How Credit Availability and Production Technologies Shape Hiring: Evidence from a Plant Closure*

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Abstract

Bank credit supply shocks have clear effects on investment, but their effects on employment are mixed. We provide evidence that the employment effect of credit supply depends on the production technology. We combine the closure of General Motors Antwerp, which released about 4,200 blue-collar workers into the local labor market, with idiosyncratic bank credit supply shocks estimated from the Belgian credit registry. Firms near the closed plant raise blue-collar employment by about 2.4% relative to similar firms farther away, and access to credit does not change this response on average. Where capital and labor are less substitutable, hiring is concentrated among firms with better access to credit, which also invest. Where capital and labor are more substitutable, firms hire regardless of their access to credit. Policies that promote credit supply may therefore raise hiring mainly where capital and labor are strong complements.

JEL classification: D24; G21; J20; J63

Keywords: bank credit supply shocks; factor substitution; labor supply shocks; mass layoffs; blue-collar workers; employment; real effects

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1 Introduction

Bank credit supply shocks have clear effects on firm investment (Peek and Rosengren, 2000; Duchin et al., 2010; Amiti and Weinstein, 2018). Their effects on employment are much less clear. Firms that borrowed from weaker lenders cut employment during the global financial crisis (Chodorow-Reich, 2013; Bentolila et al., 2018), and, on average, a 1% change in bank credit supply changes employment by about 0.36% (Berton et al., 2018). Yet, when credit constraints ease, the average firm does not hire more (Alfaro et al., 2021), firms may hold the additional credit as cash instead (Acharya et al., 2019), and shocks to small business lending leave employment largely unaffected (Greenstone et al., 2020). The employment response also differs across firms of different size, age, and banking relationships (Duygan-Bump et al., 2015; Siemer, 2019; Gutierrez et al., 2023). This ambiguity matters, because policies that support credit supply are often meant to support employment.

In this paper, we provide evidence that the link between credit supply and employment depends on the production technology. When capital and labor are strong complements, firms that hire more workers also need more capital, and credit allows them to finance this complementary investment. When capital and labor are more substitutable, firms can hire with little additional investment, and tighter credit may even lead them to replace capital with labor (Laeven et al., 2023). Promoting credit supply should then raise employment where capital and labor are strong complements, but may be ineffective where they are more substitutable.

We study this question in a setting where firms receive a common reason to hire. The closure of General Motors Antwerp, one of Belgium's largest employers, dismissed about 4,200 blue-collar workers between 2007 and 2010 and raised the number of unemployed male blue-collar workers in the region by about 45%. The closure resulted from the restructuring of GM's European operations after the losses of the parent company and its bailout in the United States, rather than from local economic conditions (Goolsbee and Krueger, 2015; Jacobs, 2019). It therefore raised the supply of experienced blue-collar workers to firms within commuting distance of the plant.

We combine this labor supply shock with granular data on firms and their banks over 2003–2011. The social balance sheets of Belgian firms report employment by collar type, which allows us to measure blue-collar employment directly. We estimate idiosyncratic bank credit supply shocks from matched bank-firm loan-level data from the Belgian credit registry, following Degryse et al. (2019), whose method extends Khwaja and Mian (2008) to firms that borrow from a single bank. This is essential in Belgium, where about

80% of the firms in our credit sample borrow from a single bank. We classify firms as having better access to credit or as relatively credit-constrained depending on whether their bank credit supply shocks are above or below the median in their industry, and we classify industries as having low or high substitutability between capital and labor, relative to the median of the elasticity estimates of Laeven et al. (2023). Because most of these estimates are below one, capital and labor are gross complements in most industries, and our comparison is between industries where they are stronger and weaker complements.

Our empirical strategy compares firms within 50 km of the closed plant, which corresponds to about one hour of commuting, with matched firms farther away, before and after the layoffs. We control for time-varying firm characteristics and for firm-level credit demand, which we estimate jointly with the credit supply shocks and which captures changes in firms' growth opportunities, and we exclude the areas exposed to the 2006 restructuring of Volkswagen's plant in Brussels. Three pieces of evidence support the interpretation of the employment response as the result of a labor supply shock. First, affected and unaffected firms follow parallel employment trends before the layoffs, and the employment response grows with the waves of layoffs and begins to fade after the closure. Second, the response is stable for commuting radii between 40 and 60 km, weaker at 70 km, and similar when we define exposure by the residential locations of the displaced workers, which we observe in the records of the Flemish public employment agency (VDAB). Third, the response is concentrated in industries with tight labor markets, where employment can rise only if labor supply rises, and it is absent in industries with slack labor markets.

Main findings. Affected firms raise blue-collar employment by about 2.4% relative to matched unaffected firms. On average, access to credit does not change this response: affected firms with better access to credit raise blue-collar employment by 2.7% and relatively credit-constrained firms by 2.2%, a difference that is not statistically significant. The average, however, masks a difference across production technologies. In industries with low capital-labor substitutability, affected firms with better access to credit raise blue-collar employment by 2.8%, whereas the estimate for relatively credit-constrained firms is 0.8% and not statistically different from zero. In industries with high substitutability, affected firms hire regardless of their access to credit, and relatively credit-constrained firms hire, if anything, slightly more (3.8% versus 3.1%). In low-substitutability industries, the difference between firms with better access to credit and relatively credit-constrained firms is not statistically significant with our baseline

elasticity estimates, but it is larger and statistically significant with two alternative sets of estimates, at the 5% level with those of Oberfield and Raval (2021) and at the 10% level with those of Chirinko and Mallick (2017).

These differences in hiring come with different adjustments of the capital stock. In low-substitutability industries, affected firms with better access to credit expand their furniture and vehicles by about 19% relative to unaffected firms. In high-substitutability industries, affected firms with better access to credit leave their fixed assets unchanged. Relatively credit-constrained firms reduce their fixed assets in both groups of industries: their furniture and vehicles fall by about 17% in both, and in high-substitutability industries their land and buildings and their plant and machinery also fall. Labor productivity does not change in any group. Credit therefore shapes not only whether firms absorb displaced workers, but also how they adjust their capital when they do.

Related literature. Our paper contributes to three strands of the literature. First, we contribute to the literature on the employment effects of credit supply shocks (Chodorow-Reich, 2013; Popov and Rocholl, 2018; Berton et al., 2018; Bentolila et al., 2018; Greenstone et al., 2020; Benmelech et al., 2021). Closest to our paper are Pezone (2023), who shows that better credit availability increases employment when the elasticity of substitution between capital and labor is low, and Laeven et al. (2023), who show that firms with high capital-labor substitutability can continue to grow when credit dries up in strictly regulated labor markets. We complement these papers by studying how firms respond to credit supply when a labor supply shock gives them a reason to hire, which allows us to examine how the production technology shapes whether credit supports hiring.

Second, we contribute to the literature on job displacement, which documents large and persistent earnings losses of workers displaced in mass layoffs (Jacobson et al., 1993; Schmieder et al., 2023) and the effects of large plant closures on local labor markets (Jofre-Monseny et al., 2018; Gathmann et al., 2020). Most related to our paper, Adamopoulou et al. (2026) show that a contraction in credit supply lowers investment and employment through capital-labor complementarity, and that the displaced workers reallocate mainly to less capital-intensive firms. We complement their evidence on job destruction by studying the other side of the reallocation, namely the firms that absorb displaced workers, and by showing that their access to credit and their production technology shape this absorption.

Third, we contribute to the literature on how local labor markets absorb labor supply shocks, which has mostly studied immigration inflows and shows that firms respond by adjusting their production technology and factor intensities (Lewis, 2011; Dustmann and

Glitz, 2015). A mass layoff differs from an immigration inflow in that it releases a large number of experienced workers with a common skill profile at once. We complement this literature by showing that firms' access to credit shapes how they adjust their factor intensities to such a shock.

The remainder of the paper is structured as follows. Section 2 describes the closure of GM Antwerp. Section 3 presents the data and the sample, and Section 4 the empirical strategy. Section 5 studies the employment effects of the labor supply shock, and Section 6 the role of credit supply and production technology. Section 7 examines fixed assets, profitability, and labor productivity. Section 8 presents robustness checks, and Section 9 concludes.

2 Background

2.1 The Closure of GM Antwerp

Founded in 1924, GM Antwerp was a long-standing US-owned car manufacturing plant in Belgium. It was strategically located near the Antwerp port, a location at the geographical center of Europe, to assist export-oriented production. Prior to its shutdown, the plant was producing around 400,000 vehicles annually, with about 90% of these being exported across Europe. As one of Belgium's largest employers, it had an average workforce of roughly 5,000 employees, predominantly blue-collar workers. These workers were noted for their productivity, versatility, and relatively higher skill level compared to their counterparts in the broader GM network (Jacobs, 2019).

The successful operations of the American car manufacturer in Europe, however, had been halted by soaring energy prices in the first decade of the 2000s.[1] While GM Antwerp managed to avoid significant losses during this period, several other subsidiaries of GM worldwide failed to do so. The escalating energy prices led to reduced demand for GM vehicles, resulting in a record loss of almost $40 billion in 2007 (Goolsbee and Krueger, 2015). In response, GM US developed a restructuring plan for its European plants, entailing wage and benefit freezes for the next three years. However, Belgian employment laws prevented GM Antwerp from implementing these measures, making it one of the most expensive plants in Europe. The global financial crisis deepened GM US's losses to nearly $70 billion, calling out for a bailout program. The program was designed to minimize job losses in the US and implicitly necessitated the closure of several

[1] Between 2002-2008, both oil and gas prices in Europe more than quadrupled, progressively weakening the automotive industry (Hamilton, 2009).

subsidiaries in Europe.[2] GM Antwerp, being among the costliest subsidiaries in Europe, was consequently closed in 2010, resulting in sizable local labor supply shocks.[3]

The closure of GM Antwerp coincided with the onset of the global financial crisis, raising concerns about the precise origin of the labor supply shocks. As a crucial port area, the Antwerp region's economy could have been uniquely affected by the global financial crisis, potentially contaminating the source of labor supply shocks. If the firms in the Antwerp region were differentially affected by the crisis than those in other parts of Belgium, the differing post-closure employment outcomes across regions could have been attributed to the global financial crisis rather than the closure of GM Antwerp. Figure 1 plots the unemployment rate in the province of Antwerp and in the rest of Flanders. Although unemployment is higher in Antwerp, the two series follow similar patterns before and after the onset of the crisis. These parallel trends indicate that the two areas faced similar financial shocks and that their firms responded similarly.[4] This makes it unlikely that the global financial crisis explains the differences in employment outcomes between affected and unaffected firms.

[INSERT FIGURE 1]

2.2 Mass Layoffs

Definition. A mass layoff is a sharp, persistent, and sizeable reduction in the firm size. Gathmann et al. (2020), for instance, define a decrease in plant size of at least 500 workers in a given year that persists for a minimum of two years as a mass layoff event. Not all sizeable and persistent reductions in firm size, however, can be deemed as mass layoffs. In case more than 30% of displaced workers from one firm move into another firm, this should be treated as a movement of the workers, rather than a mass layoff event. The sales or spin-offs can also be confused with mass layoffs. If more than 70% of those leaving a plant start to work at the same three firms, this should also not be treated as a mass layoff event (Gathmann et al., 2020). Mass layoffs are, by definition, caused by the closure or major restructuring activities of very large firms and as such, cause sizeable,

[2]The bailout agreement stipulated that additional funds were to be used solely for GM US and its subsidiaries in the US.

[3]Political factors also influenced the decision to shut down GM Antwerp in favor of preserving other less profitable European plants. For example, certain German plants of Opel, another GM subsidiary, were less profitable than GM Antwerp but remained operational, partly because they were founded in Germany (Jacobs, 2019).

[4]Alternatively, the two areas might have experienced different financial shocks, although we find no evidence for this. Even in that case, their employment responses were similar, as the parallel unemployment trends show.

local labor supply shocks.

GM Antwerp and mass layoffs. The restructuring process that GM Antwerp went through resulted in the dismissal of 1,900 blue-collar workers, first 842 in 2007 and then 1,058 in 2008 (Figure 2). Employment figures show that the manufacturing plant did not re-employ these displaced workers. Additionally, at the time of mass layoffs, or shortly afterward, no single (local) firm or three (local) firms had experienced a sizeable increase in employment.[5] As such, the initial two waves of layoffs can be deemed as mass layoffs that caused sizeable labor supply shocks to the local economy.

[INSERT FIGURE 2]

The restructuring of GM Antwerp ended up as a temporary solution following the bailout agreement between the management of GM and the U.S. government. Restricted by the deal, the headquarters decided to shut down the assembly plant in Belgium as part of the cost-cutting measures. The closure of GM Antwerp resulted in the dismissal of the remaining 2,280 blue-collar workers by the end of 2010. In total, almost 4,800 employees, of which 4,180 were blue-collar workers, lost their jobs. Figure 2 plots the number of total, white- and blue-collar employees in GM Antwerp five years before and after the start of layoffs. The sharp and permanent reduction in the number of workers, which is almost exclusively driven by the contraction in the number of blue-collar workers, since 2007 corresponds to an increase in the total number of unemployed blue-collar workers in the Antwerp region by about 25%, and the number of unemployed male blue-collar workers by about 45%.

3 Data

Firm-level data. We retrieve firm-level data from two data sources: Bel-first and Google Maps. Bel-first is a commercial database (maintained by Bureau van Dijk (BvD)), which contains comprehensive data about firms in Belgium. The financial and balance-sheet information in Bel-first comes from business registers collected by the National Bank of

[5] At the time of restructuring, Belgium hosted several domestic and foreign-owned automakers, including large multinationals like Volvo, Volkswagen (which later became AUDI) and Ford, other than GM Antwerp. These car manufacturing firms might have increased their demand for blue-collar workers upon the restructuring of GM Antwerp and the displaced workers might have considered these firms as favorable destinations. However, we find no evidence of collective re-employment of the displaced workers by any of these automakers.

Belgium (NBB) as per legal requirements. Unlike the most commonly used firm-level databases such as Worldscope and Compustat, Bel-first provides granular information on all firms in Belgium, regardless of listing status and size. Given that more than 90% of firms in Belgium are micro, small, or medium-sized unlisted firms that account for about 63% of total value added and about 68% of total employment, the coverage of these firms is pivotal for the external validity of our results. Further, Bel-first provides information on both the unconsolidated accounts and consolidated accounts. This allows us to collect granular information at the separate entity level, rather than that of parents. Access to detailed information on the accounts of separate entities gives us an edge in studying a sample of firms that plausibly picture the economic activity in Belgium. The variables in Bel-first, with a few exceptions like identifiers, are reported with annual frequency.[6] Annual information on firms enables us to keep track of changes over time within firms and use this information to reduce potential concerns regarding unobservable factors that might drive firm-level outcomes. The rich database contains information on key financials, key ratios as well as all balance sheet items including sub-categories of fixed assets. Further information about the variables can be found in Appendix A.

Bel-first also keeps a record of social balance sheet information, which is not covered by otherwise similar and larger data sources like ORBIS and AMADEUS. Social balance sheet information includes employment by the type of workers, namely, management, white-collar, blue-collar, and others. Granular employment data offers a significant advantage in identifying labor supply shocks, particularly in cases like the closure of the car manufacturing plant, which led to the layoff of a workforce predominantly composed of blue-collar workers, accounting for 90% of the total.

