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Oliver Holtemöller, Yaz Gulnur Muradoglu

 Corona Shutdown and Bankruptcy Risk

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Contact

Professor Dr Oliver Holtemöller

Tel +49 345 77 53 800

Fax +49 345 77 53 820

E-mail: oliver.holtemoeller@iwh-halle.de

Authors

Oliver Holtemöller

Martin-Luther-University Halle-Wittenberg and Halle Institute for Economic Research – IWH,
Kleine Maerkerstrasse 8, 06120 Halle (Saale), Germany, e-mail: oliver.holtemoeller@iwh-halle.de

Yaz Gulnur Muradoglu

School of Business and Management, Queen Mary University of London, Mile End Road, E1 4NS
London, UK, e-mail: y.g.muradoglu@qmul.ac.uk

Issuer

Halle Institute for Economic Research (IWH) –
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Executive Board

Professor Reint E. Gropp, PhD

Professor Dr Oliver Holtemöller

Dr Tankred Schuhmann

Address

Kleine Maerkerstrasse 8
D-06108 Halle (Saale), Germany

Postal Address

P.O. Box 11 03 61
D-06017 Halle (Saale), Germany

Tel +49 345 7753 60

Fax +49 345 7753 820

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Corona Shutdown and Bankruptcy Risk

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Corona Shutdown and Bankruptcy Risk

Abstract

This paper investigates the consequences of shutdowns during the Corona crisis on the risk of bankruptcy for firms in Germany and United Kingdom. We use financial statements from the period 2014 to 2018 to predict how pervasive risk of bankruptcy becomes for micro, small, medium, and large firms due to shutdown measures. We estimate distress for firms using their capacity to service their debt. Our results indicate that under three months of shutdown almost all firms in shutdown industries face high risk of bankruptcy. In Germany, about 99% of firms in shutdown industries and in the UK about 98% of firms in shutdown industries are predicted to be under distress. The furlough schemes reduce the risk of bankruptcy only marginally to 97% of firms in shutdown industries in Germany and 95% of firms in shutdown industries in the United Kingdom in case of a three-month shutdown. In sectors that are not shutdown under conservative estimates of contagion of sales losses, our results indicate considerable risk of widespread bankruptcies ranging from 76% of firms in Germany to 69% of firms in the United Kingdom. These early findings suggest that the impact of corona crisis on corporate sector via shutdowns can be severe and subsequent policy should be designed accordingly.

Introduction

The Corona crisis is unprecedented in its nature that it is a crisis due to the shutdown measures to spread the contagion of the corona virus across many countries of the world. The Bank of England estimate for United Kingdom is about 14% fall in output this year which is comparable to a crisis three hundred years ago in 1709. The 1709 crisis was triggered by natural causes that frosted the land and shrunken supply of food items in a mainly agricultural economic era. The German government expects a decline in output by 6.3% in 2020, which is the largest decline since World War II. The more recent 2008 crisis and the 1929 great depression have both been triggered by the financial sector. Corona virus is new and a lot is unknown medically. Social distancing was provided as the only remedy under these circumstances.¹ Many countries shutdown whole sectors to ensure their health systems not be overwhelmed and excess deaths can be prevented.

From the background of the deep cuts in economic activity, a surge in corporate bankruptcies is likely. Albeit being currently still at the beginning of the crisis, the monthly IWH bankruptcy update already shows an increase in the number of jobs affected by bankruptcy in Germany. We investigate the impact of shutdown measures on corporate sector in Germany and United Kingdom, the two largest economies in Europe. We estimate the risk of bankruptcy due to shutdown measures. We use three different timeframes one month, two months and three months for shutdowns. We then estimate the share of firms that will be distressed, i.e. face the risk of bankruptcy due to shutdowns. We use a rich database (Amadeus Financials) that includes unlisted firms as well as listed ones and covers the whole spectrum of corporate sector. We distinguish between the micro firms with less than 10 workers, small firms with less than 50 workers, medium firms with less than 250 workers, and large firms with more than 250 workers. We investigate distress in corporate sector by

¹ Sweden being an exception in terms of severity of measures used and no shutdowns in any industry.

analyzing the capacity of firms in covering their debt service obligations. Distress and insolvency are inevitable consequences of an economy where supply and demand are limited, in the case of shutdown industries, completely halted for a longer period of time. The ability of each economy to subsequently recover from this shock and the speed of recovery depends on a thorough understanding of what happened in the corporate sector.

Financial distress has long term consequences. Some firms can be liquidated. Survivors encounter other difficulties. Many firms will continue to have negative earnings for extended periods (Hotchkiss, 1995). Many others find it difficult to increase their investment expenditures following distress (James, 1995). A common feature of the aftermath of distress is debt restructurings and very high leverage ratios (Gilson, 1997). Kahl (2002) argues that creditors lack the information that is needed to make quick and correct liquidation decisions and this can explain the long-term nature of financial distress. We are now at the onset of the Corona crisis and it is important at this point to indicate the widespread nature of distress in corporate sector for designing long-terms policies.

In the following, we first introduce the data and methods we use in our estimations for corporate distress in Germany and United Kingdom. We identify the shutdown and not-shutdown industries. We estimate risk of going into bankruptcy by estimating the capacity of the firm to cover its debt service obligations using its earnings. Then we estimate the firms that will face the risk of bankruptcy in shutdown sectors. We make additional assumptions of contagion of fall in demand to non-shutdown industries to estimate the firms that face risk of bankruptcy. We interpret liquidation as a dynamic process. During the corona crisis not only the creditors but also the governments will have to make various decisions to postpone or to prevent liquidations and consecutive job losses. Our work is a first attempt to help those agencies to see the extent of firms that fall under risk of bankruptcy. We show in shutdown industries almost all firms face the risk of bankruptcy and in not-shutdown industries, under conservative contagion assumptions, about two thirds of firms can face risk of bankruptcy.

