring firms select targets based on idiosyncratic productivity shocks, then the estimates of the change in the firm-specific wage premium will be biased. For example, a young tech startup may pay low wages to productive employees due to high startup costs and low revenue. The low wages may not actually reflect low productivity, but an implicit contract to pay higher wages if the firm is successful in the future. If the acquiring firm knows the target will be profitable in the future, then it might acquire based on this signal of future productivity. The workers may experience wage increases after the acquisition due to the realized profitability of the firm, and not necessarily due to synergistic gains or rent-sharing. That is, even if the firm had not been acquired, it may still have been successful and increased wages for its employees. To partially alleviate this worry, we will replicate the above analysis for the set of matched firms. Therefore, we will compare the changes in firm-specific wage premiums of firms engaged in M&A to the changes in firm-specific wage changes for a set of matched firms. To do so, we will run the following difference-in-differences specification:

$$Y_{jt} = \alpha + \beta_1 Post_t \, x \, MA_i + \beta_2 Post_t + \theta_j + \varepsilon_{jt}$$

Where MA_i equals 1 if the firm is part of the mergers and acquisitions sample, $Post_t$equals 1 in the post M&A period, and θ_j is a firm fixed effect. The sign of β_1 captures whether the firm-specific wage premiums of firms engaged in M&A change relative to a set of matched firms. The regression above is key in delivering a benefit to the Census under Criterion 11. In particular, this regression provides evidence on the wage effects of M&A on workers. Intuitively, if $\beta_1 < 0$, then we can conclude that M&A deteriorates workers' bargaining power and leads to lower wages.

The analysis above relied on creating a synthetic firm in the years prior to M&A that is composed of workers from both merging firms. Therefore, the results are informative about the average change in wages for workers, but this may mask important heterogeneity. For example, if acquiring firms can renege on implicit and explicit contracts of target firm workers (as in Shleifer and Summers, 1988) and this increase in rent is distributed to acquiring firm workers, then we will observe a net-zero change in the firm specific wage premium of the synthetic firm. This however masks a redistribution of rent between the target and acquiring firm. However, as stated before, it is difficult to separately identify a firm-specific wage premium for both a target and acquiring firm in the years after an acquisition because all target and acquiring firm workers are listed as working at the same firm. However, the fact we know who are target and acquiring workers before the acquisition can be leveraged to identify separate firm-specific wage premiums after the acquisition. In particular, we create three synthetic firms in the periods after the acquisition. A firm composed of all target workers, a firm composed of all acquiring workers, and a firm composed of workers who begin working at the merged entity after the merger or acquisition. This allows us to estimate firm-specific wage premiums for both target and acquiring firms after the acquisition, even though all workers are listed as working at the same firm.

To identify which firm is the target and which is the acquirer, we will use the SDC database of Mergers and Acquisitions, which includes a variable indicating if the firm is the target or acquirer. Additionally, we can directly test (at least in our sample of matched M&A) whether the

disappearing EIN corresponds to the target firm and the continuing EIN the acquiring firm (or whether acquisitions also generally result in a new EIN).

We can now test the final hypothesis in the previous section, namely, do the firm-specific wage premiums converge in the years after a merger or acquisition? Let H_{jt} be an indicator which equals one if firm j is the high-wage firm and it is the post M&A period (i.e. if firm j is the target, then $H_{jt}=1$ in all periods after the acquisition if the target has a larger firm-specific wage premium than the acquiring firm.) Let $L_{jt}=1$ be an indicator which equals one if firm j is the low-wage firm and it is the post M&A period. We then run the following regression:

$$Y_{jt}=\alpha+\beta_1 H_{jt}+\beta_2 L_{jt}+\theta_j+\varepsilon_{jt}$$

Where θ_j are firm fixed effects. If firm-specific wage premiums converge in the years following acquisitions, then we expect $\beta_1<0$ and $\beta_2>0$, in which case, the low-wage firm sees a boost in earnings, while the high-wage firm sees a drop in earnings. If, for example, $\beta_1=\beta_2=0$, then the firm-specific wage premiums of both firms stay constant. This could suggest that high-wage firms might want to acquire low-wage firms in order to expand without increasing labor costs.

In summary, the first analysis in this section answers the question, do wages rise or fall, on average, after M&A activity? This contributes to the Census under Criterion 11 by studying wage effects of workers employed at firms which engage in M&A. To answer this question, we estimate firm-specific wage premiums before and after M&A in order to capture the changes in compensation which cannot be explained by changes in worker quality. The second set of analysis considers whether the firm-specific wages premiums converge in the years following M&A activity.