Our identification strategy relies on the geographical variation in exposure to the shock, which depends on the distance of the firm to the location of the closed car manufacturing plant. We retrieve postcodes of the firms and the manufacturing plant from Bel-first and use Google Maps to manually generate the distance data. The unit of measurement for distance data is kilometers and is based on the car travel distance at around 7am when most blue-collar workers begin commuting. As Google Maps does not provide the kilometer distance at the year of the event, we are unable to take potential improvements or degrading in the roads, and thus the potential changes in distance between any two locations.[7] Bird-flight distances remain intact, but cannot be relied upon

[6] Kalemli-Özcan et al. (2024) thoroughly explain the process of using the annual raw vintages of the ORBIS database, of which Bel-first is a subset, to create time-variant identifiers. We unfortunately do not have access to these vintages and are limited to the use of time-invariant identifiers.

[7] Google Maps does not provide historical distance data and we rely on the current distances from the event location.

for the purpose of this study.

The elasticity of substitution between capital and labor. The existing body of literature predominantly focuses on estimating aggregate elasticity, with only a handful of studies extending their analysis to individual industries (see Knoblach and Stöckl, 2020, for an extensive review.), and there is considerable heterogeneity in the estimates of elasticity of substitution between capital and labor, primarily due to publication bias and differences across countries (see Gechert et al., 2022, for an extensive comparison of estimates across studies).

The elasticity of substitution between capital and labor measures how easily a firm can replace one factor with the other while keeping output constant. When the elasticity is high, firms can adjust their input mix to changes in the relative cost or availability of the two factors. When it is low, capital and labor are strong complements, and firms can expand one factor productively only if they also expand the other. Most of the estimates we use are below one (Appendix B), so capital and labor are gross complements in most industries. We therefore compare industries where capital and labor are more and less substitutable, and we refer to them as industries with high and low capital-labor substitution.

In the baseline regressions, we utilize the capital-labor substitution elasticities estimated by Laeven et al. (2023).[8] Laeven et al. (2023) is one of the few studies that provide estimations for the elasticity of substitution between capital and labor at the industry level and is one of the most comprehensive among those that provide estimates for a single country.[9] To determine industry-level elasticities, the authors employ a methodology developed by León-Ledesma et al. (2010), which generates estimates through a "normalized" system of non-linear equations. This system integrates a Constant Elasticity of Substitution (CES) production function, accommodating factor demands for both capital and labor with cross-equation parameter constraints, and takes covariances of residuals into account. The method has demonstrated superior efficiency and robust-

[8]Estimating the elasticity of capital-labor substitution for our sample of firms in Belgium is not feasible due to two major constraints. First, our capacity to calculate industry-level elasticities within Belgium is considerably hampered by data limitations. Second, Belgium's employment protection legislation was notably stringent between 1990 and 2011, with its strictness index surpassing that of the US by over 18 times (OECD, 2023). As a result, deriving industry-level elasticities of factor substitution in countries like the U.S., which have less restrictive labor regulations, is expected to provide a more precise empirical approximation of industries' natural elasticities of substitution, as opposed to using Belgian data. Additionally, the estimates of the capital-labor elasticity of substitution should provide a reliable approximation, as long as the technologies in sectors across countries do not differ significantly (Pezone, 2023).

[9]A single-country focus minimizes potential biases common in cross-country estimates (Gechert et al., 2022).

ness for estimating the elasticity of substitution between capital and labor within this context.[10]

The estimates are based on a sample that spans the period between 1940 and 2007 and includes the firms in all industries in the US, except public administration and other non-market activities.[11] These estimations are particularly relevant for our study's focus period of 2003 to 2011.[12] The complete list of industries and the corresponding estimates can be found in Appendix B. We additionally test our baseline findings with the estimates of Oberfield and Raval (2021) and Chirinko and Mallick (2017), respectively.[13]

Loan-level data. Our loan-level data is sourced from the Credit Registry of Belgium, managed by the National Bank of Belgium (NBB). In compliance with legal requirements, all financial institutions registered in Belgium report details of loans exceeding 25,000 euros to this registry. By employing BvD identifiers, we have constructed a matched sample at the bank-firm loan level. This sample encompasses 57 financial intermediaries and represents approximately 80% of the total loans in the Belgian banking sector from 2003 to 2011.

Using matched bank-firm loan-level data, we estimate bank credit supply shocks and bank credit demand. To do so, we follow the methodology of Degryse et al. (2019).[14] This allows us to obtain estimates of bank credit supply shocks and bank credit demand for all sample firms with banking relationships, and keep both firms that borrow from a single bank, which is typically the case for micro-small firms that are predominant in Belgium, and firms that borrow from multiple banks in the study sample.

Sample. We use BvD identifiers to merge firm-level data, including industry-level elas-

[10]For further details on the estimation technique of elasticities of substitution between capital and labor, see Laeven et al. (2023).

[11]Due to its highly developed and liquid financial market, the distortion of production and factor decisions by credit constraints is minimal in the US (Rajan and Zingales, 1998). Additionally, labor regulations in the US, among the most flexible in the OECD, indicate that adjustments to factors in response to shifts in factor prices are less likely to be affected by labor market rigidities (Laeven et al., 2023). Similar to Laeven et al. (2023), Gopinath et al. (2017) also use the estimates of the elasticity of factor substitution for US firms to proxy factor substitutability for Spanish firms. We follow these papers and use the US estimates for Belgian firms given substantial similarities in the employment protection legislation in Spain and Belgium.

[12]While recent technological advancements, especially over the last decade, may have altered production structures in some industries, our study's time frame excludes these changes, leaving the examined industries unaffected.

[13]As we are unable to provide perfect matches for the industries due to the limited scope of estimates in these studies, we lose a part of the information in the process.

[14]The estimation of the loan growth equation by Degryse et al. (2019) follows a modified version of Khwaja and Mian (2008). For further details of the procedure, see Section 4.

ticity estimates, with loan-level estimations and thereafter, apply mild cleaning. We first exclude associations, non-profit organizations, and firms that do not need to follow the standard reporting criteria of the National Bank of Belgium.[15] We drop firms in the finance, insurance, and real estate sectors to ensure consistency across the accounting standards and business models of the firms in the sample. We treat negative firm-year observations for total assets, cash flow, total employment (or blue-collar employment), total debt, or incorporation year as reporting errors and exclude them from the sample. All variables are winsorized at 1% percentiles in both tails to alleviate the potential distortion by remaining errors and outliers. We restrict the sample to firm-year observations with at least one full-time equivalent employee, one full-time equivalent blue-collar employee, and non-missing key financials that must be reported.

We further restrict our sample to alleviate the potential differences between affected firms and unaffected firms. The presence of substantial differences between affected and unaffected groups could lead to divergent pre-intervention trends, thereby breaching the parallel trends assumption essential for unbiased causal inference in DiD analysis. This issue is especially relevant in mass layoff scenarios, where a single region experiences a shock while others do not. In such cases, pre-existing regional disparities could compromise the validity of DiD identification (Gathmann et al., 2020). To take this concern into account, we match affected and unaffected firms based on the ex-ante observable factors including the share of blue-collar workers, total assets, return on assets, and leverage using propensity score matching (1 to 5, with replacement). We present the summary statistics in Table 1 separately for matched affected and unaffected firms. A comparison of the means shows that the matching procedure yields groups that are similar in the matching variables. We also formally test and confirm that there are no statistically significant differences between affected and unaffected firms post-matching.

[INSERT TABLE 1]

Our final sample includes 63,739 observations and spans the period between 2003 and 2011. The sample roughly matches the size distribution of the population and can be treated as nationally representative. Panel A of Table 1 presents the summary statistics for the entire sample. The firms are about 20 years old, have about 11 employees, and

[15]The criteria for standard reporting vary according to a firm's size, which is determined by three key thresholds: having 50 full-time equivalent employees, a turnover of EUR 9,000,000, and a balance sheet total of EUR 4,500,000. A firm is categorized as large and required to use the full-format reporting model if it surpasses two or three of these thresholds, or if it is publicly listed on the stock exchange. Conversely, a firm is classified as small if it does not exceed more than one of these specified thresholds and, as such, is eligible to employ the abbreviated reporting format. This distinction ensures that reporting requirements are appropriately scaled to the size and complexity of the firm.

8 blue-collar workers, and hold EUR 1.41 million worth of total assets, on average. The return on assets is 3.48 and the share of cash in total assets is about 12%, on average.

In Panels B and C of Table 1, we provide summary statistics for the key variables, differentiated by treatment status. A quick examination of the data shows that our matching process successfully yielded two groups – affected and unaffected firms – with remarkably similar characteristics on average. The average employee count in both affected and unaffected firms is approximately 11, with around 78% of the workforce being blue-collar workers in each group. The mean value of total assets is close too, with affected firms at about EUR 1.40 million and unaffected firms slightly higher at EUR 1.44 million. Debt levels are also analogous, with leverage ratios averaging 0.70 for affected firms and 0.68 for unaffected ones. Profitability, as measured by return on assets, is comparable between the two groups, as is the average age of the firms. The consistency between affected and unaffected firms is further affirmed by the striking similarity in their 25th percentile, median, and 75th percentile values.

4 Empirical Strategy

Labor supply shocks. We analyze the role of capital-labor substitution in the combined effects of credit supply and labor supply shocks. We specifically study how factor substitution shapes the impact of bank credit supply shocks on employment and investment in the presence of labor supply shocks. To achieve this, we initially focus on identifying the labor supply shocks generated by the closure of GM Antwerp and the subsequent mass layoffs, which resulted in a sudden influx of a substantial number of blue-collar workers into the local economy.

The identification of labor supply shocks in the aftermath of mass layoffs initially depends on the composition of the displaced workforce. In the extreme scenario, if all displaced workers are eligible for (early) retirement, and opt for it, mass layoffs cannot translate into labor supply shocks. Around 24% of the displaced workers were eligible for (early) retirement.[16] Of those eligible for (early) retirement, around 60% opted to retire early. This implies that an estimated 600 displaced workers moved out of the labor force following the closure of GM Antwerp.[17] The remaining 4,200 displaced workers

[16]To be eligible for early retirement, a worker had to work for at least 10 years at the company or 20 years in total, and must have been at least 50 years old at the time of the closure.

[17]Our estimate is based on Maes and Deneyer (2011), who carried out a survey with workers that were displaced by GM Antwerp and revealed that 189 of 1,285 displaced workers, 15%, opted for early retirement.

stayed in the labor force and continued to look for jobs around the Antwerp region.[18]

To identify the labor supply shocks, we follow Gathmann et al. (2020) and exploit spatial and intertemporal variation.[19] Specifically, we employ a DiD setup and check whether firms within 50km of the closed manufacturing plant employ more blue-collar workers after the beginning of the mass layoffs relative to similar firms that are not within 50km of the closed plant following the commuting literature.[20] We then estimate the following Equation 1:

$$Y_{it} = \beta_1 Post_t \times Affected_i + \mathbf{\Phi}^{'} \boldsymbol{X_{it-1}} + \alpha_i + \alpha_t + \varepsilon_{it} \tag{1}$$

where Y_{it} represents the natural logarithm of the number of blue-collar workers - or another outcome variable in other specifications - for firm i at time t, $Affected_i$ is a dummy variable which takes 1 if firm i is located within 50km of GM Antwerp and 0 otherwise, $Post_t$ is a dummy variable which takes 1 for years from 2007 until 2011 and 0 for years from 2003 until 2005, X_{it-1} is a vector of control variables which includes the natural logarithm of total assets, firm age, leverage ratio, return on assets and cash, and ε_{it} is the error term.[21] In all specifications, standard errors are clustered at the firm level to account for the potential serial correlation between the unobservable part of firm-level employment decisions following Bertrand et al. (2004) and are heteroskedasticity-robust.

[18]For further information on the displaced workers, see Section 2.

[19]Similarly, a large body of literature relies on geographical and intertemporal variation to identify labor supply shocks (see Edo, 2019, for an extensive review).

[20]Empirical evidence from Dutch survey data indicates an average commute of 29 minutes, with a standard deviation of 25 minutes (Rouwendal and Meijer, 2001). Similarly, in the adjacent Flanders region of Belgium, a one-hour travel time typically covers a distance of 50km from a closed facility. An alternative, and plausible, distance measure is the travel time in minutes/hours. Indeed, studies in the epidemiology literature typically use minutes/hours to proxy travel times (see, e.g., Hansson et al., 2011; Milner et al., 2017). However, Google Maps cannot provide granular information about the travel times after 30 minutes and starts to suggest intervals, which might even range from 30 minutes to 2 hours, rather than exact distance in minutes or hours. We, therefore, rely on more granular kilometer distances and assume that an hour roughly corresponds to 40 to 60 km. We choose 50 km in our baseline specification by taking the midpoint of 40 to 60 km. Additionally, treatment definitions based on proximity to the GM Antwerp plant implicitly assume that all displaced workers lived within and sought employment in a specific radius—40 km, 50 km, 60 km, or 70 km, depending on the treatment definition—around the closed manufacturing plant. The Flemish Agency for Employment and Vocational Training (VDAB) provides more granular data, offering detailed information on the residential addresses (at the 4-digit postal code level) of all workers displaced by GM Antwerp. Leveraging this granular data, we develop an alternative treatment definition to assess the robustness of our baseline results, alongside the 40 km, 60 km, and 70 km radius-based definitions, as discussed in Section 8.

[21]One might argue that blue-collar workers affected by the closure of GM Antwerp would consider traveling beyond a 50km radius in search of higher wages. However, this option may not have been viable due to the workers' residential ties in the region, driven by long-term commitment to the firm. Additionally, Belgium's historical practice of maintaining wage parity among workers could have eliminated the role of wage differentials as a motivator for long-distance job searches.

The identifying assumption is that, absent the layoffs, blue-collar employment at affected and unaffected firms would have followed parallel trends. Belgium is divided into three distinct regions, and there exist regional differences with respect to industry concentrations, official languages, and governing bodies among other things.[22] These differences are also reflected in key economic indicators. Unemployment in the province of Antwerp, where most affected firms are located, is consistently higher than in the rest of Flanders (Figure 1). As a result, affected firms might be inherently different from unaffected firms. This might then cause ex-ante differences in employment trends that drive the ex-post differences. To address this concern, we match affected and unaffected firms using propensity score matching based on ex-ante key observables and achieve a comparison of arguably similar subsets of firms.[23] We examine pre-treatment trends with an event-study design in Section 5.

Another potential identification challenge might relate to the shocks other than labor supply shocks. If affected and unaffected firms experience different shocks or react to shocks other than labor supply shocks differently, our identification strategy might then capture the implications of these shocks rather than the labor supply shocks. The global financial crisis in 2008 might be considered as such a shock that might contaminate our identification and confound our results. However, in Section 2, we show that regional unemployment figures follow parallel trends over the study period. Further, our dynamic coefficient estimates show that the employment effects almost perfectly align with the treatment intensity, implying that our results are not confounded by shocks other than labor supply shocks. Additionally, by matching firms on key observables, we obtain a sample of affected and unaffected firms that are reasonably similar and thus, are reasonably expected to react similarly to the similar shocks.

To further alleviate concerns regarding the identification of labor supply shocks, following the approach of Gathmann et al. (2020), we exclude three regions, namely Brussels Capital, Walloon Brabant, and Flemish Brabant, from our analysis as they might have experienced another shock. In 2006, VW Vorst underwent a significant transformation, becoming Audi Brussels. Situated in Brussels, the de facto capital of the European Union and a hub for political and economic activity, many firms have their headquarters in this region, which arguably skews the accounting data. To avoid confounding our analysis with the impacts of this event, we exclude regions potentially influenced by the restructuring of VW Vorst. We also remove the year 2006 as the restructuring process of

[22] See Section 2 for a more detailed discussion of the regional differences in Belgium.
[23] We provide more detailed information about the matching procedure in Section 3.

