Real Effects of the Financial Crisis on German Economy at County Level∗

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Abstract

Motivated by Popov and Rocholl (2016) [9], this paper moves beyond firm-level studies by showing the real macroeconomic effects of the 2008 financial crisis on German public banks at the county level. With difference-in-difference results in three dimensions - at general-level, sector-level, and industry-level, we argue that the financial crisis should be responsible for counties' macroeconomic downturn during post-crisis periods in affected counties, even if the labor market was relatively stable. In particular, we find that the primary sector suffered no less than the other sectors, while at industry-level, tertiary-sector financial industries were hit harder than this sector's non-financial industries.

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† denotes the parts written by Mengxi Wang and ⋆ denotes thoes by Xuefei Han

1 Introduction † ⋆

The 2008 U.S. subprime mortgage crisis triggered a global financial crisis and the resulting Great Recession. In this context, we noticed that the German experience of this crisis was different compared to those of many other countries. As discussed in many papers, similar to other Western countries, Germany's economy was hit hard by the financial crisis, but its labor market exhibited a mild response to the global economic recession, which Rinne and Zimmerman (2012) [10] called an "economic miracle" in Germany's post-war history. This unique post-crisis performance motivates us to explore the real effects of the 2008 financial crisis on the German economy.

Popov and Rocholl (2016) [9] inspired us to design our identification strategy. They focus on the financial crisis' impact on German savings banks and German firms' employment decisions. Some of the German Landesbanken were substantially affected due to their exposure to the U.S. sub prime market. These Landesbanken's savings banks were also affected.

Motivated by their research, we ask our research question: What are the real effects of the financial crisis on Germany's economy, if we aggregate the effects from firm-level to county-level? To provide causal evidence, we implement a difference-in-difference (DID) estimation on a county-level dataset consisting of 401 German counties. We also use identification through bank-firm relationships and firms' total assets to establish a link from affected savings banks to affected firms, and then to affected counties. Our DID analysis produces findings in three dimensions - general-level, sector-level, industry-level.

The paper is outlined as follows. Section 2 describes the data sources and construction of the firm-level and county-level datasets. Section 3 reviews and replicates the identification from affected banks to affected firms in Popov and Rocholl (2016) [9]. Section 4 details the identification strategy from affected firms to affected counties, reports the key empirical results at general, sector, and industry levels, and also presents tests for robustness and parallel trend assumption for our DID regression. Section 5 concludes our contribution to and potential problems

during the research.

2 Data

2.1 Firm-Level Data †

Our firm-level data come from Orbis, a commercial database provided by Bureau van Dijk, containing financial information about over 1 million public and private companies in Germany. Crucially, for the purpose of our research, Orbis provides detailed information on these firms' bank relationships and on the location of the firms that would be used later for the county-level identification strategy.

Orbis also reports firm-level information on total employment, which is used to construct the outcome variable when replicating Popov and Rocholl (2016) [9]. All variables are reported with annual frequency, and we focus on firms whose data that Orbis observed and collected before and after the financial crisis. We focus on the period 2005–2012, and the final sample has 5,623 firms with sufficient employment data.

Although Popov and Rocholl (2016) [9] also used data from Orbis within the timeframe 2005–2012, they had a much larger dataset than ours. Since Orbis only presents data for the past ten years, in 2022 it is difficult to obtain the data for 2005–2012. Finally, Dr. Oliver Rehbein enabled us to gain access to a random sample of Popov and Rocholl (2016)'s data [9]. Table 1 shows definitions and summary statistics of the firm-level variables that we use to replicate the main results of Popov and Rocholl (2016) [9].

2.2 County-Level Data †

To obtain outcome variables for county-level regression, we filter data from the Federal Statistical Office of Germany. Although county reforms occurred several times, mainly in Saxony, Saxony-Anhalt, and Mecklenburg-Western Pomerania during our observation period, the Federal Statistical Office of Germany counts only the most recent regionalism of counties. Therefore, we follow the regionalism demonstrated by the Federal Statistical Office of Germany and observe a total of 401

counties, including 294 Landkreise (rural districts) and 107 kreisfreie Städte (urban districts).

In our research, various county-level variables related to gross domestic product, gross value added, persons in employment, and volume of work are used as outcome variables to estimate the effects of the 2008 financial crisis in Germany (Descriptions in Table 2 and 3). Specifically, the data for the above-mentioned variables in different sectors and industries are also available. This data can be used to compare the financial crisis' impact on finance-related industries and other industries in the tertiary sector. Table 4 and 5 presents descriptive statistics for those variables at the county-level.

3 Firm Level - Replication of Popov and Rocholl (2016)

3.1 Identification from Bank to Firm †

As public banks, Landesbanken and savings banks together comprise one of the three pillars of Germany's banking system. The two other pillars are private commercial banks and cooperative banks. According to the institutional situation, a unique geographical linkage exists between Landesbanken and savings banks - a savings bank can only be the owner of the Landesbank that operates in its federal state. In emergencies, Landesbanken rely on the support of their owners, including the savings banks in their region.

Popov and Rocholl (2016) [9] focused mainly on savings banks when examining the impact of exogenous funding shocks on German firms' labor decisions during the U.S. subprime mortgage crisis. Back in late 2007 and 2008, only five Landesbanken of the eleven publicly announced losses from the financial crisis, including those in Saxony, North Rhine-Westphalia, Baden-Württemberg, Bavaria, Hamburg, and Schleswig-Holstein. As a result, savings banks in these regions are also considered affected due to their respective ownership. In detail, if firm i has a credit relationship with at least one savings bank that became affected during the financial crisis, this firm i is defined as affected, and the dummy variable $Affected_i$ is equal to one, and to zero otherwise.