2.5 Effects of M&A on turnover

Looking at changing firm-specific wage premiums misses a key component of M&A activity, namely, employment losses. A common concern is that M&A activity leads to increased turnover at firms which could lead to large earnings losses for displaced workers. In addition to studying changes in wages, this study will consider (1) what type of workers leave the after M&A activity (by type we mean low-wage or high-wage workers) and (2) do they suffer earnings losses due to the displacement. If workers are able to find equally well-paying jobs quickly, then although M&A may lead to employment losses, the negative consequences for workers are probably limited.

First, we simply ask whether firms engaged in M&A activity see excess turnover compared to the set of matched firms by estimating linear probability models. Let $D_{it}=1$ if the worker is displaced by M&A activity in year t (specifically, we count an individual as being displaced by M&A in period t if the individual is no longer working at the firm in period $t+1$¿. In constructing D_{it} we assume a worker who moves employers or transitions into unemployment in the year following the merger or acquisition is displaced. Some individuals will voluntarily leave the firm following M&A and so these workers will falsely be reported as displaced. If we are solely interested in involuntary job losses, this variable definition will overstate the effects of M&A. However, we believe voluntary turnover to be of interest as well, as it signals that the

worker now finds an outside option preferable, indicating that the value of working at the firm has fallen. We will also run specifications specifically trying to capture the probability of unemployment, rather than general displacement).

Formally, we run regression of the following form:

$$D_{it} = \alpha + \beta_1 MA_{it} x Post_t + \beta_2 Post_t + \theta_j + X_{it}\pi + \varepsilon_{it}$$

Where $MA_{it} = 1$ if worker i works for a firm involved in M&A activity in year t. X_{it} is a set of control variables including age, gender, a full set of year indicators, education, interactions between year indicators and age, and interactions between year indicators and education. $Post_t$ equals 1 if the M&A event has occurred. θ_j is a firm fixed effect. D_{it} is an indicator which equals 1 if the worker is displaced in period t (which occurs if the worker does not have a job in period $t+1$ or is working at a different firm in $t+1$¿. The coefficient β_1 informs us to what extent firms engaged in M&A firms see excess turnover.

To get a sense of what type of workers leave after M&A, we will will split workers into wage quantiles within their firms and restrict the sample to workers within M&A firms. For example, let there be $q \in \{1, \ldots, Q\}$ wage quantiles (we will at most set $Q = 5$ so that there will be millions of workers within a wage quantile). Again $D_{it} = 1$ if worker i is displaced after a change in ownership, and I_{qi} equal 1 if worker i is in wage quantile q . We will then run the following linear probability models:

$$D_{it} = \sum_{q=1}^{Q} \gamma_g I_{qi} + \theta_j + \varepsilon_i$$

Where θ_j are a set of firm-fixed effects. Roughly speaking, this regression will reveal whether high-wage or low-wage workers are generally displaced by M&A activity. A priori, it is not clear which type of workers are more likely to be displaced. In Shleifer and Summers (1988), the top managers must be replaced in order to renege on labor contracts, so we might expect high turnover among the top quantiles of the wage distribution. If, as in Atalay et al. (2013), target firms begin to resemble the acquiring firm, then we might expect firms which use relatively high-skilled labor will fire the low-skilled labor at the target firm (who are more likely to be in the low wage quantiles).

Next, we consider whether workers displaced workers suffer future earnings losses due to the displacement. To do so we consider whether the workers displaced end up at equally well-paying firms. Formally, we test:

$$E\left[\psi_{J(i,t)} \middle| D_i = 0, \alpha_i, X_{it}\right] - E\left[\psi_{J(i,t)} \middle| D_i = 1, \alpha_i, X_{it}\right] \geq 0$$

Simply put, is the expected firm-specific wage premium of workers who are not displaced greater than the firm-specific wage premium of workers who are displaced? If this quantity is positive, then, on average, workers displaced by M&A end up at lower paying firms.

2.6 Further Research Questions

A key strength of the LEHD is access to worker-level data. This allows us to study how changes in firm boundaries affect workers at different points in the wage distribution. For example, even if average wages do not change following an acquisition, it could be the rent within the firm is re-distributed. Most notably, the CEO may pursue a merger and acquisition if they believe it will allow them to raise their own wages at the detriment of other workers' wages. In this way, increased M&A could be one potential channel through which within firm inequality grows. A recent paper by Bloom et al. (2015) shows that increased inequality among large firms, almost half of the increase inequality came within firms. M&A activity may be one channel through which CEOs can raise their wages, which may be an important determinant of within-firm wage inequality.