VW Vorst might have contaminated potential control regions in that year.[24]

At the firm level, we can only observe the equilibrium level of employment - and the changes in it over time. The equilibrium level of employment is simultaneously determined by the labor demand and labor supply, and as such, to accurately identify the impact of the labor supply shocks in the changes in employment, we need to isolate labor supply from labor demand. To do so, following Popov and Rocholl (2018) and Bentolila et al. (2018), we first use a vector of one-year lagged controls, X_{it-1}, including firm size, age, profitability, indebtedness, and cash ratio that arguably explain firm-level labor demand. These controls account for the variation in labor demand over time for all firms and are lagged to eliminate potential endogeneity that might arise from reverse causality.

We also use firm-level estimated bank credit demand to further improve the isolation of the labor supply from labor demand. Credit demand is a strong indicator of imminent growth opportunities, and as such, labor demand at the firm level.[25] Time-varying estimated credit demand at the firm level therefore helps us to account for the remaining variation in labor demand over time. We provide the details for the estimation procedure in the next subsection. We further saturate our model with the time fixed effects to control for the effects of global shocks on employment outcomes. To account for the inherent time-invariant and unobservable firm-level variation in labor demand, we include firm fixed effects.

Under these assumptions, the coefficient of interest, β_1, measures the extent to which affected firms absorb the local blue-collar labor supply shock resulting from the closure of GM Antwerp.

Bank credit supply shocks. We next focus on the identification of credit supply shocks. Changes in the equilibrium credit level can be driven by changes in credit demand, changes in credit supply, or both. Without granular information on the drivers of the growth of equilibrium lending, one might falsely attribute a credit-supply-driven growth - or contraction - to the changes in credit demand, or vice versa. The seminal contributions by Gan (2007) and Khwaja and Mian (2008) show that this identification problem can be dealt with the use of firm fixed effects and the correlates of bank fixed effects -

[24] In line with anticipation effects in case of mass layoffs (Schwerdt, 2011), we could have started the treatment in 2006. However, distance-based identification might not accurately capture the impact of the labor supply shocks following the restructuring of VW Vorst as the Brussels-Capital Region is characterized by persistent, structural high unemployment that is particularly driven by the lack of demand for blue-collar workers. We therefore choose to remove the year 2006 from the analysis.

[25] A large body of literature establishes the link between credit with labor demand (see Güler et al., 2021, for an extensive review).

such as the change in deposits in Khwaja and Mian (2008). This method successfully isolates credit supply from credit demand but only in the case that firms borrow from at least two banks. In settings where single-bank firms dominate, this might mean losing information about a large portion of the economic activity.[26]

Belgium is a country where firms predominantly rely on a single bank for lending. Indeed, about 80% of the firms that are in our credit sample are single-bank firms. Further, these firms account for about 60% of the economic activity in Belgium. The reliance on firms borrowing from at least two banks to distinguish credit supply from credit demand therefore presents a significant limitation for our study. Degryse et al. (2019) show that this limitation can be overcome with an alternative approach. The authors show that clustering firms into bins can generate variation in bank lending for single-bank firms as the bins that include single-bank firms would be borrowing from multiple banks. The estimation of the loan growth equation then allows for the isolation of credit demand from credit supply even for single-bank firms. Additionally, the resulting estimates for the bank credit supply shocks exhibit a high correlation with those derived using firm-time fixed effects. We therefore follow Degryse et al. (2019) to identify credit supply shocks and estimate the following loan growth equation:

$$\Delta Credit_{bit} = \alpha_{ILSt} + \gamma_{bt} + \varepsilon_{bit} \tag{2}$$

where $\Delta Credit_{bit}$ is the intensive margin annual growth rate of credit from bank b to firm i at time t, α_{ILSt} is the Industry-Location-Size (ILS)-time fixed effects, γ_{bt} is the bank-time fixed effects, and ε_{bit} is the error term. If all firms in an industry-location-size bin have homogeneous bank credit demand across banks, then γ_{bt} successfully identifies the bank credit supply shocks.[27] We convert the bank-time level credit supply shocks into firm-time bank credit supply shocks by using the share of each bank in the matched firm's loan portfolio as weights. This transformation allows us to accurately reflect the impact of credit supply variations at the firm level, based on their specific banking relationships.

Importantly, the estimation of Equation 2 also provides the estimates for the credit demand. These estimates play an important role in our identification of labor supply shocks. Estimated credit demand at the firm level can arguably proxy imminent growth opportunities, and as such, may have explanatory power over the employment deci-

[26] Additionally, the methodology of Gan (2007) and Khwaja and Mian (2008) relies on specific exogenous events for the estimation of credit supply shocks, such as the nuclear tests in Pakistan in Khwaja and Mian (2008), restricting the estimation to particular time periods.

[27] See Degryse et al. (2019) for a more detailed discussion of the identification of credit supply shocks using industry-location-size clusters and bank-time fixed effects.

sions.[28]

5 Labor Supply Shocks and Employment

We begin our empirical analysis with the study of the employment effects of the labor supply shocks. The closure of GM Antwerp resulted in the layoff of about 4,800 workers. Almost 90% of these workers were blue-collar workers.[29] We therefore expect firms that are affected by the labor supply shocks to hire significantly more *blue-collar* workers than unaffected firms.

The results from the estimation of Equation 1 are presented in Table 2. Column (1) of Table 2 excludes all fixed effects and demand controls and shows that affected firms employ 3% more blue-collar workers than unaffected firms. The inclusion of control variables, including credit demand, substantially increases the fit of the model, and the estimated coefficient of interest slightly increases (Column (2)). The coefficient of interest does not change when we add year fixed effects (Column (3)). Adding firm fixed effects reduces the estimated employment effect from 3.3% to 2.4% (Column (4)). Our preferred model specification, presented in Column (4), provides a relatively better and overall good fit for the estimation of employment. We therefore conclude that affected firms employ about 2.4% more blue-collar workers than unaffected firms after the labor supply shock.

Two observations follow. First, the controls and fixed effects substantially increase the explanatory power of the model, while the coefficient of interest changes little. Following the logic of Altonji et al. (2005), this stability makes it unlikely that omitted variables drive our estimates. Second, adding the controls, including estimated credit demand, barely changes β_1, which suggests that the controls capture changes in labor demand and that β_1 reflects the labor supply shock.

[INSERT TABLE 2]

To test whether these findings are driven by ex-ante trends, we inspect the differences across coefficient estimates over time through an event study design. Figure 3 illustrates the employment trends among blue-collar workers using a modified version

[28] Our sample is limited to firms with at least one banking relationship. There are also firms that have positive credit demand but of which the loan applications are rejected. While we cannot investigate this dimension, Berg (2018) provides an extensive study of the real effects of loan rejections.

[29] On average, displaced blue-collar workers were middle-aged and high-tenured (Maes and Deneyer, 2011) and had higher skills compared to the rest of blue-collar workers (Jacobs, 2019).

of Equation 1. In this modified equation, we incorporate the treatment variable $Affected_i$ with year-specific indicators from 2003 to 2011. 2005 serves as the benchmark year for the coefficients of the other years. The blue dots represent the estimated values of the year-specific coefficients. Additionally, the blue dashed lines depict the 90% confidence intervals. A red vertical line is used to distinguish between the periods before and after the treatment. The plots of coefficients during the period before the treatment, in comparison to the reference year, suggest that there is no significant pre-existing trend prior to the start of the treatment.[30] The impact of the labor supply shocks on employment becomes noticeable one year after the treatment started, coinciding with GM Antwerp's restructuring phase. Over the following two years, as GM Antwerp continued to lay off blue-collar workers, the significance of the coefficient increased in tandem with the treatment intensity and peaked with the closure of the manufacturing plant four years after the initial mass layoffs. The differential employment effect rapidly began to fade away in the next year in line with the end of the treatment. These results, after the implementation of the matching procedure, imply that our baseline findings are unlikely to be driven by systematic differences between affected and unaffected firms.

[INSERT FIGURE 3]

Our dynamic coefficient estimates have two important implications. First, our baseline findings are unlikely to be driven by systematic ex-ante differences between affected and unaffected firms. In different terms, we can conclude that our matching method effectively removes any disparities between firms that were affected and those that were unaffected by the treatment, which could have otherwise led to potential variations in employment trends before the treatment. Second, because we control for time-varying labor demand, our dynamic estimates suggest that the employment response follows the labor supply shock rather than imminent growth opportunities. Figure 3 shows that the additional employment of blue-collar workers strictly depends on the continuation of blue-collar labor supply shocks and begins to fade away once the manufacturing plant shuts down.

[30] The pre-treatment period covers a relatively shorter period than the post-treatment period due to our data limitations.

6 Credit, Production Technologies, and Employment

Our baseline findings show that following the closure of the manufacturing plant, firms that are affected by the labor supply shocks employ more blue-collar workers than the unaffected ones. This result provides a foundation for exploring the mechanisms that influence employment - and potentially, other firm outcomes - after labor supply shocks. We initially focus on the impact of capital-labor substitution on the absorption of the labor supply shocks, which is followed by the examination of the role of bank credit supply on employment, and then we combine the two mechanisms and study the employment effects of bank credit supply channel through the lens of capital-labor substitution.

Capital-labor substitution channel. The absorption of labor supply shocks might significantly depend on the firm-level capital-labor substitutability. Firms with relatively higher capital-labor substitutability, for instance, might choose to switch to a more labor-oriented strategy by hiring the potentially cheaper and redundant supply of workers while firms with relatively lower capital-labor substitutability might absorb the labor supply shocks as a part of a (long-term) growth strategy. To study the role of capital-labor substitution in the absorption of labor supply shocks, we rely on the estimates of the elasticity of substitution between capital and labor by Laeven et al. (2023). Accordingly, we split the sample into two groups: firms with high capital-labor substitution and firms with low capital-labor substitution. A firm is "high" capital-labor substitution if the elasticity estimate in the sector it operates is above the median elasticity estimate of the sample and "low" capital-labor substitution if the elasticity estimate in the sector it operates is below the median elasticity estimate of the sample.[31] We then examine the employment outcomes for each of these groups.

[INSERT TABLE 3]

Columns (1) and (2) of Table 3 show the results of the baseline regression for firms with low and high capital-labor substitution, respectively. Our findings show that both affected firms with high capital-labor substitution and affected firms with low capital-labor substitution hire more workers than similar unaffected firms. In line with Caselli and Coleman II (2006), who show that countries rely more on the relatively abundant factor of production, affected firms might be prone to increase employment following

[31] The estimates of the elasticity of substitution between capital and labor are only available at the sector level and thus, we use the sample median as the benchmark. Additionally, the elasticity estimates are constant over time, making pre- or post-treatment choices irrelevant.

labor supply shocks.[32] The employment effect is, however, twice as large among the firms with high capital-labor substitution (3.4% versus 1.7%), although the difference is not statistically significant at conventional levels.[33] To have an understanding of the underlying reasons behind the differences between the absorption of labor supply shocks by the firms with low capital-labor substitution and firms with high capital-labor substitution, we next examine the role of credit supply in the employment of displaced workers.

To test the robustness of our findings, we use two additional measures: the elasticity of substitution between capital and labor as estimated by Chirinko and Mallick (2017) and Oberfield and Raval (2021). We divide the sample into two groups based on these estimates: firms with high capital-labor substitution and firms with low capital-labor substitution. Columns (3) and (4) of Table 3 present the baseline regression results for firms with low and high capital-labor substitution, respectively, using the estimates from Chirinko and Mallick (2017). The employment effect is again larger among firms with higher capital-labor substitution (5.0% versus 2.4%), and the difference is significant at the 10% level. In Columns (5) and (6) of Table 3, we present the results based on the estimates from Oberfield and Raval (2021) to proxy firm-level capital-labor substitutability. These results also suggest that the employment effect is more pronounced in firms with higher capital-labor substitutability than in those with lower substitutability, although this difference is not statistically significant.

Bank credit supply channel. One might argue that labor is self-financing and does not require external finance but in theory, the availability of credit might matter for employment. There is often a time-mismatch between the return on labor and payments for labor, especially for small and young firms, and this might generate the need for external financing (Greenwald and Stiglitz, 1986). Additionally, labor is associated with fixed costs such as investment costs in hiring and training activities (Oi, 1962), which might require external funding to start with.[34] The employment - and potentially, other firm outcomes - in the aftermath of labor supply shocks may thus depend on the firms'

[32] Caselli and Coleman II (2006) also show that countries specialize in the use of abundant factor of production, which implies that the labor supply shocks generated by the closure of GM Antwerp might have affected firm-level capital-labor substitutability for the affected firms. We are, however, unable to investigate this dimension given that our capital-labor substitutability measure does not vary over time.

[33] We estimate Equation 1 separately for each sub-sample. Because the sub-samples contain different firms and standard errors are clustered at the firm level, the coefficient estimates from two sub-samples are independent, and the Wald test of their equality uses the sum of their variances.

[34] Borisov et al. (2021) show that access to public capital markets, through initial public offerings, is another significant determinant of firm-level employment growth, particularly via two main channels: commercialization and the ability to make acquisitions.

access to bank credit.

To study the implications of the bank credit supply channel, we rely on bank credit supply shocks estimated by using matched bank-firm loan-level data following Degryse et al. (2019). Accordingly, we split the sample into two groups based on the estimated bank credit supply shocks: firms with higher bank credit supply, i.e. high credit supply firms, and firms with lower bank credit supply, i.e. low credit supply firms. A firm is "high" credit supply if its post-treatment bank credit supply shocks are above the post-treatment industry median and "low" credit supply if its post-treatment bank credit supply shocks are below the post-treatment industry median.[35] We then re-estimate Equation 1 for these two sub-samples.

Columns (1) and (2) of Table 4 show the results of the baseline regression respectively for firms with lower and higher credit supply. The employment effect is significant in both groups. Affected firms with high credit supply employ 2.7% more blue-collar workers than unaffected firms with high credit supply, while the effect among firms with low credit supply is 0.5 percentage points smaller, but still statistically significant. These findings might initially seem to point to significantly higher additional employment among firms with higher credit supply compared to firms with lower credit supply. However, we cannot reject the hypothesis that the coefficient estimates from the two sub-samples are equal even at the 10% significance level based on the Wald test. Taken together, we conclude that higher credit availability does not translate into higher employment for the average firm.

[INSERT TABLE 4]

These findings are in line with the literature that shows no significant effect of bank lending on employment outcomes. Our results, for instance, are in line with Greenstone et al. (2020) who show that contraction in bank lending does not translate into lower employment for small firms during the global financial crisis of 2008. We also corroborate the evidence by Acharya et al. (2019), who show that increased bank lending towards firms via the ECB's OMT program does not translate into higher employment as borrowing firms use additional bank lending to accumulate cash holdings. The divergence of theory and empirical evidence concerning the employment impact of bank credit supply shocks suggests that the connection between bank lending and labor might hinge on

[35]Unlike the traditional sample splits based on pre-treatment values, we can safely rely on post-treatment bank credit supply shocks to proxy the availability of credit as bank credit supply shocks are exogenous by definition. This provides us the advantage of matching the timing of employment - and other real - decisions with the availability of credit.

firm heterogeneity, which we inspect next.