A difference-in-differences approach is used here with two dimensions: the time before and after the financial crisis as well as the cross-section of firms affected and not affected by the crisis. As Popov and Rocholl (2016) [9] view 2009 as the first post-crisis year, the other dummy variable $Post_t$ is equal to one after 2008, and to zero otherwise.

$$Log(Employment)_{i,t} = \beta Affected_i * Post_t + \alpha X_{i,t} + \gamma_t + \eta_i + \varepsilon_{i,t}$$

$X_{i,t}$ is a vector of time-varying firm-level control variables; η_i is a firm fixed effect; γ_t is a year fixed effect; and $\varepsilon_{i,t}$ is a clustered error term.

3.2 Difference-in-difference Results †

We run the above regression to replicate the main results of Popov and Rocholl (2016) [9]. The results showing the effects of credit access on labor demand in the dimension of employment can be found in Table 8. Column (1) includes controls for time-varying and firm-specific characteristics, whereas Column (2) includes year and firm fixed effects. In both columns, we find that the DID estimates are negative. Although only the estimate in Column (2) is significant at the 1% level, as hypothesized, credit association with an affected bank had a negative effect on the firm's employment after the credit supply shock. In detail, a firm with a credit relation with at least one affected bank reduced employment by 4.0% on average, between the 2005–2008 and the 2009–2012 periods. To a large extent, this result fits and resembles Popov and Rocholl (2016) [9].

4 County Level - Macroeconomic Effects of the Financial Crisis

4.1 Identification from Firm to County ⋆

Identification with Binary Treatment

To estimate the county-level macroeconomic effects of the financial crisis, we rely on a difference-in-difference (DID) estimation that compares macroeconomic outcome variables pre- and post-financial crisis in 2018 in affected and non-affected

counties. To define a given county as "affected", we use the firm-bank relations data and identification for affected firms in Popov and Rocholl (2016) [9] and aggregate the effects to the county level. Identifying affected counties, we first calculate the affected county's ratio as the ratio of the total assets of affected firms to the total assets of all sample firms in a given county. Geographic and numerical distribution can be found in Figure 1 and 2. Then we use the affected county's ratio to construct a dummy variable equal to one for counties where the "affected" ratio is above the mean and zero otherwise (see descriptive statistics in Table 6). As for another source of identifying variation, since real county-level effects need a reasonable period to reveal a response to a change in credit conditions, we view 2009 as the first post-crisis year.

The real county-level effects of the financial crisis are estimated in outcome variables, as follows:

$$Y_{i,t} = \beta Affected_i * Post_t + \alpha X_{i,t} + \gamma_t + \eta_i + \varepsilon_{i,t}$$

where $Y_{i,t}$ is a list of measurements of the county macroeconomic situation related to gross domestic product (GDP), gross value added (GVA), employment, and standard volume of work for employed persons (see definitions in Table 2) during year t in county i. $Affected_i * Post_t$ is an interaction dummy variable equal to one for affected counties and the post-financial crisis period. To ensure that the financial crisis is exogenous to county macroeconomics, we add county-level control variables $X_{i,t}$: residents, county industry structure and investment in new equipment (see definitions in Table 3). In this specification, β measures the relative effects of greater exposure to the financial crisis on county macroeconomics in affected counties; γ_t is the county fixed effects controlled for time-invariant differences in the long-run due to unexplained factors that differ across counties; η_i the time fixed effects controlled for the business cycle that measures the common, economy-wide shock at time t.

We also investigate the impact of the financial crisis on different county-level sectors due to different industrial dynamics across German counties. For example, the impact on the manufacturing sector contributes extensively to the aggregate

impact in some German counties because they have large manufacturing bases. For example, the headquarters of three of the largest German automobile producers are in counties that became impacted in late 2007 or in 2008. Thus, similar to the above regression, we also investigate the financial crisis' impact for the county-level sector variables, but the measurements for its respective sector data replace the outcome and control variables.

As the U.S. subprime mortgage crisis caused the collapse of the banking system and then a crisis for the international financial market, the financial service sector was directly affected compared to other economic sectors. As a result, the German financial market must have been affected, which is why we also examine the real effects of the 2008 financial crisis on the financial service sector within the tertiary sector to find empirical evidence. The settings are the same as above.

Identification with Continuous Treatment

In the binary treatment setting, we assure if a county's "affected" ratio is below mean, the county-level aggregate outcome variables should be modest and thus this county is identified as unaffected. The distribution of the "affected" ratio in Figure 1 and 2 shows that a few counties whose "affected" ratio is distributed between 0 and mean value (0.627) are defined as unaffected. To this end, we further argue that DID treatments have a "dose" and affect counties with varying intensity. We allow for continuous treatment to further investigate the real county-level effects. $Affected\_ratio_i * Post_t$ now is an interaction of the "affected" ratio of a county and post-financial crisis period. In this specification: others are the same as in the binary treatment setting, except that β now estimates whether counties with higher "affected" ratios during the financial crisis see a stronger impact in county growth measurements. The regression equation is below:

$$Y_{i,t} = \beta Affected\_ratio_i * Post_t + \alpha X_{i,t} + \gamma_t + \eta_i + \varepsilon_{i,t}$$

4.2 Difference-in-difference Results † ⋆

General Level ⋆

Overall, the results consistently show that national income at county-level declines more following the financial crisis in affected counites. In Table 9 Columns (2) (3) and (4), the point estimates imply negative and statistically significant effects on county-level GDP in affected counties. After the financial crisis, GDP per resident in an affected county declined by 0.51 percent at a 95 percentage confidence level.