Shutdown industries

We use Eurostat turnover data in order to identify shutdown industries. We calculate the year-on-year change in monthly turnover by industry in March and in April 2020 if available. If the year-on-year-decline in monthly turnover is absolutely larger than two standard deviations (computed for the period since 1991) we define an industry as shutdown. An alternative would be to derive shutdown industries from actual measures taken by the governments only. Our measure includes all sectors shutdown by government as a policy to ensure social distancing. However, it is more conservative in the sense that for the risk of bankruptcy we account for the actual extreme fall in turnover regardless of official measures.

For the United Kingdom, turnover data for more industries is available than for Germany. For the definition of a shutdown industry, we do not distinguish between the two countries. We define a sector as shutdown if the two-standard-deviation threshold is exceeded in an industry in at least one of the two countries. Table 1 shows the shutdown industries together with the decline in turnover.

Table 1

Year-on-year change in turnover in shutdown industries

| Country | NACE | NACE Label | Std.Dev. | March | April |
|---------|-------|---|----------|-------|-------|
| Germany | C29 | Manufacture of motor vehicles, trailers and semi-trailers | 12.3 | -26.0 | -75.2 |
| UK | H51 | Air transport | 16.0 | -73.0 | |
| UK | G473 | Retail sale of automotive fuel in specialised stores | 10.7 | -23.0 | -65.6 |
| UK | N79 | Travel agency, tour operator and other reservation service and related activities | 11.5 | -55.7 | |
| Germany | I55 | Accommodation | 5.1 | -50.0 | |
| UK | I55 | Accommodation | 6.7 | -47.7 | |
| Germany | G474 | Retail sale of information and communication equipment in specialised stores | 7.2 | -24.0 | -42.9 |
| Germany | C14 | Manufacture of wearing apparel | 9.0 | -28.5 | -42.8 |
| Germany | C19 | Manufacture of coke and refined petroleum products | 14.9 | -20.8 | -42.6 |
| UK | C29 | Manufacture of motor vehicles, trailers and semi-trailers | 14.0 | -41.4 | |
| Germany | I56 | Food and beverage service activities | 4.1 | -40.7 | |
| Germany | G4719 | Other retail sale in non-specialised stores | 5.4 | -31.2 | -39.8 |
| Germany | C25 | Manufacture of fabricated metal products, except machinery and equipment | 8.8 | -9.0 | -32.9 |
| Germany | C28 | Manufacture of machinery and equipment n.e.c. | 9.7 | -7.9 | -29.1 |
| UK | I56 | Food and beverage service activities | 7.5 | -28.1 | |
| Germany | G476 | Retail sale of cultural and recreation goods in specialised stores | 4.6 | -27.5 | -28.1 |
| UK | C14 | Manufacture of wearing apparel | 11.7 | -27.5 | |
| Germany | C31 | Manufacture of furniture | 7.8 | -1.5 | -27.3 |
| Germany | C18 | Printing and reproduction of recorded media | 5.4 | -11.5 | -26.8 |
| UK | G45 | Wholesale and retail trade and repair of motor vehicles and motorcycles | 7.9 | -26.3 | |
| UK | G4719 | Other retail sale in non-specialised stores | 4.0 | 1.3 | -25.6 |
| Germany | G477 | Retail sale of other goods in specialised stores | 3.9 | -11.5 | -25.2 |
| Germany | C15 | Manufacture of leather and related products | 11.2 | -17.8 | -24.6 |
| Germany | C13 | Manufacture of textiles | 8.0 | -4.2 | -24.2 |
| Germany | C22 | Manufacture of rubber and plastic products | 7.6 | -4.6 | -23.0 |
| Germany | C27 | Manufacture of electrical equipment | 9.6 | -6.0 | -19.3 |
| Germany | C11 | Manufacture of beverages | 6.5 | 8.5 | -18.4 |
| Germany | G451 | Sale of motor vehicles | 8.1 | -17.9 | |
| Germany | G475 | Retail sale of other household equipment in specialised stores | 4.7 | -10.6 | -17.0 |
| Germany | G473 | Retail sale of automotive fuel in specialised stores | 7.3 | -6.2 | -16.9 |
| Germany | C32 | Other manufacturing | 7.1 | 2.7 | -15.3 |
| Germany | G45 | Wholesale and retail trade and repair of motor vehicles and motorcycles | 7.3 | -14.7 | |

We use turnover statistics to identify industries that are subject to an extraordinary decline in turnover (March and April 2020 if available compared to previous year). We define shutdown industries as those with decline in turnover more than two standard deviations distance in March or April. Column (1) reports the country, column (2) NACE code for industry, column (3) definition of the industry, column (4) the standard deviation of year-on-year change in turnover since 1991, and columns (5) and (6) year-on-year change in turnover for March and April 2020, respectively.

Source: Eurostat and own calculations.

Strongly affected are the car industry, air transport, travel agencies, certain retail branches and accommodation. Turnover in car manufacturing and in air transport is about 75% lower than a year ago. In accommodation, the loss amounts to about 50% compared to the previous year.