The joint role. Bank credit supply may also affect employment indirectly through its impact on firm-level investment. In the presence of capital market frictions, investment depends on access to external finance. When labor and capital are strong complements, firms adjust employment together with capital, so that easier access to credit raises both investment and employment (Benmelech et al., 2021). Alternatively, labor and capital might be more substitutable. In this scenario, easier access to credit might enable the costly transition towards more capital-intensive - and thus, more productive - production while in the absence of sufficient funding, firms might prefer to substitute labor for capital to seize imminent growth opportunities at the expense of productivity gains.[36]

To study the bank credit supply channel through the lens of capital-labor substitution we rely on our estimates of bank credit supply shocks and the estimates of the elasticity of substitution between capital and labor by Laeven et al. (2023). Accordingly, we split the sample into four groups: firms with higher bank credit supply and high capital-labor substitution, firms with higher bank credit supply and low capital-labor substitution, firms with lower bank credit supply and high capital-labor substitution, and firms with lower bank credit supply and low capital-labor substitution. We then examine the employment outcomes for each of these groups.

Table 5 presents the results from the estimation of Equation 1 for each group. We first focus on the firms with low capital-labor substitution. Affected firms with low capital-labor substitution and high credit supply employ 2.8% more blue-collar workers than unaffected firms with low capital-labor substitution (Column (1)). If credit supply is relatively limited, however, the employment outcomes of affected and unaffected firms with low capital-labor substitution following labor supply shocks are not statistically significantly different (Column (2)). The difference between the two coefficients, however, is not statistically significant with our baseline elasticity estimates (p = 0.26). With the alternative estimates of Oberfield and Raval (2021) and Chirinko and Mallick (2017), the corresponding difference is larger and significant at the 5% and 10% levels, respectively (Section 8).

[INSERT TABLE 5]

We next focus on the firms with high capital-labor substitution, for which we present the results from the estimation of Equation 1 in Columns (3) and (4) of Table 5. Among

[36]There is a growing body of literature that shows increased overall productivity through the substitution of labor with capital, particularly for most blue-collar tasks (see, e.g., Acemoglu and Restrepo, 2019).

the firms with easier access to credit, affected firms with high capital-labor substitution hire 3.1% more blue-collar workers than unaffected firms with high capital-labor substitution. The employment effect is even more pronounced for firms with relatively lower access to credit. Among these firms, affected ones hire 3.8% more blue-collar workers than unaffected ones. The difference between the coefficients, however, is not statistically significant.

Our results suggest that the relationship between credit and labor depends on the firm-level capital-labor substitutability. Among firms with low capital-labor substitution, the employment response is concentrated among firms with easier access to credit. Given that low capital-labor substitutability implies strong complementarity between capital and labor, these firms might simultaneously invest and employ to seize imminent growth opportunities following the labor supply shocks. On the other hand, easier access to credit supply does not necessarily translate into higher employment for firms with high capital-labor substitution. Instead, though the coefficient difference is insignificant, the employment effect is larger between affected and unaffected firms with a lower credit supply. This might be indicative of a transition towards more labor-intensive production.

Our findings for the firms with high capital-labor substitution are in line with Laeven et al. (2023) who show that in the absence of credit supply, firms with high capital-labor substitution switch to a production technique that relies less on costly capital and more on cheaper labor to compensate for the negative growth effect of reduced bank lending. Ceteris paribus, labor supply shocks reduce wages for the job-seekers. Additionally, in most cases, blue-collar workers lose their tenure upon dismissal and start working at lower scales and thus, lower wages. These imply that following the closure of GM Antwerp, the availability of relatively skilled and cheaper blue-collar workers could substitute for costly capital at firms with high capital-labor substitution.[37] We also corroborate the evidence by Pezone (2023) who show that easier access to credit boosts employment for firms with low capital-labor substitution. With the sudden availability of relatively skilled and cheaper blue-collar workers, affected firms with easier access to credit supply could tap into credit to simultaneously hire additional labor and make complementary investments, and seize imminent growth opportunities.

We next inspect the investment, profitability, and productivity implications to have a better understanding of the transformative effects of credit supply and labor supply shocks depending on the firm-level capital-labor substitution.

[37] Blue-collar workers of the car manufacturing plant in Antwerp had a reputation for being highly versatile, hard-working, and relatively more skilled than most other blue-collar workers within GM ecosystem (Jacobs, 2019).

7 Investment, Profitability, and Total Labor Productivity

Investment. If firm-level capital-labor substitution plays a role in the employment effects of bank credit supply shocks following labor supply shocks, then we should simultaneously observe accommodating adjustments in the value of capital whenever possible. For each sub-sample, we use granular information on the tangible fixed assets and examine the adjustments in three categories: the value of land & buildings, plant & machinery, and furniture & vehicles. The dependent variables are the logarithms of the book values of these assets, so the coefficients measure the relative change in each asset category, which reflects net investment.

Table 6 presents the results from the estimation of a modified version of Equation 1, in which we replace the dependent variable with the logarithm of each category of tangible fixed assets, for firms with low capital-labor substitution. Columns (1) to (3) provide the investment outcomes for firms with higher credit supply. Following the labor supply shock, among firms with easier access to credit, affected firms expand their fixed assets more than unaffected ones. The point estimates are positive for all three categories, but only the increase in furniture and vehicles is statistically significant: affected firms with low capital-labor substitution and high credit supply expand their furniture and vehicles by about 19% relative to unaffected firms with low capital-labor substitution and high credit supply. The positive investment effect of labor supply shocks is absent among firms with low credit supply. Interestingly, affected firms with low capital-labor substitution and low credit supply reduce their furniture and vehicles by about 17% relative to unaffected firms with low capital-labor substitution and low credit supply (Columns (4) to (6) in Table 6).

[INSERT TABLE 6]

We next focus on the investment outcomes for the firms with high capital-labor substitution. Table 7 is analogous to Table 6 but the sample now consists only of firms with high capital-labor substitution. Among the firms with easier access to credit, affected firms with high capital-labor substitution make no additional investment compared to unaffected firms with high capital-labor substitution (Columns (1) to (3) in Table 7). Among the firms with relatively scarce credit, however, investment figures of affected and unaffected firms are substantially different. Compared to unaffected firms with low credit

supply, affected firms with low credit supply reduce land and buildings, plant and machinery, and furniture and vehicles by about 20%, 9%, and 17%, respectively (Columns (4) to (6) in Table 7).

[INSERT TABLE 7]

These findings have important implications for firms with low capital-labor substitution. First, our results are consistent with the availability of credit enabling the firms with low capital-labor substitution to complement employment with investment and seize imminent growth opportunities, in line with Pezone (2023). Complementary investments are particularly driven by increased investment in furniture and vehicles, in line with the tasks for which capital and blue-collar workers can be complementary. Interestingly, we do not observe any increase in the value of plant and machinery, which might mean that blue-collar workers might substitute for plant and machinery at least to some extent in firms with low capital-labor substitution.[38] Second, among the firms with low credit supply, affected firms with low capital-labor substitution reduce investment in furniture and vehicles compared to unaffected firms with low capital-labor substitution though they do not hire significantly more blue-collar workers than unaffected firms with low capital-labor substitution. Interestingly, the reduction in furniture and vehicles almost exactly corresponds to the additional investment in the same category by affected firms with high credit supply (-0.183 versus $+0.176$ log points). Given that affected firms with low credit supply and affected firms with high credit supply are located close - within a 50km radius of the closed manufacturing plant - by definition, our results might be indicative of business-to-business relations and the spillover effects of the closure of the large car manufacturing plant. Specifically, affected firms with high credit supply might be buying - or borrowing - the assets, particularly furniture and vehicles, of affected firms with low credit supply to seize growth opportunities while affected firms with low credit supply might be unable to seize imminent growth opportunities due to a lack of credit supply. Further, firms with relatively scarce credit might be trying to decelerate the reduction in profitability through sales/leasing of their assets that otherwise would have stayed idle.[39]

[38] The specific nature of how labor can interact with and potentially substitute for capital in production processes depends on the types of capital. Labor generally cannot replace fixed assets like land, buildings, furniture, and vehicles. Any substitution between capital and labor usually involves replacing plant and machinery with labor or vice versa.

[39] Firms that sell/lease their assets might also be those that downsize following the labor supply shocks. Gathmann et al. (2020) show that the closure of large manufacturing plants can have substantial negative spillover effects on firms that benefited from the existence of the large manufacturing plants. We however are limited by the availability of data to explore this dimension.

Our results also hold significant implications for firms with high capital-labor substitution. First, easier access to credit allows these firms to seize the opportunity to hire relatively skilled but cheaper blue-collar workers to grow without needing to substitute capital for labor, i.e. move outwards from one isoquant to another. Put differently, the additional employment, which by definition can act as a substitute for capital, does not necessarily lead to a reduction in any category of tangible fixed assets. In contrast, firms with low credit supply reduce all categories of tangible fixed assets following the additional employment after the labor supply shocks. This pattern is consistent with a shift toward a production strategy that favors labor over capital when credit is scarce, in line with Laeven et al. (2023). Two observations, however, call for caution. The largest reduction is in land and buildings, which labor generally cannot replace, and the reduction in furniture and vehicles is almost identical to that of credit-constrained firms with low capital-labor substitution (-0.185 versus -0.183 log points). The reduction in fixed assets may therefore also reflect the scarcity of credit itself, and not only the substitution of labor for capital. Finally, and importantly, the asset transfer mechanism from low credit to high credit firms that appears to be active among firms with low capital-labor substitution is absent for the firms with high capital-labor substitution.

Profitability. Our research reveals that the interplay of bank credit supply and labor supply shocks prompts and allows firms to modify their workforce, investment in fixed assets, and production strategy. The degree of these adjustments is largely influenced by the firms' inherent capital-labor substitution capacity. Such adjustments could be part of a strategic plan aimed at long-term growth or may represent more immediate, short-term objectives. To gain deeper insight into the drivers of these changes, we inspect the profitability outcomes for each sub-sample.

Table 8 presents the results from the estimation of a modified version of Equation 1, in which we replace the dependent variable with our profitability measure, i.e. the ratio of net income to total assets. We initially focus on the profitability outcomes for the firms with low capital-labor substitution. We find that affected firms with high credit supply do not experience higher profitability than unaffected firms with high credit supply (Column (1)). In contrast, among firms with low credit supply, affected firms experience 9.2 pp lower profitability than unaffected firms (Column (2)). Yet, the variation between the coefficients fails to achieve statistical significance.

[INSERT TABLE 8]

Next, we focus on firms with high capital-labor substitution. The labor supply shocks

do not cause higher profitability for affected firms with high credit supply than unaffected firms with high credit supply. In contrast, among firms with low credit supply, affected ones experience 10.8 pp higher profitability than unaffected firms. The difference between the coefficients for the high credit supply firms and the low credit supply firms, however, is not statistically significant.

Our findings reveal that the firms' workforce and physical capital adjustments might have important profitability implications. Affected firms with high capital-labor substitution and low credit supply are the only group of firms in our study sample whose profitability rises relative to unaffected firms in the short run, in line with Laeven et al. (2023), although this increase is not statistically different from that of firms with high credit supply. The strong employment effect among firms with high capital-labor substitution and low credit supply is accompanied by a strong reduction in all investment categories. With limited funding options, these firms may capitalize on the availability of skilled yet cost-effective blue-collar labor, opting for a more labor-intensive production and reducing reliance on costly fixed assets.[40] In contrast, firms with high capital-labor substitution and high credit supply don't experience this surge in profitability. These firms might consider labor supply shocks as an opportunity to gradually increase production capacity as part of a long-term strategy, and given that they are not financially constrained, they can utilize their financial flexibility to maintain their capital base instead of substituting it with labor.

Among firms with low capital-labor substitution, the positive employment effect of bank credit supply shocks is only evident for affected firms with high credit supply as easier access to bank credit enables them to make complementary investments, in line with Pezone (2023). These adjustments, however, do not translate into higher profitability, at least in the short run. Interestingly, among firms with low capital-labor substitution, affected firms experience a contraction in profitability compared to unaffected firms though the employment effect is not statistically different between the two groups. This contraction in profitability might be driven by the reduction in investments, specifically in furniture and vehicles, in response to the labor supply shock. These firms might initially raise additional funds through the sales/leasing of furniture and vehicles in the shorter run. But if labor was used to do the tasks furniture and vehicles did, this could have resulted in a contraction in labor productivity and reduced profitability in the longer run. Alternatively, and more realistically, firms with low capital-labor substi-

[40] Blue-collar workers cannot substitute for all the tasks that are performed by capital. For instance, the transportation of goods might heavily depend on the vehicles. The reduction in some sub-categories, such as furniture and vehicles, of fixed assets might be driven by the overall tendency to reduce fixed assets. We however do not have more granular information to confirm this hypothesis.

tution might assign the workers, whose complementary capital is sold/leased, to (new) tasks they can still be productive, but these tasks might be less profitable.

Our findings concerning profitability outcomes should be interpreted cautiously. Some firms might be willing to sacrifice short-term gains as part of a long-term strategy while others might choose to do the opposite. Our sample can only cover a period of 5 years in the post-treatment period, which might not be long enough to observe the profitability outcomes for the firms with a long-term strategy. Additionally, labor supply shocks are spread over a period of 4 years due to the initial restructuring process before the closure, and the major labor supply shock happens in 2010, a year before the end of our study period. Our post-treatment period might not be long enough to observe the profitability effects of this labor supply shock and even the short-run implications for firms that choose to hire in the last wave of labor supply shocks. Nevertheless, our findings shed light on some interesting patterns in the profitability effects of the labor supply and credit supply shocks. To have a more complete picture of the joint implications of credit supply and labor supply shocks, we next inspect the labor productivity implications.

Total labor productivity. The adaptation of production strategies in response to labor supply shocks can significantly influence productivity. Consider a scenario where capital and labor are complementary inputs: a reduction in either can markedly decrease the other's productivity. This productivity decline may lead to reduced profitability. To understand the impact of production strategy changes on productivity, we analyze labor productivity outcomes across the sub-samples.

Table 9 displays outcomes from estimating a modified version of Equation 1, in which we substitute the dependent variable with our measure for total labor productivity — the ratio of net added value to total employment. The results indicate that changes in production strategy do not significantly impact total labor productivity in any of the sub-samples.

[INSERT TABLE 9]

These findings carry significant implications. First, for firms with low capital-labor substitution, additional employment is complemented with investment if they have a high credit supply, but complementary investment and employment do not translate into higher total labor productivity. Interestingly, divestment by affected firms with low capital-labor substitution in the absence of sufficient bank credit does not reduce total labor productivity. This might support the fact that the divestment is primarily driven

by the sales or leasing of idle assets, implying ex-ante asset overhang. Alternatively, for firms with low capital-labor substitution and low credit supply, the contraction in fixed assets is exclusively driven by the reduction in furniture and vehicles, for which the tasks are unexpected to be taken over by the workforce. The change in the composition of fixed assets might have resulted in the assignment of workers who complemented these fixed assets to new - or other - tasks that are relatively less profitable. Such a change might then lead to a contraction in profitability with no implications for labor productivity. On the other hand, for firms with high capital-labor substitution, the absence of notable changes in total labor productivity is expected as capital and labor are more substitutable in these industries.