Although the German labor market was resilient during the crisis due to earlier labor market reforms and policy instruments facilitating labor hoarding, the county-level employment in affected county still declined. The employment rate in affected counties dropped 0.48 percent and the standard volume of work for employed persons dropped by 0.63 percent at a 99 percent confidence level. This decrease in the standard volume of work for employed persons is consistent with the introduction of short-time work scheme and can explain why a huge decrease of employment in terms of persons in affected counties could be avoided like cases in France, the United Kingdom, or the United States. At the same time, GDP per hour worked per employed person and county GDP per employed person increased respectively by 0.66 percent and 0.36 percent. This increase contrasts with the decrease in GDP per resident (0.51%) also implies that the county economy's productive capacity is more efficient after the financial crisis.

The continuous treatment results in Table 12 show that one standard deviation increase in the "affected" ratio decreased GDP per resident by 0.49 percent (note that their "affected" ratio is between 0 and 100). Counties with a higher treatment intensity therefore saw a bigger decrease in county growth measurements as a result of the financial crisis.

Sector Level †

In Table 10, we report that the DID estimates provided an in-depth examination of different sectors. It shows that the 2008 financial crisis decreased employment and the volume of work (hours worked) for employed persons respectively by 2.3 and 3.2

percentage points in the primary sector in affected counties. Estimates from both specifications are statistically significant at the 1% level. Whereas, the secondary and tertiary sectors were much less hit than the primary sector and even had a smaller impact than average. These results can be partially explained by the world-wide boom in agricultural commodity prices since 2005. The bubble was pricked at the end of 2008 with the emergence of the global economic slowdown. Shortly after 2008, during the Great Recession, capital was withdrawn from the cooled-down market for agricultural products to make up other losses in many countries including Germany. Meanwhile, the German agricultural sector has become increasingly capital-intensive in recent decades. Highly reliant on external financing, its primary sector suffered a relatively larger loss, when the financial crisis occurred. This can be reflected by gross value added, employment, and the volume of work (hours worked) for employed persons.

In addition, research shows that the introduction of a short-time work scheme has contributed to relieving the financial crisis' negative impacts on the German labor market (Gehrke Balleer et al. 2016) [1]. Cutting working hours made it possible to retain staff and to avoid a sharp rise in unemployment. The result that hours worked per employed person fell in all sectors in affected counties is consistent with the above-mentioned research. Moreover, according to Mandl and Mascherini (2011) [8], short-time work allowance was granted mainly to employed persons whose job has one of the following characteristics: manufacturing sector, equipment and machine operators, and craft-related jobs. This might be a reason why the secondary sector only showed a slight decrease in employment, although it was hit hard by the financial crisis.

Industry Level †

To further understand the financial crisis' impact on financial and non-financial industries, the service sector is divided into three main categories: finance-related service, trade-related service, and public-related service. Detailed definitions are presented in Table 7.

Table 11 shows the difference-in-difference estimates when gross value added,

volume of work for employed persons, and employment of different industries in the tertiary sector are employed as outcome variables. A decrease of 1.0 to 2.0 percentage points for the above three measurements in the financial service sector in affected counties shows that the results are consistent with the existing literature mentioning that the financial service sector was hardest hit. On the contrary, the financial crisis did not decrease employment and the volume of work for employed persons for the public service sector relative to other sectors in the same county, as shown in Columns 8, and 9 respectively. In other words, the public service sector was barely affected and even picked up part of the labor force from other sectors. These results add credibility to the interpretation that the public service sector has limited crossover to the fields hardest hit by the financial crisis including exports, manufacturing, and financial services. For regression with continuous treatment, the DID estimates very closely resemble those of regression with binary treatment, when both results are statistically significant. Counties with a higher "affected" ratio experienced a more pronounced impact. (Table 14)

4.3 Robustness Check of Affected Firms' Numbers as a Measure of Affected Degree ⋆

In the previous sections, we adopt a method of identification for affected counties based on the total assets of the affected firms for a given county instead of counting the number of affected firms as mentioned in Popov and Rocholl (2016) [9]. Their identification - regarding a firm as affected by the number of affected banks is sufficient at the firm level, while it would be problematic at the county level. Intuitively, identification by using the number of affected firms for counties would cause misestimations if the affected firms vary based on their total assets in these counties. Thus, in our main regression, we define affected counties via the total asset channel instead of counting the numbers of affected firms.

Here, we conduct a robustness check for the main DID estimates by using the number of affected firms in a given county to identify the affected counties. We present the regression tables in the Table 15, 16 and 17. The estimates for general-level measurements of GDP, GVA do not go in the same direction as the coefficients

for total asset identification. Furthermore, they are nowhere near any meaningful level of statistical significance. The estimates for employment and standard volume of work for employed persons are similar to the results in Section 4.2, while the magnitude is much smaller. Thus, the number identification is not a suitable method.