2.7 Identifying Assumptions

A key component of the analysis is estimating firm-specific wage premiums using the two-way fixed effects decomposition of Abowd, Kramarz, and Margolis (1999). Consistent estimation of the firm-specific wage premiums relies on the "exogenous mobility" assumption, which assumes that workers do not sort on idiosyncratic shocks to individual productivity, idiosyncratic shocks to firm productivity, or match effects. For example, complimentary between the skills of the worker and the needs of the firm would imply that certain firms are better matches for certain types of workers. If mobility is primarily driven by sorting on match effects (i.e. workers move to firms to which they are better matched), then this framework would mistakenly attribute wage changes during job transitions to firm effects, while in reality, they are due to improved matching between workers and firms.

However, the assumptions of the statistical model lead to some stark predictions which can be tested in the data. The framework predicts that an individual moving from a high wage firm to a low wage firm will experience a loss in wages equal to an individual moving from a low wage firm to a high wage firm. It also predicts that an individual moving between two equally well-paying firms will experience no change in wages. To probe for violations in the statistical assumptions, we will follow Card, Heining and Kline (2013) and plot the mean wages of job movers classified by quartile of mean wage of co-workers at origin and destination firm. If the assumptions are approximately satisfied, then workers moving from quartile one to four should experience a gain equal to the loss of workers moving from quartile four to one. Workers moving within quartiles should experience no change in wages. Abowd et al. (2016) performs similar analysis on the LEHD and finds that the statistical assumptions of the above framework are approximately satisfied in the data.

2.8 Methodology used in providing benefits to Census Bureau

This project will enhance the quality of Census collected data through matching the SDC database of Mergers and Acquisitions to the Longitudinal Employer-Household Dynamics (LEHD) at the firm level. We will use the Compustat-SSEL bridge to link firms in the LBD to Compustat. The Compustat and SDC database of Mergers and Acquisitions have common firm identifiers, specifically stock tickers, CUSIP codes, and firm names, and are routinely linked for research purposes.

We will first use the method of Benedetto et al. (2007) to identify mergers and acquisitions using worker flows (see section 2.3 for more details). We will compare this to the set of known mergers and acquisitions deals in the SDC database of Mergers and Acquisitions. This will give us more information about the ownership change, as well as allow us to gauge the accuracy of the using worker flows to identify M&A. In particular, for every merger or acquisition in the SDC database, we will verify whether we find a matching merger or acquisition in the LEHD using worker flows. Let d indicate an M&A deal in the SDC database, and $Match_d = 1$ if there is a corresponding M&A in the LEHD for deal d. We will then run the following regression to diagnose what type of M&A is missed using the worker flows methodology.

$$Pr\left(Match_d = 1\right) = \alpha + \gamma_s + \delta_t + \beta_1 Foreign_d + \beta_2 ¿¿d + \varepsilon_d ¿$$

Where γ_s are a set of state fixed effects, δ_t are a set of year fixed effects, $Foreign_d$ is an indicator for whether the domestic firm was acquired by a foreign company, and ¿¿d¿ indicates a measure of firm size (for example, number of employees). These exploratory regressions will allow us to gauge what states, time periods, and characteristics of the M&A deal make it difficult to identify M&A using worker flows.

We expect traditional sources may have a difficult time detecting M&A among small, young firms. Therefore, we will find all M&A in the LEHD using the worker flows methodology, and then test whether we can find a corresponding M&A deal in the SDC database. We will re-run the regression above, but where $Match_d = 1$ indicates we can find a corresponding match in the SDC database. However, an important caveat to this analysis is that the worker flows methodology is not guaranteed to be accurate, and so there are two reasons we may not find a corresponding match in the SDC data: (1) the SDC database failed to report the M&A deal and (2) the worker flows methodology falsely identified an M&A deal.

The methodology used to satisfy Criterion 11 is discussed in detail in Section 2.4 and 2.5. Summarizing, this project will produce estimates and statistics of workers and firms engaged in M&A activity. In particular, it will estimate the number of workers and firms involved in M&A and how this has changed over time. It will produce estimates of the average increase (or decrease) in wages following M&A events and the average turnover following M&A events. It will also track workers displaced by M&A activity and determine, on average, whether the workers at end at higher or lower paying firms.