The evidence, however, is tentative and warrants a careful interpretation. Even if we obtain similar results using an alternative measure of total labor productivity, i.e. the ratio of net income to total employment, our measure of labor productivity cannot distinguish between the productivity of blue- and white-collar workers as we do not have information on the added value - or net income - by blue- and white-collar workers, separately. The labor supply shocks consist almost exclusively of blue-collar workers and the adjustments in the production strategy are therefore done through the adjustments in the number of blue-collar workers and capital that is primarily complementary to the blue-collar tasks.[41]

8 Robustness

To assess the sensitivity of our findings, we conduct several robustness checks. First, we employ two alternative sets of estimates for the elasticity of substitution between capital and labor. Second, we test the robustness of our results to alternative definitions of exposure to the labor supply shock. Next, we utilize a labor market tightness indicator to isolate labor supply from labor demand, aiding in identifying labor supply shocks. Finally, we use a different benchmark to classify firms into high and low credit supply categories.

Alternative measures for capital-labor substitution. To proxy the capital-labor substitutability in our sample firms, ideally, we would estimate the substitution elasticities be-

[41] If blue-collar workers could replace white-collar workers to take over white-collar tasks, we might have observed changes in the total labor productivity. This, however, might be unrealistic and to the best of our knowledge, there is no evidence for such a change in the literature, particularly for firms in developed countries like Belgium.

tween capital and labor at the firm level. This however is not applicable for two reasons. First, our capacity to calculate firm-level, or industry-level, elasticities within Belgium is considerably hampered by data limitations. Second, Belgium's stringent employment protection legislation could inhibit firms' transitions towards more capital-intensive production, even if such substitution were feasible. These constraints imply that the to-be-estimated elasticities of substitution between capital and labor might not accurately represent the true industry-specific elasticities.

A more feasible approach involves estimating the elasticities of capital-labor substitution in countries with less restrictive labor regulations. In our baseline regressions, we utilize the elasticity estimates between capital and labor provided by Laeven et al. (2023). These estimates are based on a sample of US firms spanning the period from 1940 to 2007. Considering that employment protection legislation in the US was nearly 18 times less stringent than in Belgium during this period and is among the least strict globally (OECD, 2023), these US-based estimates offer a more accurate empirical reflection of the true industry-specific elasticities of substitution.[42]

Yet, there is also considerable variation in capital-labor substitution estimates, some of which might be driven by publication bias (Gechert et al., 2022), found in existing literature (see Knoblach and Stöckl, 2020, for an extensive review). To address this variability and test the stability of our baseline results, we employ the estimates from Oberfield and Raval (2021) and Chirinko and Mallick (2017) in our robustness checks.

We first begin with the estimates of Oberfield and Raval (2021). These elasticity estimates are limited to a small set of US manufacturing industries, leading to a significant reduction in the sample size for our study. The results, presented in Table 10 where capital-labor substitution is measured by the estimates of Oberfield and Raval (2021), largely corroborate our baseline findings. Among firms with low capital-labor substitution, affected firms with high credit supply hire 5.3% more blue-collar workers than unaffected firms with high credit supply. This effect is absent among firms with low credit supply. A Wald test rejects the equality of the two coefficients at the 5% level, which supports the pattern in our baseline estimates that easier credit access is associated with higher employment in firms with low capital-labor substitution.

[INSERT TABLE 10]

Conversely, among firms with high capital-labor substitution, easier access to credit

[42]The applicability of US elasticity of substitution estimates between capital and labor to other countries hinges on the technological similarities across sectors between the US and these countries (Pezone, 2023). This condition holds as the production technologies across sectors are arguably similar between Belgium and the US.

does not translate into higher employment. Affected firms with high credit supply do not hire more blue-collar workers than unaffected firms with similar credit access. This lack of employment increase, particularly in our manufacturing firm sample, suggests that these firms might find capital accumulation a more profitable and productive route for growth rather than expanding labor. On the other hand, the employment effect is notably more pronounced among firms with low credit supply. In line with our baseline findings, affected firms with low credit supply hire 7.1% more blue-collar workers than unaffected firms with low credit supply.

Next, we apply the elasticity estimates from Chirinko and Mallick (2017), which, like Oberfield and Raval (2021), are based on US data for determining capital-labor substitution. These estimates encompass a broader range of industries, offering a more comprehensive comparison to our study's results. The outcomes, detailed in Table 11, are obtained by measuring capital-labor substitution using the estimates of Chirinko and Mallick (2017). The results follow the same pattern as our baseline findings using the estimates of Laeven et al. (2023). Among firms with low capital-labor substitution, affected firms with high credit supply hire 4.1% more blue-collar workers than unaffected firms, whereas the estimate for firms with low credit supply is 0.7% and not statistically significant, and the difference between the two coefficients is significant at the 10% level.

[INSERT TABLE 11]

Alternative treatment definitions. The decision to designate a 50km radius from a closed plant as the treatment range is based on evidence suggesting that travel beyond 1 hour can lead to severe negative symptoms.[43] However, it is possible that our findings are uniquely dependent on this specific 50km range. To address this concern, we examine the robustness of our results to different definitions of the treatment variable, $Affected_i$, in Equation 1. Initially, we reduce the treatment radius to 40km, with $Affected_i$ defined as 1 for firms within this 40km of the closed manufacturing plant (based on 2-digit postal codes) and 0 otherwise. Then, we expand the range to 60km and 70km and adjust $Affected_i$ accordingly. The analysis is replicated in Columns (1) to (4) of Table 12 using these alternate definitions. The results indicate minimal changes in both the coefficient of interest and its statistical significance, thus affirming the stability of our baseline findings. This test effectively rules out the possibility that our conclusions are exclusively reliant on a 50km radius from the closed plant. Additionally, comparing the coefficients of 50km (our preferred specification) and 70km treatments,

[43]Evidence suggests that the threshold for experiencing significant negative effects is approximately 1 hour of travel, roughly equivalent to a 40-60km distance (Christian, 2012; Urhonen et al., 2016).

we confirm that the treatment effect slowly fades away as we go further away from the event location.

[INSERT TABLE 12]

Treatment definitions based on distance from the GM Antwerp plant implicitly assume that all displaced workers lived within and sought employment in a specific radius—40 km, 50 km, 60 km, or 70 km, depending on the treatment definition—around the closed manufacturing facility. We test this assumption using granular data from the VDAB, which provides detailed information on the residential addresses (at the 4-digit postal code level) of all workers displaced by GM Antwerp. Leveraging this granular data, we develop an alternative treatment definition to evaluate the robustness of our results. Specifically, we define the treatment variable, $Affected_i$, in Equation 1, as equal to 1 for firms located in 4-digit postal codes where at least three displaced workers resided, and 0 for firms located in postal codes where no displaced workers resided.[44] The results of this analysis are presented in Column (5) of Table 12. Our findings using this alternative treatment closely align with those based on the 50 km radius treatment, thereby confirming the robustness of our 50 km treatment definition.

Labor market tightness and labor demand. A key challenge in our study is to effectively separate labor supply effects from those of labor demand even though the labor supply shocks resulting from the closure of GM Antwerp were initiated by the financial troubles of GM headquarters in the US and thus, were arguably exogenous. If firms affected by the labor supply shocks change their labor demand more than unaffected firms, then we might falsely treat the employment effects of the changes in the labor demand as the employment effects of the changes in labor supply. To mitigate this concern, we first include a large set of demand controls. We expect that time-varying firm-level variables that explain employment decisions can successfully account for the changes in firm-level labor demand. Additionally, we include estimated credit demand as an alternative control for the labor demand. We argue that these controls should successfully account for the changes in labor demand over time.

One might however argue that the employment effects are still driven by the changes in labor demand especially since we lack worker-level employment data. An alternative way to alleviate concerns regarding the isolation of labor supply from labor demand is to

[44] We also test the robustness of our findings by redefining the treatment variable, $Affected_i$, in Equation 1, as equal to 1 for firms located in 4-digit postal codes where at least one displaced worker resided, and 0 otherwise, and obtain similar results.

check the employment outcomes in tight labor markets. By definition, these markets are characterized by an excess demand for labor. Increases in labor demand in these markets would merely exacerbate the existing excess demand without altering employment levels. Therefore, for equilibrium employment to rise, the labor supply must increase. With this in mind, we use information on labor market tightness to check whether our findings are genuinely driven by labor supply shifts.

To test for this, we first proxy labor market tightness with labor cost growth across sectors in Belgium. A firm operates in a "tight" labor market if the ex-ante labor cost growth in the sector it operates is above the ex-ante median labor cost growth of the sample, and operates in a "slack" labor market if the ex-ante labor cost growth in the sector it operates is below the ex-ante median labor cost growth of the sample.

Table 13 shows the results from the estimation of Equation 1 for firms in tight labor markets and firms in slack labor markets. We find that affected firms in tight markets employ 5.6% more blue-collar workers than unaffected firms in tight markets (Column (1)). This effect is absent among affected and unaffected firms in slack markets (Column (2)). Indeed, the coefficient in tight markets is significantly larger than in slack markets. Given that equilibrium employment cannot increase without increases in labor supply, we conclude that we can successfully disentangle labor supply from labor demand, and our results are indeed driven by labor supply shocks.

[INSERT TABLE 13]

In addition, we use labor cost growth across sectors in the Netherlands as an alternative proxy for labor market tightness and similarly divide firms into categories of tight and slack labor markets with respect to this measure. The results, shown in Columns (3) and (4) of Table 13, indicate that affected firms in tight labor markets increase their blue-collar workforce by 4% more than unaffected firms in similar markets, whereas in slack markets, there is no significant difference in employment changes between affected and unaffected firms. The difference in coefficients is also statistically significant, implying substantially larger blue-collar employment in tight labor markets compared to slack ones. These results closely align with our previous findings using labor market tightness measure for the Belgian markets and reinforce our conclusion that we effectively isolate labor supply from labor demand.

Alternative credit supply benchmark. Our estimates of credit supply shocks are exogenous by construction. However, there might be concerns regarding the accuracy of categorizing firms into high and low credit supply groups based on industry bench-

marks, which could potentially misrepresent the actual credit access of firms. To address this issue, we revise our categorization approach. Instead of using industry benchmarks, we now classify a firm as "high" credit supply if its post-treatment bank credit supply shocks are above the median for the entire post-treatment sample, and as "low" credit supply if its post-treatment bank credit supply shocks are below this median.[45] The results of this reclassification, applied to Equation 1, are presented in Table 14. Affected firms in the high credit supply category employ 2.9% more blue-collar workers than their unaffected counterparts. Among firms with low credit supply, the employment effect remains significant, with affected firms employing 1.9% more blue-collar workers than unaffected ones. However, these coefficients are not statistically significantly different from each other, suggesting that credit access does not significantly impact employment for the average firm, corroborating our baseline findings.

[INSERT TABLE 14]

9 Conclusion

In this paper, we investigate the role of capital-labor substitution in the combined effects of credit supply and labor supply shocks. Specifically, we focus on understanding how factor substitution shapes the real effects of bank credit supply shocks in the presence of labor supply shocks. To undertake this analysis, we integrate detailed balance sheet, social balance sheet, and income statement data from Bel-first with confidential, matched bank-firm loan-level data from Belgium's Credit Registry. Additionally, we incorporate the estimates of elasticity of capital-labor substitution from the recent literature. Our final dataset encompasses over 63,000 firm-year observations, covering the years from 2003 to 2011.

We exploit the closure of a major car manufacturing plant in Belgium, which led to a significant increase in unemployed blue-collar workers, to identify the labor supply shock. We posit that firms located within a 50km radius of the closed plant are exposed to this labor supply shock, while those outside this range are not. To reinforce the validity of this identification, we implement several measures. First, we match affected and unaffected firms on ex-ante key observables to ensure comparable groups. Second, we exclude regions potentially impacted by other shocks and guarantee that the remaining

[45] This robustness check is only applicable for examining the credit supply mechanism, not for capital-labor substitution, as the elasticity estimates for capital-labor substitution are only available at the industry level.

firms are exposed to similar major shocks. Further, we incorporate a wide range of variables to control for firm-level variations in labor demand over time. Finally, we verify our identification with labor market tightness information. We disentangle credit supply from credit demand using industry-location-size-time fixed effects and bank-time fixed effects. This identification approach enables us to derive estimates of credit supply shocks for the entire sample.

We find that credit does not matter for employment on average. The average, however, masks differences across production technologies. Among firms with low capital-labor substitution, the employment response is concentrated among firms with easier access to credit, which also make complementary investments, but this does not generate additional profits or increase the productivity of labor. The difference between firms with easier and scarcer credit is not statistically significant with our baseline elasticity estimates, but it is with two alternative sets of estimates. These investments in low capital-labor substitution firms might be propelled by the divestment observed in similar firms lacking easy credit access. Conversely, for firms with high capital-labor substitution, easier access to credit does not affect employment levels but helps firms maintain their tangible assets. If credit supply is scarce, such firms reduce their tangible fixed assets, which may reflect a shift toward more labor-intensive production, although this does not change labor productivity.

Our findings carry important implications for understanding how quickly economies can absorb labor supply shocks and the extent to which credit supply shocks might influence unemployment levels. Our results suggest that credit supply influences the re-employment of displaced workers, with its impact depending on the level of capital-labor substitution within firms. Depending on a firm's ability to substitute or complement labor with capital, and its access to credit supply, affected firms alter their production techniques upon employment of displaced workers. The interplay between credit supply, labor supply, and capital-labor substitution not only influences employment and investment decisions but also holds consequential implications for the profitability of certain firms.

To check for the robustness of our findings, we first replace our elasticity of substitution measure with two alternative proxies from existing literature. This exercise takes the variations in the elasticity estimates in the literature into account. The pattern of our baseline findings holds with both alternative measures, and the difference between firms with easier and scarcer credit among firms with low capital-labor substitution is statistically significant with both. Next, we challenge our identification of the labor supply shock with alternative definitions of exposure: commuting radii of 40km, 60km, and

70km around the closed plant, and the residential locations of the displaced workers from the VDAB records. The key coefficient is stable for radii between 40km and 60km, smaller at 70km, and similar when we define exposure by residential locations, which indicates that our identification does not depend on a specific distance from the closed plant. Third, we further test the identification of labor supply shocks by utilizing labor market tightness information. By definition, tight markets are characterized by excess demand for labor. In such markets, the equilibrium employment level can increase only if the labor supply increases. We show that affected firms hire significantly more than unaffected firms in tight markets and this effect is not observed in slack markets, confirming the robustness of our identification. Finally, we also test the robustness of our benchmark for access to credit supply. To do so, we generate sample splits based on the post-treatment sample-median for credit supply shocks, instead of industry medians. Our findings remain consistent even after this test as well.

Our findings have important policy implications. Policies that support credit supply are often meant to support employment. Our results suggest that such policies raise hiring mainly where capital and labor are strong complements and firms can finance complementary investment, but may be ineffective where capital and labor are more substitutable. This distinction matters all the more because mass layoffs are anticipated to continue, and perhaps accelerate, in the coming years with advances in technology. Our results suggest that the reallocation of displaced workers following mass layoffs depends on both the availability of credit and capital-labor substitutability at the firm level. Put differently, access to credit and capital-labor substitutability are two significant determinants of how quickly the labor supply shocks will be absorbed by the local economy and what the implications for the hiring firms will be. For instance, startups and small-medium enterprises, which typically have the highest growth opportunities and are the main pillars of the job creation, are often credit-constrained or heavily dependent on a single bank. In the absence of sufficient credit, these firms, in which the displaced workers would likely be the most productive and profitable, might fail to hire the displaced workers. To avoid such - and potentially extended - efficiency losses, policymakers can take a number of measures. First, policymakers can establish programs, such as targeted subsidies, to ease credit constraints of firms that face, particularly layoff-induced, labor supply shocks. This can significantly improve the allocation of workers as with easier access to credit, affected firms with low capital-labor substitution can play an even more important role in the absorption of displaced workers while affected firms with high capital-labor substitution can continue their transition to a more capital-intensive production. Second, among affected firms with low capital-labor substitution,

hiring is concentrated among those with a high credit supply, which also make complementary investments in capital. Policymakers might attempt to support these firms' asset purchases with appropriate programs. Such programs, for instance, can facilitate the transfer of idle assets to these firms at a discount, improving their ability to absorb labor supply shocks further. Finally, affected firms with high capital-labor substitution hire, if anything, more workers when they face low credit supply, possibly because they are unable to finance the shift towards a more capital-intensive production technology. Though profitable in the short run, this might result in productivity losses in the long run. Policymakers can closely monitor the firms with high capital-labor substitution that are affected by labor supply shocks and provide them sufficient incentives for continued technology transition. This could include targeted technology adoption subsidies to ease their credit constraints and industry-specific assistance to facilitate a smoother adjustment to new production methods.