5 Test for Parallel Trends ⋆

DID regression requests a parallel trend for the control and treatment groups in the pre-treatment periods. In our case, the assumption should be that in the absence of the financial crisis, county behaviors would have evolved in parallel as in the years before the financial crisis. We plot the pre-treatment trend comparison for the general-level, sector-level and industry-level measurements (Figure 3-6). To better observe pre-existing trends, we subtract the mean values for both affected and non-affected county-level time series and mark 2009 as the first post-crisis year. The vertical axis shows the individual outcome measures during the periods before and after the financial crisis. The dots represent the annual average values for all affected and non-affected counties. It clearly shows that all measurements for county macroeconomics indicate a pre-existing parallel trend between the affected and non-affected counties.

To verify the timing of treatment effects, another method is used here to test the parallel trend. The different trends in county macroeconomics we observed during the crises may have already been in place before the financial crisis, as discussed in Roberts and Whited (2012) [11]. Thus, we interact $Affected_i * Post_t$ with a dummy equal to one for the year during the 2005–2012 period and check for general-level GDP, GVA, employment, and standard volume of work for employed persons in Table 18. If treatment and control variables had already caused different outcomes before the crisis, there should be statistically significant estimates for affected counties during 2005–2006. However, the estimates reported in Table 18 imply that this is not the case. While the coefficients for GVA and employment are positive, they lack statistical significance at any confidence level. The same applies to the evolution of the GDP measurements. The evidence thus suggests that the effects

are indeed due to the county adjustments when faced with the impacts of the 2008 financial crisis.

6 Conclusion

6.1 Summary and Contribution † ⋆

This paper describes the real macroeconomic effects of the financial crisis that impacted German public banks at the county level based on 3,208 observations in Germany during the period 2005–2012. We argue that the financial crisis should be responsible for the counties' macroeconomic downturn. After the financial crisis, GDP in an affected county declined, but when the short-time work scheme was introduced, the labor market was relatively stable. We also further analyze the real effects based on each sector and find that there was a large impact on agriculture due to its capital-intensive nature, which is commonly masked by its more prominent impact on manufacturing. Moreover, we compare the impact on financial and non-financial industries in the service sector and find a larger impact on the financial industry regarding the national income and labor market. This paper provides a new perspective to study the real effects of a financial crisis based on the county level. At the same time, the findings are still consistent with existing literature on the German experience during the financial crisis.

6.2 Miscellaneous †

This paper's approach has several shortcomings, which should be addressed in further research. Most importantly, identifying affected counties through total assets of affected firms in given counties is a feasible but imperfect strategy. Our initial idea was to focus on firms' total debt volume in the balance sheet related to affected saving banks in the counties where firms are located. We can define an "affected" ratio as follows: the firms' total debt volume related to affected savings banks in given counties divided by the total debt volume of all firms. In this case, this ratio could more accurately measure the link between affected savings banks and counties. Unfortunately, we lack access to relevant data.

Secondly, when investigating the real macroeconomic effects of the 2008 financial crisis, Germany's strong dependence on exports must be discussed. However, a lack of data means that our research does not focus on counting this factor in our calculations.

Last, our research generally considers that the treatment occurred in 2008 and chooses 2009 as the first post-crisis year. However, it is important to note that the Landesbanken announced losses at different time points (Sachsen Landesbank in summer 2007, West Landesbank in November 2007, Bayern Landesbank in February 2008, and finally Landesbank Baden-Württemberg and HSH Nordbank in November 2008). If this is considered as a time-varying treatment along with relevant quarterly or monthly data, it would be possible to modify the regression model.

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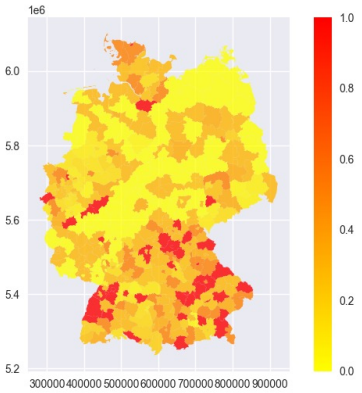
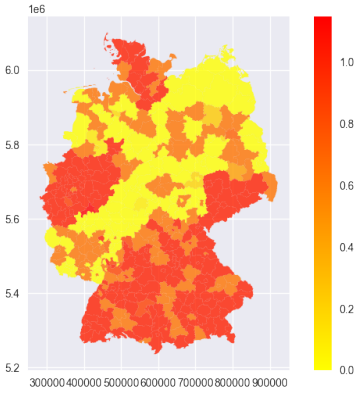
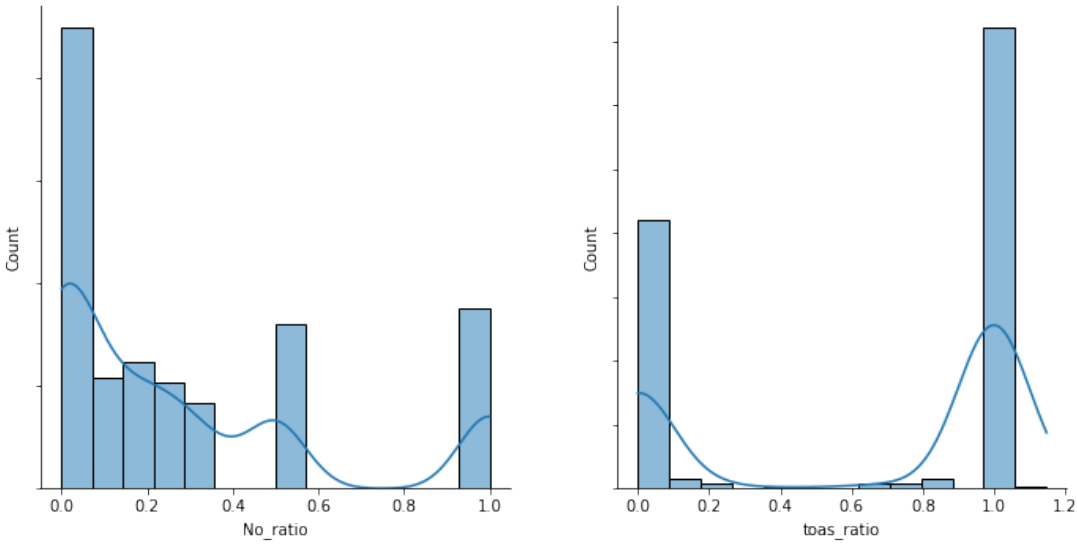