3. Data

3.1 Census-Provided Data

Employer Characteristics File (ECF and ECF-T26) 2011 snapshot and if available 2012-2016
The ECF jointly with the EHF will be used to track the job change of employees and to estimate firm-specific wage premium.

Employment History File (EHF) 2011 snapshot and if available 2012-2016

The EHF data are integral in this project. First, they are used to identify changes in firm ownership through worker flows. Second, they allow us to estimate firm-specific wage premiums while controlling for the quality of the workers within the firm.

Individual Characteristics File (ICF and ICF-T26) 2011 snapshot and if available 2012-2016
The ICF contains biographical information at the individual level and place-of-residence at the person-year level. These controls will be included in estimating firm-specific wage premiums.

Quarterly Workforce Indicators (QWI) 2011 snapshot and if available 2012-2016
The QWI provides quarterly measures of workforce composition and worker turnover at the establishment level and will allow us to study turnover at M&A firms.

Successor-Predecessor File (SPF) 2011 snapshot and if available 2012-2016
The Successor-Predecessor File will serve as a benchmark for identifying mergers and acquisitions.

Longitudinal Business Database (LBD), 1980-2014, and if available 2015-2016
The LBD provides establishment age, industry classification, establishment-level employment and payroll information. The LBD is important for producing additional firm-level covariates. It will also be used to link firms to Compustat and the SDC database of mergers and acquisitions. We ask for years prior to coverage in the 2011 LEHD snapshot to provide more information about pre-trends when analyzing M&A. For example, data is available in Maryland starting in 1985. Given LBD data goes further back in time we can determine whether wages or employment at M&A firms had significant pre-trends which would bias the main analysis.

Standard Statistical Establishment List/Business Register Name and Address File (SSEL-NA), 1980-2014
The access to SSEL-NA and Compustat-SSEL Bridge makes it possible to connect the LBD to Compustat, through which firms can be linked to the the SDC database of Mergers and Acquisitions using firm-level identifiers which are common to both datasets (stock tickers, CUSIP codes, and firm names). Also, for private firms which do not appear in Compustat, we can use name and address to match firms.

Compustat-SSEL Bridge 1976-2011
The access to SSEL-NA and Compustat-SSEL Bridge makes it possible to connect the LBD to Compustat, through which firms can be linked to the the SDC database of Mergers and Acquisitions using firm-level identifiers which are common to both datasets (stock tickers, CUSIP codes, and firm names).

3.2 User-Provided Data

SDC database of Mergers and Acquisitions 1985-2016 (Data Source: Princeton University)
The SDC database will be linked to Compustat in order to assess the accuracy of using worker flows to identify mergers and acquisitions in the LEHD. Using the SDC database of Mergers and Acquisitions is key in delivering a benefit to the census. The SDC database is proprietary data

for which Princeton University pays a subscription and the researchers have access to. The data can be comingled with Census data. See appendix for further details on the SDC database.

Compustat 1985-2016 (Data Source: Princeton University)
The access to SSEL-NA and Compustat-SSEL Bridge makes it possible to connect the LBD to Compustat, through which firms can be linked to the the SDC database of Mergers and Acquisitions using firm-level identifiers which are common to both datasets. Compustat is proprietary data for which Princeton University pays a subscription and the researchers have access to. The data can be comingled with Census data.

3.3 Data Linkages and Justification

The LBD data will be linked with the LEHD/ECF data through the SSEL-NA. The LBD will be matched to Compustat through SSEL-NA and Compustat-SSEL Bridge. Compustat will be linked to the SDC database of Mergers and Acquisitions will be accomplished through matching ticker, CUSIP identifiers, and firm names, all of which appear in both datasets. Private firms may be matched through matching business name and address, both of which appear in the SSEL-NA and the SDC database of Mergers and Acquisitions.

4. Project Output and Disclosure Risk

The project output will take the form of model estimates and regression results. The output will include coefficient point estimates and coefficient standard errors for the main variables. We will also provide some summary statistics at the firm level, for example, the mean and variance of firm size for firms engaged in M&A. We will not disclose medians, percentiles, maximum or minimum values for any summary statistics. While for some analysis we restrict to firms engage in mergers and acquisitions and spinoffs, we will work with CES to avoid disclosing information on specific firms or individuals. The analysis will be done at the national level. We have been appraised of the fact that data from only 12 states will be made immediately available upon approval. This will not impede the proposed work.

In the following table, we list the key dependent and independent variables, units of observations and the samples that will be used to generate coefficient estimates. The time period depends on the state. The earliest time period will be for Maryland which includes data starting in 1985. The time period ends in 2011.