Our paper has some limitations as well. First, we are unable to calculate the elasticity of substitution between capital and labor at the individual firm level. Such detailed analysis could have provided more nuanced insights into each firm's ability to substitute or complement capital with labor, thereby enriching our arguments. Second, while the VDAB records locate the displaced workers, our analysis is at the firm level, so we do not study the consequences of the reallocation for the displaced workers themselves. Lastly, an extended time frame of post-treatment data would be beneficial. Longer-term data would facilitate an investigation into the enduring effects of both labor supply and credit supply shocks.

Our study paves the way for numerous future research opportunities. First, the rapid advancements in technology, particularly in artificial intelligence, suggest that capital-labor substitution dynamics may be evolving significantly in certain sectors. This evolution could unveil novel or shifting patterns in how credit supply shocks impact employment. Next, the pace of mass layoffs rapidly increases and is expected to continue in the upcoming decades, particularly for white-collar workers. Our findings for the blue-collar workers might extend to white-collar workers as well, but an investigation of the credit supply shocks and labor supply shocks that largely consist of white-collar workers through the lens of capital-labor substitution might reveal additional implications. Lastly, our research indicates indirect effects of labor supply and credit supply shocks on some firms, hinting at potential spillover effects. A thorough examination of these spillovers could offer a more comprehensive understanding of the implications of such shocks.

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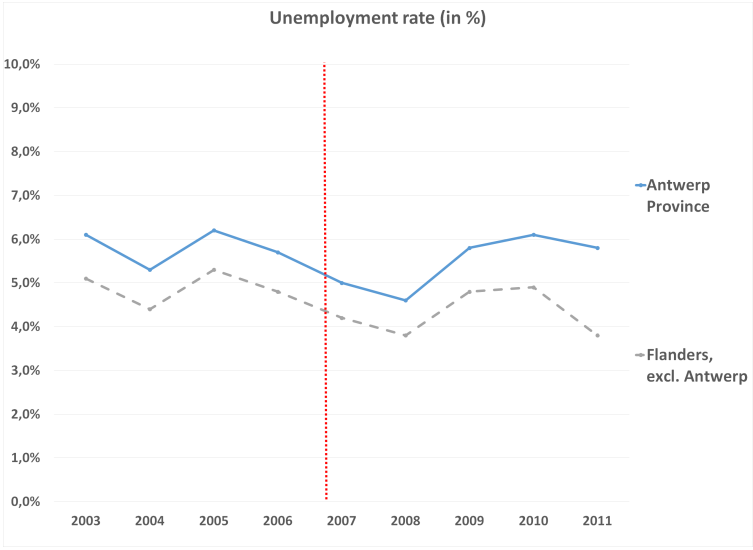
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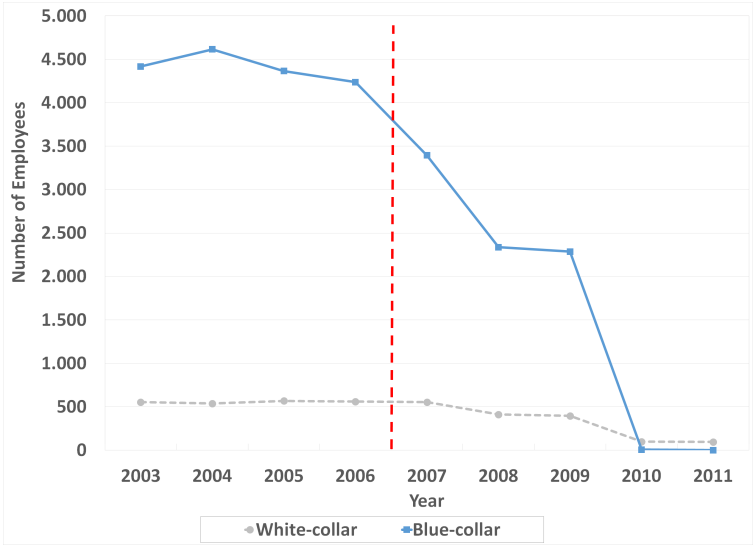
Tables and Figures

Figure 1: Unemployment rate in Antwerp province and the rest of Flanders



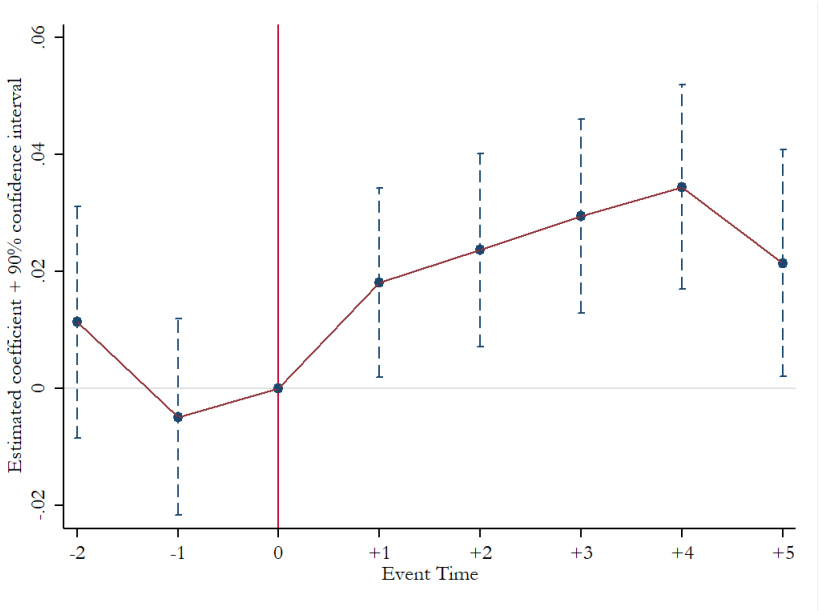
Notes: This figure plots the unemployment rate in the province of Antwerp and the rest of Flanders (excluding Antwerp) from 2003 to 2011. The red vertical dashed line separates the pre- and post-restructuring and closure periods.

Figure 2: GM Antwerp Number of Employees, by Collar Type



Notes: This figure plots the number of employees of GM Antwerp from 2003 to 2011, by collar type. The red vertical dashed line separates the pre- and post-restructuring and closure periods.

Figure 3: Parallel Trends Analysis



Notes: This figure plots coefficients from the regression of the natural log of blue-collar employment on indicator variables extending from 2003 to 2011, interacted with a dummy equal to 1 if a firm is within 50km of GM Antwerp and 0 otherwise. The reference year is 2005 and omitted so that coefficients are measured relative to 2005. Firm controls and firm fixed effects are included in the regression (see Equation 1). Dashed blue lines represent 90% confidence intervals with standard errors clustered at the firm level. The vertical red line separates the pre- and post-treatment periods.

Table 1: Descriptive Statistics for Key Variables

Panel A: Entire Sample						
	Obs	Mean	Std Dev	p25	Median	p75
Employment	63,739	11.28	11.30	4	7	14
Blue-collar Employment	63,739	8.40	8.37	3	5	11
Share of Blue-collar	63,739	0.78	0.24	0.67	0.86	1
Total Assets (M €)	63,739	1.41	1.81	0.46	0.90	1.73
Return on Assets	63,739	3.48	10.20	-0.11	2.76	7.74
Age	63,739	20.20	11.19	12	18	26
Leverage	63,739	0.68	0.26	0.52	0.69	0.83
Cash	63,739	0.12	0.13	0.02	0.07	0.17
Bank Credit Supply	63,739	0.5	0.5	0	0.5	1
Panel B: Affected Firms						
	Obs	Mean	Std Dev	p25	Median	p75
Employment	19,925	11.17	11.57	4	7	14
Blue-collar Employment	19,925	8.38	8.52	3	5	11
Share of Blue-collar	19,925	0.78	0.25	0.67	0.86	1
Total Assets (M €)	19,925	1.40	1.64	0.42	0.86	1.68
Return on Assets	19,925	3.55	10.58	-0.15	2.85	8.06
Age	19,925	20.63	11.81	12	18	26
Leverage	19,925	0.70	0.26	0.53	0.70	0.85
Cash	19,925	0.12	0.14	0.02	0.07	0.17
Bank Credit Supply	19,925	0.5	0.5	0	0.5	1
Panel C: Unaffected Firms						
	Obs	Mean	Std Dev	p25	Median	p75
Employment	43,484	11.33	11.18	4	7	14
Blue-collar Employment	43,484	8.41	8.30	3	5	11
Share of Blue-collar	43,484	0.78	0.24	0.66	0.86	1
Total Assets (M €)	43,484	1.44	1.88	0.48	0.91	1.76
Return on Assets	43,484	3.44	10.01	-0.09	2.73	7.57
Age	43,484	20.00	10.90	12	18	25
Leverage	43,484	0.68	0.25	0.52	0.69	0.82
Cash	43,484	0.12	0.13	0.02	0.07	0.17
Bank Credit Supply	43,484	0.5	0.5	0	0.5	1

Notes: This table reports the summary statistics for the key variables used in the empirical analysis for the entire sample, affected firms, and unaffected firms after matching affected and unaffected firms using propensity score matching with replacement. A firm is assumed to be "affected" if it is located within the 50km radius around the closed plant, and unaffected otherwise. Share of Blue is the share of blue-collar workers in total employment. Return on Assets is the ratio of profits for the period to total assets. Leverage is the ratio of total debt to total assets. Cash is the ratio of cash and cash equivalent to total assets. Bank credit supply is a firm-level dummy that takes the value 1 if the post-treatment bank credit supply of a firm is above the post-treatment median bank credit supply in its industry and 0 otherwise.

Table 2: Employment

	Blue-collar Employment			
	(1)	(2)	(3)	(4)
Post	0.083***	-0.041***		
	(0.009)	(0.008)		
Affected	-0.043***	-0.023**	-0.023**	
	(0.013)	(0.012)	(0.012)	
Post x Affected	**0.030***	**0.033****	**0.033****	**0.024*****
	(0.016)	(0.015)	(0.015)	(0.006)
Credit Demand		0.225***	0.226***	0.027***
		(0.019)	(0.019)	(0.008)
Total Assets		0.406***	0.406***	0.270***
		(0.004)	(0.004)	(0.007)
Age		0.070***	0.071***	0.174***
		(0.006)	(0.006)	(0.015)
Leverage		0.264***	0.263***	-0.045***
		(0.016)	(0.016)	(0.015)
Return on Assets		0.002***	0.002***	0.002***
		(0.000)	(0.000)	(0.000)
Cash		0.219***	0.222***	-0.002
		(0.028)	(0.029)	(0.020)
Year Fixed Effects			Yes	Yes
Firm Fixed Effects				Yes
Observations	63,739	63,739	63,739	63,739
R-squared	0.003	0.183	0.183	0.908

Notes: This table presents the results for the estimation of four different specifications of Equation 1. Column (1) provides the results of estimating the equation with no controls and fixed effects. In Columns (2), (3), and (4), controls, controls and time fixed effects, and controls, time and firm fixed effects are added, respectively. The dependent variable is the natural log of blue-collar employment. Affected is a dummy variable that is 1 if a firm is located within 50km of the closed plant and 0 otherwise. Post is a dummy variable that is 1 for the post-treatment period and 0 for the pre-treatment period. All control variables, except exogenous credit demand, are lagged by one year. Standard errors are clustered at the firm level and are in parentheses. Adjusted *R*-squareds are reported. Further information about the variables can be found in Appendix A. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Factor substitution channel

	Blue-collar Employment					
	Sorting by					
	Capital-labor substitution					
	Laeven et al. (2023)		Chirinko and Mallick (2017)		Oberfield and Raval (2021)	
	Low	High	Low	High	Low	High
	(1)	(2)	(3)	(4)	(5)	(6)
Post x Affected	**0.017***	**0.034*****	**0.024****	**0.050*****	**0.008**	**0.030***
	(0.009)	(0.008)	(0.009)	(0.012)	(0.018)	(0.018)
Equality test	$p = 0.16$		$p = 0.08$		$p = 0.39$	
Credit Demand	0.026**	0.029***	0.042***	-0.029	0.058***	0.041**
	(0.012)	(0.011)	(0.011)	(0.022)	(0.018)	(0.019)
Total Assets	0.234***	0.310***	0.294***	0.239***	0.293***	0.347***
	(0.009)	(0.009)	(0.010)	(0.014)	(0.018)	(0.019)
Age	0.177***	0.172***	0.234***	0.093***	0.300***	0.201***
	(0.021)	(0.020)	(0.023)	(0.032)	(0.040)	(0.047)
Leverage	-0.011	-0.093***	0.007	-0.030	-0.077*	0.018
	(0.021)	(0.022)	(0.022)	(0.035)	(0.044)	(0.045)
Return on Assets	0.002***	0.001***	0.001***	0.003***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Cash	0.025	-0.024	0.014	0.057	-0.077	0.007
	(0.031)	(0.025)	(0.032)	(0.047)	(0.053)	(0.061)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	31,914	31,825	26,008	17,784	6,154	5,849
R-squared	0.901	0.909	0.905	0.879	0.925	0.922

Notes: This table presents the results for the estimation of Equation 1 for two sub-samples with respect to capital-labor substitution, respectively. The proxy for capital-labor substitution at the firm-level is based on the industry-level estimates of elasticity of substitution between capital and labor by Laeven et al. (2023) in Columns (1) and (2); the industry-level estimates of elasticity of substitution between capital and labor by Chirinko and Mallick (2017) in Columns (3) and (4); and the industry-level estimates of elasticity of substitution between capital and labor by Oberfield and Raval (2021) in Columns (5) and (6). The benchmark for capital-labor substitution is the median elasticity of substitution between capital and labor. A firm has a "high" capital-labor substitution if its elasticity of substitution between capital and labor is above the median and a "low" capital-labor substitution if its elasticity of substitution between capital and labor is below the median. The dependent variable is the natural log of blue-collar employment. Affected is a dummy variable that is 1 if a firm is located within 50km of the closed plant and 0 otherwise. Post is a dummy variable that is 1 for the post-treatment period and 0 for the pre-treatment period. Control variables include estimated credit demand, natural log of total assets, age and leverage, return on assets and cash ratio. All control variables, except exogenous credit demand, are lagged by one year. All regressions include firm fixed and year fixed effects. Wald test is used to test the equality of coefficient estimates. Standard errors are clustered at the firm level and are in parentheses. Adjusted R-squareds are reported. Further information about variables and the distribution of industries with respect to the extent of factor substitution can be found in Appendix A and Appendix B, respectively. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Bank credit supply channel