Firm-level data

Data

The data source for firms' balance sheets and income statements is Bureau van Dijk AMADEUS Financials for the years 2014 to 2018, which we access via Wharton Research Data Services. We exclude financial and insurance activities (NACE section K), public administration and defense, compulsory social security (section O), activities of households as employers (section T) and activities of extraterritorial organizations and bodies (section U). We clean the data as follows:

- Observations with missing values or negative values for relevant balance sheet items, operating return (turnover) or number of employees are excluded.
- Duplicates
 - » We order observations by firm, reporting basis (descending, “Unconsolidated data” first) and consolidation code (descending, “U2” first), close date (descending).
 - » If there is more than one observation for a firm-year combination, we only keep the first one that is the most recent unconsolidated observation in case of duplicates.
- Only observations for firms with legal status “active” are included. There is no survivorship bias.
- Observations with balance sheet ratios larger than 100% are excluded.
- Observations where at least one of the relevant balance sheet ratios is lower than the 2.5% quantile or larger than the 97.5% quantile are excluded.

Variable definitions and size groups

The interest coverage ratio is

$$ICR = \frac{\text{Earnings Before Interest and Taxes}}{\text{Interest Expense}} = \frac{EBIT}{INTE}$$

and the inverse interest coverage ratio is

$$ICRI = \frac{1}{ICR}$$

We define a dummy $ICRD = 1$ if $INTE > EBIT$ and 0 otherwise which indicates if a firm is not able to cover interest expenses from current earnings. The payables coverage ratio (PCR) is defined as

$$PCR = \frac{\text{Current liabilities: creditors}}{\text{Earnings Before Interest and Taxes}} = \frac{CRED}{EBIT}$$

and $PCRD = 1$ if $CRED > EBIT$ and 0 otherwise. The payables-to-sales ratio (PSR) is defined as

$$PSR = \frac{\text{Current liabilities: creditors}}{\text{Turnover}} = \frac{CRED}{TURN}$$

and $PSRD = 1$ if $CRED > TURN$ and 0 otherwise.

We define leverage ($LEVR$) as ratio of total liabilities ($TOLI$) to total assets ($TOAS$), where total liabilities is the sum of current liabilities ($CULI$) and long-term debt ($LTDB$). Working capital (WC) is defined as working capital ($WKCA$) divided by total assets. We calculate retained earnings as other shareholder funds ($OSFD$) divided by total assets and the EBIT-to-total-assets ratio ($EBITA$) as earnings before interest and taxes ($EBIT$) over total assets. The sales-to-turnover ratio ($SALES$) is turnover divided by total assets.

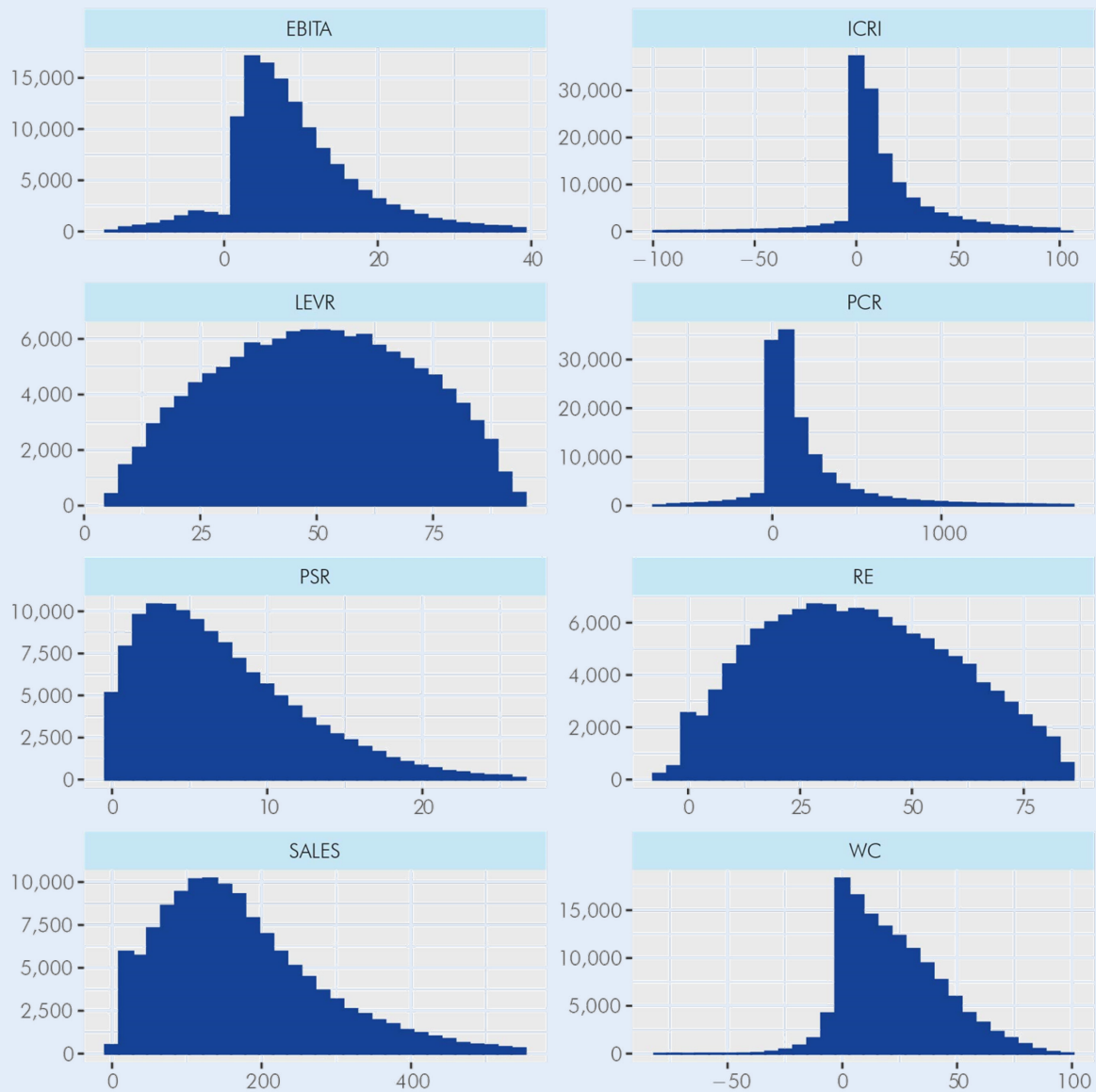
In the definition of size groups for firms, we follow the definition of small and medium-sized enterprises by the European Commission (see Table A.2 in the appendix).