(a) Identification through number of firms



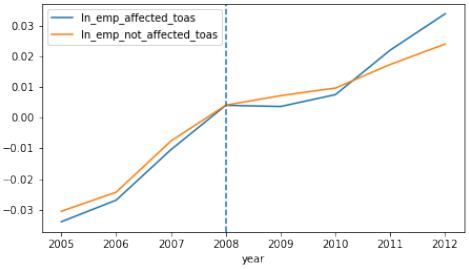
(b) Identification through total assets

Figure 1: Identification for "affected" ratio for German counties



(a) Identification through number of firms **(b)** Identification through total assets

Figure 2: Distribution of affected German counties



(a) Employment trends at general-level

(b) GDP trends at general-level

Figure 3: County macroeconomic measurements at general level

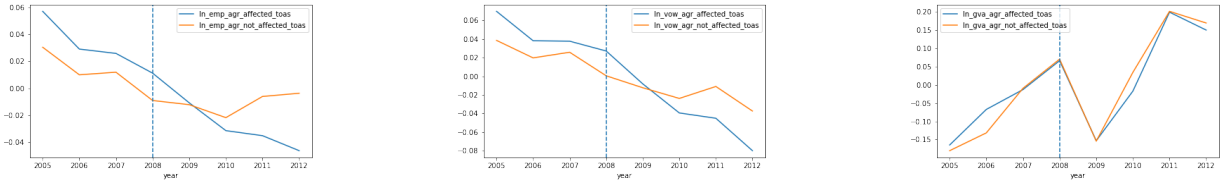


Figure 4: County macroeconomic measurements in primary sector

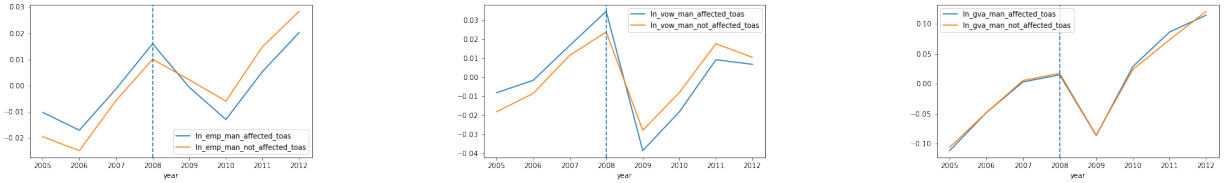


Figure 5: County macroeconomic measurements in secondary sector

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Table 1: Descriptive statistics for firm-level data

Variables	**# Firms**	**Mean**	**Median**	**St. dev.**	**Min**	**Max**
Affected	7,957	0.70	1.00	0.46	0.00	1.00
Employment	7,957	234.56	84.00	600.39	1.00	11450.00
Assets	7,957	65.64	16.15	260.94	1.03	6156.70
Sales	5,807	72.74	23.36	219.43	1.00	4018.98
Capital	7,957	0.39	0.37	0.23	0.00	0.99
Cash flow	7,019	0.08	0.07	0.16	−3.27	3.10
No. bank relationships	7,957	0.73	1.00	0.52	0.00	3.00

'Affected' is a dummy variable equal to one when at least one of the firm's banks is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007, and to zero otherwise. 'Employment' denotes the number of the firm's total employees. 'Assets' denotes the firm's total assets, in € million. 'Sales' denotes the firm's total sales, in € million. 'Capital' denotes the ratio of the firm's equity to total assets. 'No. bank relationships' reports the total number of banks with which the firm has a credit relationship. The sample period is 2005-2012.

Table 2: Variable descriptions (1) county-level outcome variables

Variables	Denotation
gdp	Gross domestic product, in million EUR
gdpr	Gross domestic product per resident, in EUR
gdpe	Gross domestic product per employed person, in EUR
gdpev	Gross domestic product per employed person per hour worked, in EUR
gva	Gross value added, in million EUR
gva1	Gross value added in primary sector, in million EUR
gva2	Gross value added in secondary sector, in million EUR
gva3	Gross value added in tertiary sector, in million EUR
gva3f	Gross value added in financial-related service sector, in million EUR
gva3t	Gross value added in trade-related service sector, in million EUR
gva3p	Gross value added in public-related service sector, in million EUR
emp	Employed persons, in 1000 people
emp1	Employed persons in primary sector, in 1000 people
emp2	Employed persons in secondary sector, in 1000 people
emp3	Employed persons in tertiary sector, in 1000 people
emp3f	Employed persons in financial-related service sector, in 1000 people
emp3t	Employed persons in trade-related service sector, in 1000 people
emp3p	Employed persons in public-related service sector, in 1000 people
vow	Standard volume of work for employed persons, in mill. hours worked
vow1	Standard volume of work for employed persons in primary sector, in million hours worked
vow2	Standard volume of work for employed persons in secondary sector, in million hours worked
vow3	Standard volume of work for employed persons in tertiary sector, in million hours worked
vow3f	Standard volume of work for employed persons in financial-related service sector, in million hours worked
vow3t	Standard volume of work for employed persons in trade-related service sector, in million hours worked
vow3p	Standard volume of work for employed persons in public-related service sector, in million hours worked