	Blue-collar Employment	
	Sorting by	
	Bank Credit Supply	
	Low	High
	(1)	(2)
Post x Affected	**0.022*** **	**0.027*** **
	(0.008)	(0.009)
Equality test	p = 0.68	
Credit Demand	0.020	0.033***
	(0.012)	(0.011)
Total Assets	0.265***	0.275***
	(0.009)	(0.009)
Age	0.197***	0.151***
	(0.020)	(0.021)
Leverage	-0.029	-0.061***
	(0.022)	(0.022)
Return on Assets	0.002***	0.001***
	(0.000)	(0.000)
Cash	0.015	-0.020
	(0.028)	(0.028)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	32,174	31,565
R-squared	0.903	0.913

Notes: This table presents the results for the estimation of Equation 1 for two sub-samples with respect to bank credit supply, respectively. The proxy for bank credit supply is the bank credit supply estimated by using matched bank-firm loan-level data following Degryse et al. (2019). The benchmark for bank credit supply is the post-treatment median bank credit supply within each industry. A firm has a "high" bank credit supply if its post-treatment bank credit supply is above the benchmark and a "low" credit supply if its post-treatment credit supply is below the benchmark. The dependent variable is the natural log of blue-collar employment. Affected is a dummy variable that is 1 if a firm is located within 50km of the closed plant and 0 otherwise. Post is a dummy variable that is 1 for the post-treatment period and 0 for the pre-treatment period. Control variables include estimated credit demand, natural log of total assets, age, leverage, return on assets, and cash ratio. All control variables, except exogenous credit demand, are lagged by one year. All regressions include firm fixed and year fixed effects. Wald test is used to test the equality of coefficient estimates. Standard errors are clustered at the firm level and are in parentheses. Adjusted R-squareds are reported. Further information about variables can be found in Appendix A. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Bank credit supply and capital-labor substitution channels

	Blue-collar Employment			
	Sorting by			
	Capital-labor substitution			
	Low substitution		High substitution	
	High credit	Low credit	High credit	Low credit
	(1)	(2)	(3)	(4)
Post x Affected	**0.028****	**0.008**	**0.031*****	**0.038*****
	(0.013)	(0.012)	(0.012)	(0.011)
Equality test	$p = 0.26$		$p = 0.67$	
Firm Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	15,701	16,213	15,864	15,961
R-squared	0.905	0.897	0.913	0.904

Notes: This table presents the results for the estimation of Equation 1 for four sub-samples with respect to capital-labor substitution and bank credit supply, respectively. The proxy for capital-labor substitution at the firm level is based on the industry-level estimates of the elasticity of substitution between capital and labor by Laeven et al. (2023). The benchmark for capital-labor substitution is the median elasticity of substitution between capital and labor. A firm has a "high" capital-labor substitution if its elasticity of substitution between capital and labor is above the median and a "low" capital-labor substitution if its elasticity of substitution between capital and labor is below the median. The proxy for bank credit supply is the bank credit supply estimated by using matched bank-firm loan-level data following Degryse et al. (2019). The benchmark for bank credit supply is the post-treatment median bank credit supply within each industry. A firm has a "high" bank credit supply if its post-treatment bank credit supply is above the benchmark and a "low" credit supply if its post-treatment credit supply is below the benchmark. The dependent variable is the natural log of blue-collar employment. Affected is a dummy variable that is 1 if a firm is located within 50km of the closed plant and 0 otherwise. Post is a dummy variable that is 1 for the post-treatment period and 0 for the pre-treatment period. Control variables include estimated credit demand, natural log of total assets, age, leverage, return on assets, and cash ratio. All control variables, except exogenous credit demand, are lagged by one year. All regressions include firm fixed and year fixed effects. Wald test is used to test the equality of coefficient estimates. Standard errors are clustered at the firm level and are in parentheses. Adjusted *R*-squareds are reported. Further information about variables and the distribution of industries with respect to the extent of factor substitution can be found in Appendix A and Appendix B, respectively. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Tangible Fixed Assets Decomposition - Low Capital-Labor Substitution

	Low capital-labor substitution					
	Sorting by					
	High credit			Low credit		
	Land & Buildings (1)	Plant & Machinery (2)	Furniture & Vehicles (3)	Land & Buildings (4)	Plant & Machinery (5)	Furniture & Vehicles (6)
Post x Affected	**0.125**	**0.022**	**0.176*** **	**-0.100**	**-0.066**	**-0.183*** **
	(0.086)	(0.054)	(0.060)	(0.075)	(0.049)	(0.054)
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,701	15,701	15,701	16,213	16,213	16,213
R-squared	0.895	0.778	0.664	0.899	0.778	0.661

Notes: This table presents the results for the estimation of Equation 1 using three dependent variables for two sub-samples with respect to and bank credit supply. The proxy for capital-labor substitution at the firm level is based on the industry-level estimates of the elasticity of substitution between capital and labor by Laeven et al. (2023). The benchmark for capital-labor substitution is the median elasticity of substitution between capital and labor. A firm has a "high" capital-labor substitution if its elasticity of substitution between capital and labor is above the median and a "low" capital-labor substitution if its elasticity of substitution between capital and labor is below the median. The proxy for bank credit supply is the bank credit supply estimated by using matched bank-firm loan-level data following Degryse et al. (2019). The benchmark for bank credit supply is the post-treatment median bank credit supply within each industry. A firm has a "high" bank credit supply if its post-treatment bank credit supply is above the benchmark and a "low" credit supply if its post-treatment credit supply is below the benchmark. The dependent variable is the natural log of land and buildings (Column (1)), plant and machinery (Column (2)), and furniture and vehicles (Column (3)). Affected is a dummy variable that is 1 if a firm is located within 50km of the closed plant and 0 otherwise. Post is a dummy variable that is 1 for the post-treatment period and 0 for the pre-treatment period. Control variables include estimated credit demand, natural log of total assets, age, leverage, return on assets, and cash ratio. All control variables, except exogenous credit demand, are lagged by one year. All regressions include firm fixed and year fixed effects. The sample of this table consists only of firms with low capital-labor substitution. Standard errors are clustered at the firm level and are in parentheses. Adjusted *R*-squareds are reported. Further information about variables and the distribution of industries with respect to the extent of factor substitution can be found in Appendix A and Appendix B, respectively. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Tangible Fixed Assets Decomposition - High Capital-Labor Substitution

	High capital-labor substitution					
	Sorting by					
	High credit			Low credit		
	Land & Buildings (1)	Plant & Machinery (2)	Furniture & Vehicles (3)	Land & Buildings (4)	Plant & Machinery (5)	Furniture & Vehicles (6)
Post x Affected	**0.009**	**-0.008**	**-0.010**	**-0.220*****	**-0.092***	**-0.185*****
	(0.085)	(0.056)	(0.054)	(0.080)	(0.049)	(0.050)
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,864	15,864	15,864	15,961	15,961	15,961
R-squared	0.881	0.782	0.656	0.878	0.792	0.680

Notes: This table presents the results for the estimation of Equation 1 using three dependent variables for two sub-samples with respect to and bank credit supply. The proxy for capital-labor substitution at the firm level is based on the industry-level estimates of the elasticity of substitution between capital and labor by Laeven et al. (2023). The benchmark for capital-labor substitution is the median elasticity of substitution between capital and labor. A firm has a "high" capital-labor substitution if its elasticity of substitution between capital and labor is above the median and a "low" capital-labor substitution if its elasticity of substitution between capital and labor is below the median. The proxy for bank credit supply is the bank credit supply estimated by using matched bank-firm loan-level data following Degryse et al. (2019). The benchmark for bank credit supply is the post-treatment median bank credit supply within each industry. A firm has a "high" bank credit supply if its post-treatment bank credit supply is above the benchmark and a "low" credit supply if its post-treatment credit supply is below the benchmark. The dependent variable is the natural log of land and buildings (Column (1)), plant and machinery (Column (2)), and furniture and vehicles (Column (3)). Affected is a dummy variable that is 1 if a firm is located within 50km of the closed plant and 0 otherwise. Post is a dummy variable that is 1 for the post-treatment period and 0 for the pre-treatment period. Control variables include estimated credit demand, natural log of total assets, age, leverage, return on assets, and cash ratio. All control variables, except exogenous credit demand, are lagged by one year. All regressions include firm fixed and year fixed effects. The sample of this table consists only of firms with high capital-labor substitution. Standard errors are clustered at the firm level and are in parentheses. Adjusted *R*-squareds are reported. Further information about variables and the distribution of industries with respect to the extent of factor substitution can be found in Appendix A and Appendix B, respectively. *** p<0.01, ** p<0.05, * p<0.1

Table 8: Profitability

	Profitability			
	Sorting by			
	Capital-labor substitution			
	Low substitution		High substitution	
	High credit (1)	Low credit (2)	High credit (3)	Low credit (4)
Post x Affected	**-0.039**	**-0.092***	**0.010**	**0.108****
	(0.061)	(0.055)	(0.056)	(0.052)
Equality test	$p = 0.52$		$p = 0.20$	
Firm Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	15,696	16,210	15,857	15,950
R-squared	0.297	0.299	0.283	0.275

Notes: This table presents the results for the estimation of Equation 1 for four sub-samples with respect to capital-labor substitution and bank credit supply, respectively. The proxy for capital-labor substitution at the firm level is based on the industry-level estimates of the elasticity of substitution between capital and labor by Laeven et al. (2023). The benchmark for capital-labor substitution is the median elasticity of substitution between capital and labor. A firm has a "high" capital-labor substitution if its elasticity of substitution between capital and labor is above the median and a "low" capital-labor substitution if its elasticity of substitution between capital and labor is below the median. The proxy for bank credit supply is the bank credit supply estimated by using matched bank-firm loan-level data following Degryse et al. (2019). The benchmark for bank credit supply is the post-treatment median bank credit supply within each industry. A firm has a "high" bank credit supply if its post-treatment bank credit supply is above the benchmark and a "low" credit supply if its post-treatment credit supply is below the benchmark. The dependent variable is the natural log of return on assets, measured by the ratio of profit (loss) for the period to total assets. Affected is a dummy variable that is 1 if a firm is located within 50km of the closed plant and 0 otherwise. Post is a dummy variable that is 1 for the post-treatment period and 0 for the pre-treatment period. Control variables include estimated credit demand, natural log of total assets, age, leverage, return on assets, and cash ratio. All control variables, except exogenous credit demand, are lagged by one year. All regressions include firm fixed and year fixed effects. Wald test is used to test the equality of coefficient estimates. Standard errors are clustered at the firm level and are in parentheses. Adjusted *R*-squareds are reported. Further information about variables and the distribution of industries with respect to the extent of factor substitution can be found in Appendix A and Appendix B, respectively. *** p<0.01, ** p<0.05, * p<0.1

Table 9: Labor productivity

	Labor Productivity			
	Sorting by			
	Capital-labor substitution			
	Low substitution		High substitution	
	High credit (1)	Low credit (2)	High credit (3)	Low credit (4)
Post x Affected	**-0.014**	**-0.005**	**-0.006**	**0.001**
	(0.011)	(0.010)	(0.009)	(0.009)
Equality test	p = 0.54		p = 0.58	
Firm Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	15,701	16,213	15,864	15,961
R-squared	0.732	0.732	0.736	0.698

Notes: This table presents the results for the estimation of Equation 1 for four sub-samples with respect to capital-labor substitution and bank credit supply, respectively. The proxy for capital-labor substitution at the firm level is based on the industry-level estimates of the elasticity of substitution between capital and labor by Laeven et al. (2023). The benchmark for capital-labor substitution is the median elasticity of substitution between capital and labor. A firm has a "high" capital-labor substitution if its elasticity of substitution between capital and labor is above the median and a "low" capital-labor substitution if its elasticity of substitution between capital and labor is below the median. The proxy for bank credit supply is the bank credit supply estimated by using matched bank-firm loan-level data following Degryse et al. (2019). The benchmark for bank credit supply is the post-treatment median bank credit supply within each industry. A firm has a "high" bank credit supply if its post-treatment bank credit supply is above the benchmark and a "low" credit supply if its post-treatment credit supply is below the benchmark. The dependent variable is the total labor productivity, measured by the ratio of net added value to total employment. Affected is a dummy variable that is 1 if a firm is located within 50km of the closed plant and 0 otherwise. Post is a dummy variable that is 1 for the post-treatment period and 0 for the pre-treatment period. Control variables include estimated credit demand, natural log of total assets, age, leverage, return on assets, and cash ratio. All control variables, except exogenous credit demand, are lagged by one year. All regressions include firm fixed and year fixed effects. Wald test is used to test the equality of coefficient estimates. Standard errors are clustered at the firm level and are in parentheses. Adjusted R-squareds are reported. Further information about variables and the distribution of industries with respect to the extent of factor substitution can be found in Appendix A and Appendix B, respectively. *** p<0.01, ** p<0.05, * p<0.1

Table 10: Alternative I: Capital-labor substitution measure

	Blue-collar Employment			
	Sorting by			
	Capital-labor substitution			
	Low substitution		High substitution	
	High credit (1)	Low credit (2)	High credit (3)	Low credit (4)
Post x Affected	**0.053****	**-0.032**	**-0.015**	**0.071*****
	(0.026)	(0.025)	(0.027)	(0.024)
Equality test	p = 0.02		p = 0.02	
Firm Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	3,029	3,125	2,911	2,938
R-squared	0.927	0.923	0.926	0.920

Notes: This table presents the results for the estimation of Equation 1 for four sub-samples with respect to capital-labor substitution and bank credit supply, respectively. The proxy for capital-labor substitution at the firm level is based on the estimates by Oberfield and Raval (2021). The estimates are only available for firms in certain 3-digit manufacturing industries. The benchmark for capital-labor substitution is the median elasticity of substitution between capital and labor for available 3-digit manufacturing industries. A firm has a "high" capital-labor substitution if its elasticity of substitution between capital and labor is above the median and a "low" capital-labor substitution if its elasticity of substitution between capital and labor is below the median. The proxy for bank credit supply is the bank credit supply estimated by using matched bank-firm loan-level data following Degryse et al. (2019). The benchmark for bank credit supply is the post-treatment median bank credit supply within each industry. A firm has a "high" bank credit supply if its post-treatment bank credit supply is above the benchmark and a "low" credit supply if its post-treatment credit supply is below the benchmark. The dependent variable is the natural log of blue-collar employment. Affected is a dummy variable that is 1 if a firm is located within 50km of the closed plant and 0 otherwise. Post is a dummy variable that is 1 for the post-treatment period and 0 for the pre-treatment period. Control variables include estimated credit demand, natural log of total assets, age, leverage, return on assets, and cash ratio. All control variables, except exogenous credit demand, are lagged by one year. All regressions include firm fixed and year fixed effects. Wald test is used to test the equality of coefficient estimates. Standard errors are clustered at the firm level and are in parentheses. Adjusted R-squareds are reported. Further information about variables and the distribution of industries with respect to the extent of factor substitution can be found in Appendix A and Appendix B, respectively. *** p<0.01, ** p<0.05, * p<0.1

Table 11: Alternative II: Capital-labor substitution measure

	Blue-collar Employment			
	Sorting by			
	Capital-labor substitution			
	Low substitution		High substitution	
	High credit	Low credit	High credit	Low credit
	(1)	(2)	(3)	(4)
Post x Affected	**0.041*****	**0.007**	**0.042****	**0.058*****
	(0.014)	(0.013)	(0.017)	(0.017)
Equality test	$p = 0.08$		$p = 0.51$	
Firm Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	12,898	13,110	8,708	9,076
R-squared	0.906	0.904	0.888	0.872