Descriptive statistics

In total, we have about 48,000 observations of 19,000 firms for Germany and 81,000 observations of 29,000 firms for the United Kingdom, see Table A.1 in the Appendix. Overall, the firms in our sample account for 30% of total employment in Germany and for 58% in the United Kingdom. The data covers all industries (except the excluded ones, see section 3.1) and all size groups. Therefore, the sample we are using is representative of the corporate sector in both countries and encompasses the majority of employment that can be considered under risk due to shutdown measures.

Figure

Distributions of selected variables



Note: *EBITA* denotes earnings before interest and taxes (*EBIT*) divided by total assets (*TOAS*). Leverage (*LEVR*) is the ratio of total liabilities (current liabilities plus long-term debt) to total assets in percent. Working capital (*WC*) is the ratio of working capital (*WKCA*) to total assets in percent. Retained earnings (*RE*) are other shareholder funds (*OSFD*) in relation to total assets in percent. *SALES* denotes turnover in relation to total assets in percent. *ICRI* is the inverse of interest coverage ratio in percent, *PCR* is the payables coverage ratio defined as payables (*CRED*) divided by *EBIT* and *PSR* is the payables-to-sales ratio in percent.

Source: Amadeus Financials 2014-2018 and own calculation.

Histograms of the observations at the firm-year level are shown in Figure 1.

Findings

Main financial indicators for firms in shutdown industries

Table 2 reports the main financial indicators for firms in Germany and United Kingdom. We observe that firms in shutdown industries have more fragile financial structures even before the corona crisis. For example, in Germany leverage is higher in shutdown industries (49.2%) compared to industries that were still operating (44.4%). Working capital is higher in shutdown industries compared to non-shutdown industries in Germany (30.1% and 21.5% respectively) but similar in the UK (21.7% and 21.4% respectively). Retained Earnings is less for shutdown industries than in non-shutdown industries in Germany (30.8% and 35.8% respectively) while being slightly higher (41% and 39.5% respectively) in the UK.

In the United Kingdom, *EBITA* is lower and *SALES* levels are higher in shutdown industries (9.4% and 173%) compared to the non-shut down industries (9.8% and 169%). In Germany although *EBITA* is higher (9.5%) in shutdown industries compared to non-shutdown industries (7.8%) sales levels on average are higher (206% versus 168%). In both countries the shutdown sectors depend very much on generating high levels of sales demonstrating the fragility loss of sales brings to them.

In the United Kingdom interest expenses scaled by EBIT (*ICRI*) is higher (12%) than that in non-shutdown industries (11.4%) indicating further fragility due to interest payments in case of loss of sales. An important measure of distress is the liabilities to the suppliers of these firms. The ratio of payables to EBIT is higher for shutdown firms compared to non-shutdown firms in both Germany (139% and 123% respectively) and United Kingdom (223% and 192% respectively). Similarly, the ratio of payables to sales is higher in shutdown sectors compared to non-shutdown sectors in both Germany (5.5% and 5.0% respectively) and the United Kingdom (9.0% and 7.9% respectively). Payables to suppliers is not covered under government furlough schemes and therefore do constitute additional fragility in terms of going under distress.

Table 2

Main financial indicators by country and by shutdown

| Country | Shutdown | N | LEVR | WC | RE | EBITA | SALES | ICRI | PCR | PSR |
|---------|----------|--------|------|------|------|-------|-------|------|-------|-----|
| Germany | No | 37,280 | 44.4 | 21.5 | 35.8 | 7.8 | 168.3 | 17.1 | 123.4 | 5.0 |
| Germany | Yes | 10,927 | 49.2 | 30.1 | 30.8 | 9.5 | 206.3 | 14.2 | 138.7 | 5.5 |
| UK | No | 58,095 | 53.1 | 21.4 | 39.5 | 9.8 | 169.4 | 11.4 | 192.2 | 7.9 |
| UK | Yes | 23,181 | 51.6 | 21.7 | 41.0 | 9.4 | 173.3 | 12.1 | 222.8 | 9.0 |

This table reports main financial indicators for firms in Germany and United Kingdom (UK) in sectors that are shutdown due to corona crisis and those that are not. *EBITA* denotes earnings before interest and taxes (EBIT) divided by total assets (TOAS). Leverage (LEVR) is the ratio of total liabilities (current liabilities plus long-term debt) to total assets in percent. Working capital (WC) is the ratio of working capital to total assets in percent. Retained earnings (RE) are other shareholder funds in relation to total assets in percent. *SALES* denotes turnover in relation to total assets in percent. *ICRI* is the inverse of interest coverage ratio in percent, *PCR* is the payables coverage ratio defined as payables (CRED) divided by EBIT and *PSR* is the payables-to-sales ratio in percent.

Source: Amadeus Financials 2014-2018 and own calculations.