Table 3: Variable descriptions (2) county-level control variables

Variables	Denotation
res	residents by county, in 1000 people
fix	investment in new equipment, in million EUR
fix1	investment in new equipment in primary sector, in million EUR
fix2	investment in new equipment in secondary sector, in million EUR
fix3	investment in new equipment in tertiary sector, in million EUR
gvaw1	weight of gross value added in primary sector over all sectors
gvaw2	weight of gross value added in secondary sector over all sectors
gvaw3	weight of gross value added in tertiary sector over all sectors
empw1	weight of employment in primary sector over all sectors
empw2	weight of employment in secondary sector over all sectors
empw3	weight of employment in tertiary sector over all sectors
voww1	weight of standard volume of work for employed persons in primary sector over all sectors
voww2	weight of standard volume of work for employed persons in secondary sector over all sectors
voww3	weight of standard volume of work for employed persons in tertiary sector over all sectors

Table 4: Descriptive statistics for county-level outcome variables

Variables	**Observations**	**Mean**	**Median**	**St. dev.**	**Min**	**Max**
gdp	3,192	6,308.69	3,876.80	9,634.63	882.29	109,771.99
gdpr	3,192	29,091.86	25,522.50	13,029.63	11,428.00	128,296.00
gdpe	3,192	57,105.47	55,221.50	11,059.32	36,143.00	132,099.00
gdpev	3,024	40.62	39.72	7.74	25.03	89.87
gva	3,192	5,676.20	3,491.97	8,667.35	797.99	98,595.70
gva1	3,176	50.41	39.48	48.18	0.08	423.87
gva2	3,192	1,682.25	1,083.40	1,918.96	133.03	18,997.46
gva3	3,192	3,943.79	2,230.69	7,030.55	490.57	82,304.97
gva3f	3,192	1,543.41	824.62	3,060.60	152.90	32,603.91
gva3t	3,192	1,176.32	622.67	2,268.93	98.56	29,738.69
gva3p	3,192	1,224.06	782.19	1,905.97	194.13	30,136.26
emp	3,208	101.47	68.61	129.36	19.16	1,744.89
emp1	3,208	1.64	1.40	1.38	0.01	8.59
emp2	3,208	25.36	19.00	21.44	3.44	221.13
emp3	3,208	74.47	47.12	111.15	12.83	1,523.24
emp3f	3,208	16.67	8.80	32.20	1.70	395.10
emp3t	3,208	26.45	17.05	36.41	4.64	443.73
emp3p	3,208	31.35	21.06	44.34	5.71	684.41
vow	3,024	149.91	102.08	193.72	26.68	2,544.16
vow1	3,024	3.22	2.79	2.73	0.05	17.00
vow2	3,024	39.69	30.21	33.39	5.57	343.85
vow3	3,024	107.00	68.05	165.27	17.11	2,199.47
vow3f	3,024	24.61	13.12	48.57	2.57	579.18
vow3t	3,024	39.14	25.25	55.13	5.83	635.83
vow3p	3,024	43.25	28.92	64.51	7.29	988.53

Table 5: Descriptive statistics for county-level control variables

Variables	Observations	Mean	Median	St. dev.	Min	Max
res	3,192	201.86	148.79	223.12	34.11	3,350.61
fix	3,208	59,207.13	59,858.60	37,207.23	3,674.38	117,747.20
fix1	3,208	1,078.69	858.56	720.85	2.98	2,399.58
fix2	3,208	14,172.42	12,032.26	9,158.30	885.18	28,863.28
fix3	3,208	43,955.95	45,744.49	27,824.52	2,716.93	88,991.90
fix3f	3,208	27,071.85	28,015.28	18,016.27	1,105.47	57,683.87
fix3t	3,208	7,661.91	7,590.47	4,994.10	461.41	20,399.80
fix3p	3,208	9,222.66	9,329.03	5,178.38	607.02	17,655.75
gvaw1	3,176	0.02	0.02	0.02	0.00	0.11
gvaw2	3,176	0.32	0.27	0.09	0.06	0.58
gvaw3	3,176	0.66	0.70	0.10	0.36	0.93
empw1	3,208	0.02	0.01	0.01	0.00	0.09
empw2	3,208	0.28	0.32	0.11	0.05	0.75
empw3	3,208	0.70	0.66	0.11	0.25	0.95
voww1	3,024	0.03	0.02	0.03	0.00	0.16
voww2	3,024	0.29	0.29	0.09	0.07	0.61
voww3	3,024	0.67	0.67	0.10	0.32	0.93

Table 6: Descriptive statistics for affected degree of counties

Variables	Type	Mean	St. dev.	Min	Max
county_no	dummy	0.26	0.44	0.00	1.00
county_toas	dummy	0.47	0.50	0.00	1.00
ratio_no	continuous	0.29	0.34	0.00	1.00
ratio_toas	continuous	0.63	0.48	0.00	1.15

"ratio_no" denotes the ratio of affected firm numbers to all firm numbers in a given county. "ratio_toas" denotes the ratio of total assets of affected firms to sum of assets of all firms in a given county. "county_no" is a dummy variable equal to one when "ratio_no" is larger than its mean value, and to zero otherwise. "county_toas" is a dummy variable equal to one when "ratio_toas" is larger than its mean value, and to zero otherwise.