Notes: This table presents the results for the estimation of Equation 1 for four sub-samples with respect to capital-labor substitution and bank credit supply, respectively. The proxy for capital-labor substitution at the firm level is based on the estimates of elasticity of substitution between capital and labor by Chirinko and Mallick (2017). The estimates are only available for firms in certain industries. The benchmark for capital-labor substitution is the median capital-labor substitution across available industries. A firm has a "high" capital-labor substitution if its estimate for capital-labor substitution is above the median and a "low" capital-labor substitution if its estimate for capital-labor substitution is below the median. The proxy for bank credit supply is the bank credit supply estimated by using matched bank-firm loan-level data following Degryse et al. (2019). The benchmark for bank credit supply is the post-treatment median bank credit supply within each industry. A firm has a "high" bank credit supply if its post-treatment bank credit supply is above the benchmark and a "low" credit supply if its post-treatment credit supply is below the benchmark. The dependent variable is the natural log of blue-collar employment. Affected is a dummy variable that is 1 if a firm is located within 50km of the closed plant and 0 otherwise. Post is a dummy variable that is 1 for the post-treatment period and 0 for the pre-treatment period. Control variables include estimated credit demand, natural log of total assets, age, leverage, return on assets, and cash ratio. All control variables, except exogenous credit demand, are lagged by one year. All regressions include firm fixed and year fixed effects. Wald test is used to test the equality of coefficient estimates. Standard errors are clustered at the firm level and are in parentheses. Adjusted *R*-squareds are reported. Further information about variables and the distribution of industries with respect to the extent of factor substitution can be found in Appendix A and Appendix B, respectively. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 12: Alternative Treatment Definitions

	Blue-collar Employment				
	40km	50km	60km	70km	Residential
	(1)	(2)	(3)	(4)	(5)
Post x Affected	**0.023*** **	**0.024*** **	**0.023*** **	**0.016*** **	**0.017*** **
	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
Firm Controls	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	63,739	63,739	63,739	63,739	63,739
R-squared	0.908	0.908	0.908	0.908	0.908

Notes: This table presents the results for the estimation of Equation 1 for five treatment definitions: radii of 40km, 50km, 60km, and 70km around the closed plant, and the residential locations of the displaced workers. The dependent variable is the natural log of blue-collar employment. Affected is a dummy variable that is 1 if a firm is located within 40km of the closed plant and 0 otherwise (Column (1)); that is 1 if a firm is located within 50km of the closed plant and 0 otherwise (Column (2)); that is 1 if a firm is located within 60km of the closed plant and 0 otherwise (Column (3)); and that is 1 if a firm is located within 70km of the closed plant and 0 otherwise (Column (4)); and that is 1 for firms that are located in the 4-digit postcodes where at least 3 displaced workers resided and 0 for firms that are located in the 4-digit postcodes where no displaced worker resided (Column 5). Post is a dummy variable that is 1 for the post-treatment period and 0 for the pre-treatment period. Control variables include estimated credit demand, natural log of total assets, age, leverage, return on assets, and cash ratio. All control variables, except exogenous credit demand, are lagged by one year. All regressions include firm fixed and year fixed effects. Standard errors are clustered at the firm level and are in parentheses. Adjusted *R*-squareds are reported. Further information about variables can be found in Appendix A. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 13: Labor Market Tightness

	Blue-collar Employment			
	Sorting by			
	Labor Cost Growth for BE		Labor Cost Growth for NL	
	Tight	Slack	Tight	Slack
	(1)	(2)	(3)	(4)
Post x Affected	**0.056*** **	**0.008**	**0.040*** **	**0.010**
	(0.010)	(0.009)	(0.010)	(0.007)
Equality test	p = 0.00		p = 0.01	
Firm Controls	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	20,372	26,538	28,742	34,997
R-squared	0.911	0.898	0.894	0.915

Notes: This table presents the results for the estimation of Equation 1 for two sub-samples with respect to labor market tightness. The proxies for labor market tightness are the labor cost growth in Belgium (Columns (1) and (2)) and the labor cost growth in the Netherlands (Columns (3) and (4)). The benchmark for labor market tightness is the ex-ante median of the sample for both measures. A firm operates in a "tight" labor market if the ex-ante total labor cost growth in the sector it operates is above the benchmark. A firm operates in a "slack" labor market if the ex-ante total labor cost growth in the sector it operates is below the benchmark. The dependent variable is the natural log of blue-collar employment. Affected is a dummy variable that is 1 if a firm is located within 50km of the closed plant and 0 otherwise. Post is a dummy variable that is 1 for the post-treatment period and 0 for the ex-ante period. Control variables include estimated credit demand, natural log of total assets, age, leverage, return on assets, and cash ratio. All control variables, except exogenous credit demand, are lagged by one year. All regressions include firm fixed and year fixed effects. Wald test is used to test the equality of coefficient estimates. Standard errors are clustered at the firm level and are in parentheses. Adjusted R-squareds are reported. Further information about variables can be found in Appendix A. *** p<0.01, ** p<0.05, * p<0.1

Table 14: Alternative benchmark for bank credit supply channel

	Blue-collar Employment	
	Sorting by	
	Bank Credit Supply	
	Low	High
	(1)	(2)
Post x Affected	**0.019****	**0.029*****
	(0.008)	(0.009)
Equality test	p = 0.41	
Firm Controls	Yes	Yes
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	32,376	31,363
R-squared	0.905	0.911

Notes: This table presents the results for the estimation of Equation 1 for two sub-samples with respect to bank credit supply, respectively. The proxy for bank credit supply is the bank credit supply estimated by using matched bank-firm loan-level data following Degryse et al. (2019). The benchmark for bank credit supply is the post-treatment median bank credit supply of the sample, instead of industry. A firm has a "high" bank credit supply if its post-treatment bank credit supply is above the benchmark and a "low" credit supply if its post-treatment credit supply is below the benchmark. The dependent variable is the natural log of blue-collar employment. Affected is a dummy variable that is 1 if a firm is located within 50km of the closed plant and 0 otherwise. Post is a dummy variable that is 1 for the post-treatment period and 0 for the pre-treatment period. Control variables include estimated credit demand, natural log of total assets, age, leverage, return on assets, and cash ratio. All control variables, except exogenous credit demand, are lagged by one year. All regressions include firm fixed and year fixed effects. Wald test is used to test the equality of coefficient estimates. Standard errors are clustered at the firm level and are in parentheses. Adjusted R-squareds are reported. Further information about variables can be found in Appendix A. *** p<0.01, ** p<0.05, * p<0.1

APPENDIX

How Credit Availability and Production Technologies Shape Hiring: Evidence from a Plant Closure*

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A Data Sources and Definitions

Table 15: Balance Sheet Data

Panel A. Social Balance Sheet Data		
Variable	Definition	Source
Blue-Collar Employment	The number of blue-collar employees.	Bel-first
Share of Blue-Collar	Blue-Collar Employment / Total Employment	
Total Employment	The total number of employees = Management + Blue-collar workers + White-collar workers + Other	
White-Collar Employment	The number of white-collar employees.	
Panel B. Financial Balance Sheet Data		
Variable	Definition	Source
Age	Panel Year minus Incorporation Year	Bel-first
Cash & Cash Equivalent	Cash or Equivalent (all immediate negotiable medium of exchange or instrument normally accepted by banks for deposits and immediate credit to a customer account) and short-term investment (quoted and unquoted) that can be realized on short notice. The unit of measurement is Euro.	
Cash ratio	Cash & Cash Equivalent / Total Assets	
Land & Buildings	Land and Buildings. The unit of measurement is Euro.	
Leverage	Total Debt / Total Assets	
Long-term Debt	Debts payable after 1 year.	
Plant & Machinery	Plant and Machinery. The unit of measurement is Euro.	
Size	The natural log of Total Assets	
Short-term Debt	Debts payable within 1 year.	
Tangible Fixed Assets	The book value of the total amount (after depreciation) of tangible assets on the balancing date and consists of three sub-categories: plant and machinery, vehicles and furniture, and land and buildings. The unit of measurement is Euro.	
Total Assets	The book value of total assets. The unit of measurement is Euro.	
Total Debt	Short-term Debt + Long-term Debt. The unit of measurement is Euro.	
Vehicles & Furniture	Vehicles and Furniture. The unit of measurement is Euro.	
Notes: All variables represent the values on the balancing date.		

Table 16: Income Statement Data

Variable	Definition	Source
Net Added Value	Staff costs + Profit (loss) for period + Taxation + Interest Expenses. The unit of measurement is Euro.	Bel-first
Profitability	Profit (loss) for the period / Total Assets	
Profit (loss) for Period	The net income for the year. It is calculated before the deduction of minority interests if any (profit after taxation plus extraordinary and other profit). The unit of measurement is Euro.	
Return on Assets	Profit (loss) for Period / Total Assets	
Total Labor Productivity	Net Added Value / Total Employment	
Notes: All variables represent the values on the balancing date.		

Table 17: Bank Credit, Distance, Tightness & Worker Characteristics Data

Variable	Definition	Source
2-digit Postal Codes	2-digit postal code of the firm location. This variable is time-invariant.	Bel-first
Bank Credit Supply	Credit supply is proxied by bank credit supply estimated using matched bank-firm loan-level data following Degryse et al. (2019).	Credit Registry of Belgium
Credit Demand	Credit demand is proxied by credit demand estimated using matched bank-firm loan-level data following Degryse et al. (2019).	Credit Registry of Belgium
Distance	Distance is measured by kilometer distance and represents the distance between the event location and the location of the 2-digit postal code for each firm. This variable is constant over time.	Google Maps
Labor Cost Growth for Belgium	Labor costs are defined as expenditures done by employers to employ staff. This includes employee compensation, social security contributions, and taxes minus any subsidies received. Using the percentage change in the annual labor cost index, labor cost growth is generated.	Statbel - NBB
Labor Cost Growth for the Netherlands	Labor costs are defined as expenditures done by employers to employ staff. This includes employee compensation, social security contributions, and taxes minus any subsidies received. Using the percentage change in the annual labor cost index, labor cost growth is generated.	Eurostat
Worker Characteristics	Information on the workers displaced by GM Antwerp. This includes tenure, age, and job satisfaction, among other things.	Maes and Deneyer (2011)

B Factor substitution data

Table 18: Estimates of elasticity of substitution between capital and labor

Industry	**2-digit Codes**	**Elasticity of Substitution**
Food, beverages, and tobacco	10–12	1.59
Textiles, textile, leather, and footwear	13–15	0.92
Wood and products of wood and cork	16, 31	0.69
Pulp, paper, printing, and publishing	17–18	1.8
Coke, refined petroleum, and nuclear fuel	19	0.36
Chemicals and chemical products	20–21	0.9
Rubber and plastic	22	0.57
Other non-metallic mineral products	23	0.41
Basic metals and fabricated metal products	24–25	0.42
Electrical, electronic, and optical equipment	26–27	0.79
Machinery, not else specified	28	0.54
Transportation equipment	29–30	0.64
Manufacturing, not else specified	32–33	0.66
Electricity, gas, and water supply	35–39	1.26
Construction	41–43	1.96
Sale, maintenance, and repair of motor vehicles and motorcycles	45	0.72
Wholesale trade, except of motor vehicles and motorcycles	46	0.86
Retail trade, except of motor vehicles and motorcycles	47	0.75
Transportation and storage	49–53	0.92
Hotels and restaurants	55–56	0.57
Post and telecommunications	61	0.82
IT and other information services	62–63	0.66
Real estate, renting and business activities	68–82	0.78

Notes: This table presents the industry-level estimates of the elasticity of substitution between capital and labor by Laeven et al. (2023) and are used in the baseline regressions.

Table 19: Alternative I - Estimates of elasticity of substitution between capital and labor

Industry	**3-digit Codes**	**Elasticity of Substitution**
Textiles	313	0.12
Chemicals	325	0.24
Wood Products	321	0.28
Rubber	326	0.4
Transportation Equipment	336	0.44
Primary Metals	331	0.49
Furniture	337	0.55
Computers	334	0.56
Fabricated Metals	332	0.57
Machinery	333	0.59
Apparel	315	0.59
Stone, Clay, Glass, Concrete	327	0.6
Paper	322	0.64
Electrical Equipment	335	0.66
Printing	323	0.67
Misc	339	0.68
Petroleum Refining	324	0.69
Food Products	311	0.76
Textile Products	314	0.76
Leather	316	0.9
Beverage	312	1.11

Notes: This table presents the industry-level estimates of the elasticity of substitution between capital and labor by Oberfield and Raval (2021) and are used for the sensitivity checks. The estimates are only available for firms in certain 3-digit manufacturing industries.

Table 20: Alternative II - Estimates of elasticity of substitution between capital and labor

Industry	**Elasticity of Substitution**
Agriculture	0.289
Metal mining	0.667
Coal mining	0.305
Oil and gas extraction	0.649
Non-metallic mining	0.586
Construction	0.41
Food and kindred products	0.078
Tobacco	0.312
Textile mill products	0.204
Apparel	0.547
Lumber and wood	0.484
Furniture and fixtures	0.203
Paper and allied products	0.148
Printing, publishing, and allied	0.484
Chemicals	0.21
Petroleum and coal products	0.294
Rubber and misc. plastics	0.3
Leather	0.425
Stone, clay, glass	0.371
Primary metal	0.562
Fabricated metal	0.401
Machinery, non-electrical	0.483
Electrical machinery	0.486
Motor vehicles	0.365
Transportation equipment and ordnance	0.419
Instruments	0.57
Misc. manufacturing	0.246
Transportation	0.358
Communications	0.24
Electric utilities	0.231
Gas utilities	0.473
Trade	0.744
Finance, insurance, and real estate	1.16
Services	0.633
Government enterprises	0.272

Notes: This table presents the industry-level estimates of the elasticity of substitution between capital and labor by Chirinko and Mallick (2017) and are used as part of the robustness checks.

C Additional Tables

Table 21: Additional Descriptive Statistics

Panel A. Balance Sheet and Income Statement Data						
Variable	Observations	Mean	Median	Std. Dev.	Min	Max
Total Debt (M €)	63,739	0.90	0.57	0.97	0.06	5.40
Cash & Cash Equivalent (M €)	63,739	0.14	0.06	0.22	0.00	1.32
Profitability	63,718	0.03	0.02	0.08	-0.3	0.26
Labor Productivity (th €)	63,739	62.15	54.24	39.07	-1.34	2,266
Tangible Fixed Assets (th €)	63,739	548.41	295.46	970.40	5.91	4,050
Plant and Machinery (th €)	63,739	79.52	25.30	142.41	0.00	818
Vehicles and Furniture (th €)	63,739	67.67	34.95	101.00	0.00	596
Land and Buildings (th €)	63,739	264.73	106.57	428	0.00	2,602
Profit (loss) for period (M €)	63,718	0.05	0.02	0.14	-0.41	1.28
Net Added Value (M €)	63,739	0.54	0.37	0.51	0.03	7.22
Panel B. Credit and Tightness Data						
Variable	Observations	Mean	Median	Std. Dev.	Min	Max
Credit demand	63,739	0.03	0.004	0.17	-0.61	2.34
Labor cost growth in BE	63,739	0.028	0.031	0.005	0.019	0.034
Labor cost growth in NL	63,739	2.585	2.450	0.158	2.450	3.025

Notes: This table excludes key variables that are presented in Table 1. M represents millions. The number of observations might differ due to the data availability.