Table 3 reports the details of the main financial indicators in each of the shutdown industries in Germany and the United Kingdom. In terms of leverage Administrative Services (N) in the United Kingdom (60%) and Wholesale and Retail Trade (G) in Germany (64%) have highest fragility.

Accommodation and Food (I) and Administrative Services (N) are most fragile in terms of working capital even before the corona crisis with ratios close to zero in Germany (3.5% and 1.7%) and even slightly negative in the UK (1.3% and 0.5%) indicating severe cash shortages in dealing with distressful circumstances.

The ratio of retained earnings to total assets is lowest (22%) for Wholesale and Retail Trade (G) in Germany while UK firms have higher retained earnings usually above 30% in all shut down sectors. On the other hand, *EBITA* is lowest in the United Kingdom Administrative Services (N) and Transportation (H) sectors (7.2% in both cases) while all shutdown sectors in Germany have higher EBIT ratios between 9 % and 10%. Average *SALES* levels are lowest in UK Accommodation and Food (I) and Transportation (H) sectors and highest in Wholesale and Retail Trade (G) in both Germany and United Kingdom.

Debt service obligations are measured by the ratio of interest expenses to EBIT (*ICRI*, inverse of interest coverage ratio). The lowest interest burden is in the UK Manufacturing (C) sector with interest burden about 10% of EBIT while the highest is in Wholesale and Retail Trade (G) in Germany with interest expenses close to 15.4% of EBIT.

Payables coverage ratio (*PCR*) is the ratio of payables to suppliers to EBIT. This ratio is especially important during the corona crisis as most governments provided furloughs for salaries or several schemes to postpone debt service and repayment but firms must pay their suppliers to avoid bankruptcy without any help from government. Wholesale and Retail Trade (G) has the highest ratio of payables to suppliers about three times of EBIT in the United Kingdom. The ratio of payables to sales is highest in Manufacturing (C) in the United Kingdom about 10% of turnover. In Germany the highest payables coverage ratio is in Wholesale and retail trade (G) about two and a half times of EBIT and the highest payables-to-sales ratio (*PSR*) is about 7.2% of Sales also in Wholesale and Retail Trade (G).

Table 3
Main financial indicators for shutdown industries

| Country | NACE | N | LEVR | WC | RE | EBITA | SALES | ICRI | PCR | PSR |
|---------|------|--------|------|------|------|-------|-------|------|-------|-----|
| Germany | C | 7,440 | 43.1 | 32.9 | 34.3 | 9.3 | 172.0 | 14.1 | 98.4 | 4.8 |
| Germany | G | 3,053 | 64.0 | 26.9 | 22.2 | 9.9 | 290.2 | 15.4 | 244.6 | 7.2 |
| Germany | H | 13 | 55.7 | 12.4 | 23.8 | 9.9 | 178.3 | -5.6 | 96.1 | 6.0 |
| Germany | I | 3,05 | 48.8 | 3.5 | 30.5 | 9.9 | 203.7 | 12.1 | 70.4 | 4.0 |
| Germany | N | 116 | 48.8 | 1.7 | 31.0 | 9.5 | 204.3 | 2.8 | 117.2 | 4.7 |
| UK | C | 12,965 | 48.5 | 27.8 | 43.1 | 10.1 | 155.0 | 10.0 | 199.6 | 9.9 |
| UK | G | 6,127 | 56.3 | 23.8 | 38.4 | 8.5 | 238.4 | 13.8 | 338.9 | 9.0 |
| UK | H | 222 | 51.5 | 9.5 | 36.0 | 7.2 | 139.3 | 12.4 | 156.5 | 6.7 |
| UK | I | 3,582 | 54.1 | -1.3 | 38.7 | 8.4 | 129.4 | 16.5 | 110.1 | 6.3 |
| UK | N | 285 | 59.8 | 0.5 | 34.0 | 7.2 | 184.5 | 13.6 | 252.5 | 7.1 |

This table reports main financial indicators for firms in Germany and United Kingdom (UK) in sectors that are shutdown due to corona crisis. *EBITA* denotes earnings before interest and taxes (EBIT) divided by total assets (TOAS). Leverage (*LEVR*) is the ratio of total liabilities (current liabilities plus long-term debt) to total assets in percent. Working capital (*WC*) is the ratio of working capital to total assets in percent. Retained earnings (*RE*) are other shareholder funds in relation to total assets in percent. *SALES* denotes turnover in relation to total assets in percent. *ICRI* is the inverse of interest coverage ratio in percent, *PCR* is the payables coverage ratio defined as payables (*CRED*) divided by EBIT and *PSR* is the payables-to-sales ratio in percent.

Source: Amadeus Financials 2014-2018 and own calculations.

Distress and bankruptcy risk in shutdown industries

Table 4 presents our simulation results for shutdown and not-shutdown industries reporting the fraction of firms that are under distress and risk of bankruptcy. We use interest coverage ratio dummy (*ICRD*) as an indicator of distress and in line with previous research. We classify firms whose EBIT does not cover their interest expenses as firms under distress and under risk of bankruptcy. In practice interest coverage ratio of 1.5, earnings covering 1.5 the interest payments is normally considered to be a bare minimum below which lenders will refuse to lend the company any more as the company's risk for default is considered to be too high. We used an inverse interest coverage ratio below 1 to indicate firms under distress. The inverse interest coverage ratio below 1 indicates the firm is not generating earnings enough to satisfy its interest payment obligation. If a firm's inverse interest coverage ratio is below 1 it will either have to spend from its cash reserves in order to meet the difference or borrow more, which is highly unlikely as discussed above. As a result, the company risks falling into bankruptcy.