Table 7: Sector classification

Sectors	Industries included
primary sector	agriculture and forestry, fisheries
secondary sector	manufacturing
tertiary sector	service
finance-raleted service	financial, insurance and business services; real estate and housing
trade-raleted service	trade, transport and warehousing, hospitality, information and communication
public-raleted service	public and other service providers, education and health, household service

Table 8: DID results for firm-level regression

	Log (employment)	
	(1)	(2)
Affected_Post	-0.0583	-0.0399***
	(0.0572)	(0.0149)
Affected	-0.1862**	
	(0.0736)	
Post_2008	0.0024	
	(0.0484)	
Log (Assets)	-0.0586***	0.1637***
	(0.0150)	(0.0447)
Log (Sales)	0.8034***	0.3009***
	(0.0171)	(0.0450)
Capital	0.8648***	0.1041**
	(0.0587)	(0.0479)
Cash flow	-0.6426***	-0.0889*
	(0.0899)	(0.0512)
No. bank relationships	0.2709***	
	(0.0567)	
Year fixed effects	No	Yes
Firm fixed effects	No	Yes
Observations	5,609	5,609
R^2	0.5299	0.1321

Table 9: General-level: DID results with binary treatment by total asset identification

Variable	**Log(gdp)**	**Log (gdpr)**	**Log (gdpe)**	**Log (gdpev)**
	(1)	(2)	(3)	(4)
Affected_Post	-5.854e-06	-0.0051^{**}	0.0036^{*}	0.0066^{***}
	(0.0021)	(0.0021)	(0.0019)	(0.0021)
County Controls	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
County Fixed Effect	Yes	Yes	Yes	Yes
Observations	3176	3176	3176	3008
R^2	0.4423	0.4324	0.4277	0.4218

Variable	**Log (gva)**	**Log (emp)**	**Log (vow)**
	(5)	(6)	(7)
Affected_Post	-5.833e-06	-0.0048^{***}	-0.0063^{***}
	(0.0021)	(0.0012)	(0.0013)
County Controls	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes
County Fixed Effect	Yes	Yes	Yes
Observations	3176	3192	3024
R^2	0.4423	0.2898	0.2717

Table 10: Sector-level: DID results with binary treatment by total asset identification

	Primary sector			Secondary sector			Tertiary sector		
	log(gva)	log(emp)	log(vow)	log(gva)	log(emp)	log(vow)	log(gva)	log(emp)	log(vow)
Affected_Post	−0.0028	−0.0228***	−0.0316***	−0.0014	−0.0038**	−0.0056***	0.0012	−0.0031**	−0.0049***
	(0.0081)	(0.0048)	(0.0050)	(0.0023)	(0.0015)	(0.0017)	(0.0020)	(0.0012)	(0.0014)
County controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
County FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Time FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	3176	3192	3024	3176	3192	3024	3176	3192	3024
R^2	0.2506	0.2898	0.2295	0.8753	0.6440	0.6300	0.1406	0.4762	0.4857

Table 11: Industry-level: DID results with binary treatment by total asset identification

	Finance industry			Trade industry			Public industry		
	log(gva)	log(emp)	log(vow)	log(gva)	log(emp)	log(vow)	log(gva)	log(emp)	log(vow)
Affected_Post	-0.0071^{*}	-0.0194^{***}	-0.0137^{***}	0.0172^{***}	-0.0013	-0.0060^{***}	-0.0016	0.0056^{***}	0.0036^{**}
	(0.0041)	(0.0037)	(0.0037)	(0.0032)	(0.0020)	(0.0020)	(0.0021)	(0.0015)	(0.0017)
County Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
County FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Time FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	3176	3192	3024	3176	3192	3024	3176	3192	3024
R^2	0.0380	0.1310	0.1482	0.1323	0.1390	0.1669	0.0966	0.4169	0.4103

Table 12: General-level: DID results with continuous treatment by total asset identification

Variable	**Log(gdp)**	**Log (gdpr)**	**Log (gdpe)**	**Log (gdpev)**
	(1)	(2)	(3)	(4)
Affected-ratio_Post	0.0007	−0.0049*	0.0032	0.0051**
	(0.0026)	(0.0026)	(0.0024)	(0.0025)
County Controls	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
County Fixed Effect	Yes	Yes	Yes	Yes
Observations	2376	2376	2376	2376
R^2	0.4602	0.4548	0.4479	0.4433
Variable	**Log (emp)**	**Log (gva)**		**Log (vow)**
	(5)	(6)		(7)
Affected-ratio_Post	−0.0048***	0.0007		−0.0045***
	(0.0014)	(0.0026)		(0.0017)
County Controls	Yes	Yes		Yes
Time Fixed Effect	Yes	Yes		Yes
County Fixed Effect	Yes	Yes		Yes
Observations	2392	2376		2304
R^2	0.3005	0.4602		0.2957

Table 13: Sector-level: DID results with continuous treatment by total asset identification