Specification	**Independent Variables**	**Key Dependent Variables**	**Sample**	**Unit of Observation**	**Criterion 11 Statistic**
Difference-in-differences	Log quarterly wage	Indicator for whether worker is in a firm which takes part in M&A	All LEHD workers with annual wages above $3250 (in 2011 dollars) who are employed	Individual	On average, wages fall (rise) X percent following M&A

			at either a firm which engaged in M&A or a matched firm (as described in Section 2)		
Estimation of Firm-specific wage premiums	Log quarterly wage	Individual and firm fixed effects, control variables (age, ethnicity, and gender)	All LEHD workers with annual wages above $3250 (in 2011 dollars)	Individual	Not Applicable
Estimation of wage effect of M&A	Firm-specific wage premiums	An indicator for the post M&A period	All firms in the LEHD which take part in M&A	Firm	On average, firm-specific wage premiums fall (rise) X percent following M&A
Estimation of wage effect of spinoffs	Firm-specific wage premiums	An indicator for being a spinoff firm	All spinoff and origin firms	Firm	On average, firm-specific wage premiums fall (rise) X percent following a spinoff
Estimation of turnover effect of M&A	Indicator for whether worker is displaced	Indicator for whether worker is in a firm which takes part in M&A	All LEHD workers with annual wages above $3250 (in 2011 dollars) who are employed at either a firm which engaged in M&A or a matched firm (as described in Section 2)	Individual	On average, X percent of workers are displaced due to an M&A event
Estimation of Wage losses	Firm-specific wage	Indicator for whether	LEHD workers with annual	Individual	On average, workers

due to turnover	premium	worker is displaced during M&A	wages above $3250 (in 2011 dollars) who are employed at a firm which takes part in M&A during their tenure.		displaced by M&A end up at firms that pay X percent less (more) than their original firm

For the individual level regressions, the output will be a point estimate from a regression which captures on average how workers' wages changes around M&A events. Therefore, this will include millions of workers and will not identify any individual workers. For the firm level regressions, the output will be a point estimate from a regression which captures on average how workers' wages changes around M&A events. This regression will include thousands of firms and will not identify any individual firms.

In addition to the main specifications above, we will also run analysis by year to see how the effects evolve over time and change during recessions. For the estimate of the wage effect, we will also perform this analysis separately for whether the target firm is a high-paying relative to the acquiring firm (a high-paying target is defined as a target firm with a firm-specific wage premium (see section 2.4) greater than the firm-specific wage premium of the acquiring firm). For estimating the turnover effect for M&A we will also include specifications which include individuals' wage quantile within the firm, in order to see how the probability of displacement changes at different points in the wage distribution. At most, we will use five quantiles to split the sample.

Note that our estimation of firm-specific wage premiums includes individual fixed effects. However, we will not report any of these coefficients, but will merely note their inclusion in the specification. Also, changes in firm fixed effects will be estimated, but we will not report firm fixed effects for any individual firms.

This project is expected to yield working papers for publication in academic journals and for presentations at conferences. At least one working papers will be submitted to the CES working paper series. Furthermore, this project will generate a technical memorandum that details the findings that benefit Census Bureau as described in this proposal.

We have been appraised of the fact that if graphs are part of output, then the graphs will be saved in a format which does not have data points embedded within the document. Also, we have been made aware of 3-state requirement.

5. Project Duration and Funding Source

We expect the project to last up to 60 months, with 15 hours of data use per week at the NYRDC - Baruch. This project will be funded by Princeton University's membership of the NYRDC consortium.

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7. Appendix

Thomson Reuters Database of Mergers and Acquisitions (SDC)	
Sample Coverage	Includes over 1 millions deals from 1970s onwards. All deals involving a 5% stake or 3% with a value of at least $1 million are covered. Includes both private and public firms, as well as foreign and domestic
Accuracy	Barnes et al. (2014) study the accuracy of the SDC database of Mergers and Acquisitions and find that the database has nearly perfect universal coverage from 2000s onward. Aboody, Kaznik, and Williams (2000) claim SDC has universal coverage of acquisitions after 1991.
Sources of Data	Thomson Reuters receives content from direct deal submissions from banking and legal contributors, as well as through extensive research across regulatory filing, corporate statements, media and pricing wires.
Firm Identifiers	Database includes firm names, Committee on Uniform Securities Identification Procedures (CUSIP) identifiers, ticker symbols, as well as industry and firm location.
Other Variables	Parent company information, deal terms, deal value, stock premia, and financial sponsor/investor details.