Table 4
Risk of bankruptcy

| Country | Shutdown | Salary Subsidy | Shutdown duration in months | | | |
|----------------|----------|----------------|-----------------------------|------|------|------|
| | | | 0 | 1 | 2 | 3 |
| Germany | No | No | 0.08 | 0.76 | 0.94 | 0.98 |
| Germany | No | Yes | 0.08 | 0.63 | 0.85 | 0.93 |
| Germany | Yes | No | 0.08 | 0.81 | 0.97 | 0.99 |
| Germany | Yes | Yes | 0.08 | 0.71 | 0.91 | 0.97 |
| United Kingdom | No | No | 0.06 | 0.69 | 0.90 | 0.96 |
| United Kingdom | No | Yes | 0.06 | 0.57 | 0.80 | 0.89 |
| United Kingdom | Yes | No | 0.05 | 0.73 | 0.93 | 0.98 |
| United Kingdom | Yes | Yes | 0.05 | 0.61 | 0.86 | 0.95 |

The table shows the share of firms with interest expenses (INTE) larger than EBIT depending on the length of the shutdown. For each month of the shutdown, we subtract 1/12 of annual turnover from earnings before interest and taxes. If the entry in column Salary Subsidy is equal to Yes we add 1/12 of cost of employees (STAF) to EBIT for each month of the shutdown.

Source: Amadeus Financials 2014-2018 and own calculations.

Shutdown duration 0 months refers to the situation without crisis or shutdown. The corresponding column shows the average percent of firms that cannot cover their interest expense with their earnings (EBIT) during the previous five years in Germany and UK. In Germany about 8% of firms and in the UK about 5% of firms in shutdown industries have inverse interest coverage ratios below 1 indicating they are under risk of bankruptcy. In our simulations for shutdowns we first assume firms are shutdown for one month then two months and then for three months and firms in these industries lose sales for one, two and three months respectively. If the shutdown is for one month 81% of firms in Germany and 73% of firms in the UK become under risk of falling into bankruptcy. If the shutdown is for two months 97% of firms in Germany and 93% of firms in the United Kingdom are under risk of bankruptcy and in three months of shutdown about 99% of firms in Germany and 98% of firms in United Kingdom become under risk of insolvency. This is an entire economy that is under risk of bankruptcy with severe economic and labor market consequences.

Additionally, we simulate assuming furloughs for employees (salary subsidy) for each month of shutdown by the state. In this case, the share of firms under distress becomes lower than in the scenario without salary subsidy, but the share does still increase substantially for each month of shutdown. In case of three months of shutdowns even when salaries of workers are paid completely by the government risk of bankruptcy is very high. In Germany 97% of firms are under risk of bankruptcy and in the UK 95% of firms are under risk of bankruptcy in shutdown sectors even when the government pays labor costs entirely.

The insolvencies in shutdown industries will have impact on the firms in non-shutdown industries. We assume in total these firms may lose about one month sale revenue (We also report results for loss of two and three months sales in non-shutdown industries for comparison). In Germany, if we assume contagion of sales losses from shutdown to non-shutdown industries reducing their sales by about 1/12 we observe that about 76% of firms in non-shutdown industries become distressed and under risk of bankruptcy. In the United Kingdom, about 69% of firms in shutdown sectors go into distress and face bankruptcy. Even if the governments paid all salaries in non-shutdown industries 63% of firms in Germany and 57% of firms in the UK would be in distress and face risk of bankruptcy. Economic consequences of these possible bankruptcies in the non-shutdown industries are also devastating for the economy.

Table 5 repeats the analysis for micro firms. These are firms with less than 10 workers or 2,000,000 EUR in revenue. In Germany about 6% of firms and in the United Kingdom about 7% of micro firms in shutdown industries have inverse interest coverage ratios below 1 before the shutdowns. In our simulations for shutdowns we observe that if the shutdown is for one month 77% of firms in Germany and 69% of firms in the United Kingdom become under risk of falling into bankruptcy. If the shutdown is for two months 94% of firms in Germany and 87% of firms in the United Kingdom are under risk of bankruptcy and in three months of shutdown about 97% of firms in Germany and 93% of firms in United Kingdom become under risk of insolvency. Assuming that the insolvencies in shutdown industries will have impact on the firms in non-shutdown industries and these firms may lose about one month sale revenue, in Germany 58% of micro firms in not-locked down industries face bankruptcy. In the United Kingdom about 49% of not-shut down industry firms face risk of bankruptcy.

Table 5

Risk of bankruptcy for micro firms

| Country | Shutdown | Salary Subsidy | Shutdown duration in months | | | |
|----------------|----------|----------------|-----------------------------|------|------|------|
| | | | 0 | 1 | 2 | 3 |
| Germany | No | No | 0.10 | 0.58 | 0.81 | 0.91 |
| Germany | No | Yes | 0.10 | 0.50 | 0.71 | 0.84 |
| Germany | Yes | No | 0.06 | 0.77 | 0.94 | 0.97 |
| Germany | Yes | Yes | 0.06 | 0.68 | 0.86 | 0.94 |
| United Kingdom | No | No | 0.11 | 0.49 | 0.67 | 0.77 |
| United Kingdom | No | Yes | 0.11 | 0.41 | 0.59 | 0.70 |
| United Kingdom | Yes | No | 0.07 | 0.69 | 0.87 | 0.93 |
| United Kingdom | Yes | Yes | 0.07 | 0.58 | 0.84 | 0.88 |

The table shows the share of firms with interest expenses (INTE) larger than EBIT depending on the length of the shutdown. For each month of the shutdown, we subtract 1/12 of annual turnover from earnings before interest and taxes. If the entry in column Salary Subsidy is equal to Yes we add 1/12 of cost of employees (STAF) to EBIT for each month of the shutdown. Source: Amadeus Financials 2014-2018 and own calculations.