	Primary sector			Secondary sector			Tertiary sector		
	log(gva)	log(emp)	log(vow)	log(gva)	log(emp)	log(vow)	log(gva)	log(emp)	log(vow)
Affected-ratio_Post	−0.0022	−0.0118*	−0.0251***	−0.0004	0.0008	0.0011	0.0024	−0.0004	−0.0001
	(0.0111)	(0.0067)	(0.0071)	(0.0031)	(0.0020)	(0.0022)	(0.0024)	(0.0015)	(0.0018)
County Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
County FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Time FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	2376	2392	2304	2376	2392	2304	2376	2392	2304
R^2	0.2560	0.1831	0.2957	0.8809	0.4719	0.6346	0.1364	0.2392	0.4988

Table 14: Industry-level: DID results with continuous treatment by total asset identification

	Financial service			Trade service			Public service		
	log(gva)	log(emp)	log(vow)	log(gva)	log(emp)	log(vow)	log(gva)	log(emp)	log(vow)
Affected-ratio_Post	-0.0151^{***}	-0.0139^{***}	-0.0016	0.0177^{***}	0.0036^{*}	-0.0032	-0.0030	0.0057^{***}	0.0082^{***}
	(0.0051)	(0.0043)	(0.0071)	(0.0045)	(0.0021)	(0.0023)	(0.0026)	(0.0019)	(0.0023)
County Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2392	2392	2304	2392	2392	2304	2392	2392	2304
R^2	0.0356	0.1184	0.1403	0.1348	0.1263	0.1675	0.1139	0.4205	0.4346

Table 15: General-level: DID results with binary treatment by number identification

Variable	**Log(gdp)**	**Log (gdpr)**	**Log (gdpe)**	**Log (gdpev)**
	(1)	(2)	(3)	(4)
Affected_Post	0.0030	0.0006	0.0018	0.0032
	(0.0024)	(0.0024)	(0.0021)	(0.0022)
County Controls	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
County Fixed Effect	Yes	Yes	Yes	Yes
Observations	3176	3176	3176	3176
R^2	0.4427	0.4312	0.4272	0.4199

Variable	**Log (gva)**	**Log (emp)**	**Log (vow)**
	(5)	(6)	(7)
Affected_Post	0.0030	-0.0003	-0.0003
	(0.0024)	(0.0012)	(0.0013)
County Controls	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes
County Fixed Effect	Yes	Yes	Yes
Observations	3176	3192	3024
R^2	0.4427	0.2856	0.2651

Table 16: Sector-level: DID results with binary treatment by number identification

	Primary sector			Secondary sector			Tertiary sector		
	log(gva)	log(emp)	log(vow)	log(gva)	log(emp)	log(vow)	log(gva)	log(emp)	log(vow)
Affected_Post	−0.0166*	−0.0006	−0.0021	0.0051*	0.0048***	0.0047***	0.0044**	0.0033**	0.0031**
	(0.0093)	(0.0050)	(0.0051)	(0.0025)	(0.0016)	(0.0017)	(0.0023)	(0.0013)	0.0014
County Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
County FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Time FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	3176	3193	3024	3176	3193	3024	3176	3193	3024
R^2	0.2513	0.2321	0.2181	0.8754	0.6442	0.6293	0.1418	0.4761	0.4839

Table 17: Industry-level: DID results with binary treatment by number identification

	Financial service			Trade service			Public service		
	log(gva)	log(emp)	log(vow)	log(gva)	log(emp)	log(vow)	log(gva)	log(emp)	log(vow)
Affected_Post	−0.0012	−0.0076*	−0.0003	0.0155***	0.0030	0.0023	−0.0026	0.0100***	0.0076***
	(0.0044)	(0.0041)	(0.0041)	(0.0036)	(0.0021)	(0.0022)	(0.0023)	(0.0016)	(0.0018)
County Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
County FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Time FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	3176	3192	3024	3176	3192	3024	3176	3192	3024
R^2	0.037	0.1231	0.1436	0.1294	0.1394	0.1644	0.0968	0.4214	0.4129

Table 18: Check of treatment timing using general-level data

Variable	**Log(gdp)**	**Log (gdpr)**	**Log (gdpe)**	**Log (gdpev)**
	(1)	(2)	(3)	(4)
AffectedDummy_2005_2006	-0.0043	0.0008	-0.0051	-0.0020
	(0.0034)	(0.0035)	(0.0031)	(0.0033)
AffectedDummy_2008_2009	-0.0011	0.0005	-0.0012	-0.0071^{***}
	(0.0027)	(0.0027)	(0.0025)	(0.0027)
AffectedDummy_2009_2010	-0.0042	-0.0054^{**}	-0.0014	0.0054^{*}
	(0.0027)	(0.0014)	(0.0025)	(0.0027)
County Controls	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
County Fixed Effect	Yes	Yes	Yes	Yes
Observations	2376	2376	2376	2288
R^2	0.4610	0.4578	0.4537	0.4427

Variable	**Log (emp)**	**Log (gva)**	**Log (vow)**
	(5)	(6)	(7)
AffectedDummy_2005_2006	-0.0043	0.0029	-0.0016
	(0.0034)	(0.0020)	(0.0022)
AffectedDummy_2008_2009	-0.0011	0.0012	0.0055^{***}
	(0.04)	(0.06)	(0.06)
AffectedDummy_2009_2010	-0.0042	-0.0053^{*}	-0.0087^{***}
	(0.0027)	(0.0014)	(0.0015)
County Controls	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes
County Fixed Effect	Yes	Yes	Yes
Observations	2376	2392	2304
R^2	0.4610	0.3027	0.3022

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