Table 6 presents the share of small firms under risk of bankruptcy due to shutdowns. These are firms with less than 50 workers or 10,000,000 EUR in revenue. In Germany about 6% of small firms and in the United Kingdom about 7% of small firms in shutdown industries have inverse interest coverage ratios below 1 before the shutdowns. In our simulations for shutdowns we observe that if the shutdown is for one month 88% of firms in Germany and 72% of firms in the United Kingdom become under risk of falling into bankruptcy. If the lockdown is for two months 98% of firms in Germany and 93% of firms in the United Kingdom are under risk of bankruptcy and in three months of shutdown 99% of small firms in Germany and 98% of firms in United Kingdom become under risk of insolvency. Assuming that the insolvencies in shutdown industries will have impact on the firms in non-shutdown industries and these firms may lose about 1/12 of sales, we calculate the percent of firms that fall under distress. In Germany, about 65% of small firms and in the UK about 69% of not-shutdown industry firms face risk of bankruptcy.

Table 6

Risk of bankruptcy for small firms

| Country | Shutdown | Salary Subsidy | Shutdown duration in months | | | |
|----------------|----------|----------------|-----------------------------|------|------|------|
| | | | 0 | 1 | 2 | 3 |
| Germany | No | No | 0.08 | 0.65 | 0.87 | 0.94 |
| Germany | No | Yes | 0.08 | 0.56 | 0.79 | 0.89 |
| Germany | Yes | No | 0.06 | 0.88 | 0.98 | 0.99 |
| Germany | Yes | Yes | 0.06 | 0.80 | 0.93 | 0.98 |
| United Kingdom | No | No | 0.06 | 0.69 | 0.90 | 0.95 |
| United Kingdom | No | Yes | 0.06 | 0.61 | 0.83 | 0.90 |
| United Kingdom | Yes | No | 0.07 | 0.72 | 0.93 | 0.98 |
| United Kingdom | Yes | Yes | 0.07 | 0.64 | 0.87 | 0.95 |

The table shows the share of firms with interest expenses (INTE) larger than EBIT depending on the length of the shutdown. For each month of the shutdown, we subtract 1/12 of annual turnover from earnings before interest and taxes. If the entry in column Salary Subsidy is equal to Yes we add 1/12 of cost of employees (STAF) to EBIT for each month of the shutdown.

Source: Amadeus Financials 2014-2018 and own calculations.

Table 7 presents the ratio of medium firms under risk of bankruptcy due to shutdowns. These are firms with less than 250 workers or 50,000,000 EUR in revenue. In Germany about 8% of medium firms and in the United Kingdom about 5% of medium firms in shutdown industries have inverse interest coverage ratios below 1 before the shutdowns. In our simulations for shutdowns we observe that if the shutdown is for one month 83% of medium firms in Germany and 72% of medium firms in the United Kingdom become under risk of falling into bankruptcy. If the shutdown is for two months 97% of medium firms in Germany and 93% of medium firms in the United Kingdom are under risk of bankruptcy. In the case of three months of lock down 99% of medium firms in Germany and 98% of medium firms in United Kingdom become under risk of insolvency. Assuming that the insolvencies in shutdown industries will have impact on the firms in non-shutdown industries and these firms may lose about 1/12 sale revenue, in Germany 73% of medium firms in not-locked down industries and in the UK 69% not-shutdown industry firms face risk of bankruptcy.

Table 7

Risk of bankruptcy for small firms

| Country | Shutdown | Salary Subsidy | Shutdown duration in months | | | |
|----------------|----------|----------------|-----------------------------|------|------|------|
| | | | 0 | 1 | 2 | 3 |
| Germany | No | No | 0.07 | 0.73 | 0.93 | 0.98 |
| Germany | No | Yes | 0.07 | 0.61 | 0.84 | 0.93 |
| Germany | Yes | No | 0.08 | 0.83 | 0.97 | 0.99 |
| Germany | Yes | Yes | 0.08 | 0.73 | 0.92 | 0.97 |
| United Kingdom | No | No | 0.05 | 0.69 | 0.90 | 0.97 |
| United Kingdom | No | Yes | 0.05 | 0.58 | 0.81 | 0.89 |
| United Kingdom | Yes | No | 0.05 | 0.72 | 0.93 | 0.98 |
| United Kingdom | Yes | Yes | 0.05 | 0.60 | 0.85 | 0.95 |

The table shows the share of firms with interest expenses (INTE) larger than EBIT depending on the length of the shutdown. For each month of the shutdown, we subtract 1/12 of annual turnover from earnings before interest and taxes. If the entry in column Salary Subsidy is equal to Yes we add 1/12 of cost of employees (STAF) to EBIT for each month of the shutdown.

Source: Amadeus Financials 2014-2018 and own calculations.

Table 8 presents the share of large firms under risk of bankruptcy due to shutdowns. These are firms with more than 250 workers and more than 50,000,000 EUR in revenue. In Germany about 9% of large firms and in the United Kingdom about 5% of large firms in shutdown industries have inverse interest coverage ratios below 1 before the shutdowns. In our simulations for shutdowns we observe that if the shutdown is for one month 79% of large firms in Germany and 74% of large firms in the United Kingdom become under risk of falling into bankruptcy. If the lockdown is for two months 96% of large firms in Germany and 94% of large firms in the United Kingdom are under risk of bankruptcy. In the case of three months of shutdown 99% of large firms in Germany and 99% of large firms in United Kingdom become under risk of insolvency. Assuming that the insolvencies in lockdown industries will have impact on the firms in non-shutdown industries and these firms may lose 1/12 of their sales in Germany about 81% of large firms in not-locked down industries face bankruptcy. In the United Kingdom 69% of not-shutdown industry firms face risk of bankruptcy.

Table 8

Risk of bankruptcy for large firms

| Country | Shutdown | Salary Subsidy | Shutdown duration in months | | | |
|----------------|----------|----------------|-----------------------------|------|------|------|
| | | | 0 | 1 | 2 | 3 |
| Germany | No | No | 0.08 | 0.81 | 0.96 | 0.99 |
| Germany | No | Yes | 0.08 | 0.66 | 0.88 | 0.94 |
| Germany | Yes | No | 0.09 | 0.79 | 0.96 | 0.99 |
| Germany | Yes | Yes | 0.09 | 0.68 | 0.90 | 0.97 |
| United Kingdom | No | No | 0.06 | 0.69 | 0.90 | 0.96 |
| United Kingdom | No | Yes | 0.06 | 0.55 | 0.77 | 0.88 |
| United Kingdom | Yes | No | 0.05 | 0.74 | 0.94 | 0.99 |
| United Kingdom | Yes | Yes | 0.05 | 0.62 | 0.88 | 0.96 |

The table shows the share of firms with interest expenses (INTE) larger than EBIT depending on the length of the shutdown. For each month of the shutdown, we subtract 1/12 of annual turnover from earnings before interest and taxes. If the entry in column Salary Subsidy is equal to Yes we add 1/12 of cost of employees (STAF) to EBIT for each month of the shutdown.

Source: Amadeus Financials 2014-2018 and own calculations.

Conclusions

We investigate the corporate consequences of shutdowns during the Corona crisis on the risk of bankruptcy. We use a rich database (Amadeus Financials) including unlisted as well as listed firms in Germany and United Kingdom. We predict how pervasive risk of bankruptcy becomes for micro, small, medium and large firms due to shutdown measures. Our results indicate that under three months of shutdown almost all firms in shutdown industries face high risk of bankruptcy. In sectors that are not shutdown, we estimate contagion of sales losses and considerable risk of widespread bankruptcies for two thirds of firms. Furlough schemes used during the shutdown reduce risk of bankruptcy but not considerably. Our early findings on the widespread nature of risk of bankruptcy in the corporate sector, both shutdown and not-shutdown, suggests that the impact of corona crisis is severe and subsequent policy should be designed accordingly.

Appendix

Number of firms and observations

Table A.1

Number of firms and observations by country and industry

| Sector | Germany | | | United Kingdom | | |
|--------------|---------------|---------------|-------------------|----------------|---------------|-------------------|
| | Firms | Observations | Employment | Firms | Observations | Employment |
| A | 132 | 279 | 17,910 | 381 | 1,097 | 125,317 |
| B | 53 | 137 | 13,749 | 263 | 657 | 735,670 |
| C | 4,954 | 12,350 | 4,067,245 | 7,058 | 21,058 | 2,846,990 |
| D | 866 | 2,842 | 174,195 | 126 | 280 | 91,182 |
| E | 335 | 897 | 53,860 | 359 | 1,041 | 81,362 |
| F | 980 | 1,935 | 153,570 | 2,548 | 7,027 | 657,325 |
| G | 3,698 | 9,098 | 1,299,393 | 5,674 | 16,706 | 4,406,312 |
| H | 765 | 1,719 | 484,627 | 1,445 | 4,331 | 1,134,692 |
| I | 153 | 305 | 59,185 | 1,260 | 3,582 | 1,448,065 |
| J | 714 | 1,690 | 267,210 | 1,633 | 3,911 | 1,032,240 |
| L | 1,193 | 3,352 | 228,054 | 762 | 1,934 | 184,396 |
| M | 2,518 | 6,768 | 3,400,801 | 2,753 | 6,657 | 2,283,326 |
| N | 800 | 1,752 | 594,487 | 2,812 | 7,090 | 2,195,090 |
| P | 118 | 276 | 42,657 | 264 | 607 | 88,531 |
| Q | 1,402 | 3,895 | 1,168,497 | 1,036 | 2,586 | 529,285 |
| R | 121 | 287 | 32,124 | 455 | 1,178 | 245,323 |
| S | 288 | 625 | 146,026 | 590 | 1,534 | 265,115 |
| TOTAL | 19,021 | 48,207 | 12,163,472 | 29,383 | 81,276 | 18,334,942 |

Data for 2014-2018. Source: Amadeus Financials and own calculations.

Size groups

Table A.2

Size groups

| Category | Staff headcount | Turnover | or | Balance sheet total |
|---------------------|-----------------|-----------|----|---------------------|
| Medium-sized | <250 | ≤ 50m EUR | | ≤ 43m EUR |
| Small | <50 | ≤ 10m EUR | | ≤ 10m EUR |
| Micro | <10 | ≤ 2m EUR | | ≤ 2m EUR |

The size group definition is follows the European Commission's definition of small and medium-sized enterprises (<https://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition/>).

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Halle Institute for Economic Research (IWH) -
Member of the Leibniz Association

Kleine Maerkerstrasse 8
D-06108 Halle (Saale)
Germany

P.O. Box 11 03 61
D-06017 Halle (Saale)
Germany

Tel +49 345 7753 60
Fax +49 345 7753 820

www.iwh-halle.de

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