A structural corporate insolvency model to predict sectoral Austrian insolvencies amid the COVID-19 pandemic and beyond

EBA Research Workshop
16 November 2021

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Disclaimer

• All authors Oesterreichische Nationalbank (OeNB):
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  • Martin Schneider from the Economic Analysis Division

• Opinions expressed by the authors of the presentation do not necessarily reflect those of the OeNB or the ESCB.

• This presentation is based on Hesse et al. (2021): “A structural corporate insolvency model to predict sectoral Austrian insolvencies amid the COVID-19 pandemic and beyond”.

• Hesse et al. (2021) is an update of Puhr and Schneider (2021): “Have mitigating measures helped prevent insolvencies in Austria amid the COVID-19 pandemic?”, published in OeNB’s “Monetary Policy and the Economy”-Series January 2021.

• It has been revisited and expanded for EBA’s Research Workshop November 2021.

• The authors would like to thank Dieter Huber, Michael Kaden, Doris Oswald, Christoph Prenner and Ralph Spitzer (all OeNB) for helpful comments and valuable support.
In a joint project between the economics and the banking supervision departments following the COVID-19 pandemic we developed a sectoral insolvency model for Austria based on simulated balance-sheet data at the firm level and a macroeconomic scenario.

We assess the effectiveness and efficiency of how mitigating measures help to prevent corporate insolvencies following AT government’s containment measures to quell the spread of the COVID-19 pandemic.

Our results (sectoral insolvency rates) serve the following purposes:

- From a macroeconomic perspective, they can be used to assess the loss of productive capacities (lost potential output).
- From a fiscal policy perspective, they provides policy makers with an estimate of the costs of the measures.
- From a micro and macro prudential perspective, they are an important input to the estimation of credit default probabilities for the banking stress test and a broader vulnerability assessment of individual banks and the banking system.
A stylized view of the modelling set-up

- **Containment Measures**
- **AQM** (Austrian Quarterly Model)
- **Macro-Scenarios**
- **Input / Output Model**
- **Sectoral Output Shocks**
- **Firm Reporting Data**
- **Monte Carlo Simulation**
- **Firm-Level Data**
- **Corporate Insolvency Model**
- **Mitigating Measures**
- **Sectoral Insolvency Rates**
BACH and SABINA data form the basis for firms' balance sheets and P&L

### Balance Sheet

<table>
<thead>
<tr>
<th>Current assets (CA*)</th>
<th>Current Liabilities (CL*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash &amp; Bank (A7)</td>
<td>Equity (E)</td>
</tr>
<tr>
<td>Trade receivables (A3)</td>
<td>Current bonds (L11)</td>
</tr>
<tr>
<td>Other receivables (A41)</td>
<td>Current bank debt (L21)</td>
</tr>
<tr>
<td>Financial assets (A6)</td>
<td>Trade payables (L4)</td>
</tr>
<tr>
<td>Other Assets (A-A7 -CA)</td>
<td>Other Liabilities (L-E-CL)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total assets (A)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Total liabilities (L)</th>
</tr>
</thead>
</table>

### Profit & Loss Statement

<table>
<thead>
<tr>
<th>Turnover (I1)</th>
<th>Cost of inputs (I5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in inventories (I2)</td>
<td>External input (I6)</td>
</tr>
<tr>
<td>Capitalised production (I3)</td>
<td>Staff costs (I7)</td>
</tr>
<tr>
<td>Financial income (I42)</td>
<td>Operating charges (I81)</td>
</tr>
<tr>
<td>Other income (I4-I42)</td>
<td>Financial expenses (I83)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total income (It1)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Total expenses (It2)</th>
</tr>
</thead>
</table>

### Balance Sheet Ratios

<table>
<thead>
<tr>
<th>Current to total assets (R13)</th>
<th>Current to total liabilities (R16)</th>
</tr>
</thead>
</table>

### Variables used in model

- Extrapolated
- MC simulation

Variables currently not used

*CA & CL definitions deviate from BACH
A Monte Carlo simulation to fill data gaps of the firm-level data set

- Due to the absence of sufficient data at the firm-level, we simulate a firm-level data set for corporated firms of 18 variables for 17 NACE-1 sectors by means of a Monte Carlo method in 2 steps:

1. For our six core variables, we generate 100,000 draws from an estimated multivariate distribution that replicate the marginal distribution for each variable and the correlation structure between aggregated time series. For each variable, we estimate the marginal distribution based on the following data and distributional forms:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Source</th>
<th>Distribution</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity</td>
<td>SABINA</td>
<td>Firm-level data</td>
<td>Firm-level data available</td>
</tr>
<tr>
<td>Cash &amp; bank</td>
<td>SABINA</td>
<td>Firm-level data</td>
<td>Firm-level data available</td>
</tr>
<tr>
<td>Total income</td>
<td>BACH</td>
<td>Normal</td>
<td>Estimated with data for first quartile and mean</td>
</tr>
<tr>
<td>Total expenses</td>
<td>BACH</td>
<td>Normal</td>
<td>Estimated with data for first quartile and mean</td>
</tr>
<tr>
<td>Current assets</td>
<td>BACH</td>
<td>Gamma</td>
<td>Estimated with data for first quartile and mean</td>
</tr>
<tr>
<td>Current liabilities</td>
<td>BACH</td>
<td>Gamma</td>
<td>Estimated with data for first quartile and mean</td>
</tr>
</tbody>
</table>

2. The remaining 12 variables of the balance sheet and the profit & loss account are given as shares of the six simulated variables.
This presentation includes calculations based on three different scenarios

Aggregate output shocks based on OeNB’s forecasts 2020H1-2021H1

in percent
Overview of the insolvency model without mitigating measures

Shock to turnover

Profit & Loss Statement (t)

<table>
<thead>
<tr>
<th>Income(t0)</th>
<th>Expenses(t0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Δ Income(t)</td>
<td>- Δ Expenses(t)</td>
</tr>
</tbody>
</table>

Check for insolvency

if Cash & Bank(t) < -10%
OR
if Equity(t) < -30%

Balance Sheet (t)

<table>
<thead>
<tr>
<th>Cash &amp; Bank(t-1) + CF(t)</th>
<th>Equity(t-1) + Profit(t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Assets(t-1) - X</td>
<td>Current liabilities(t-1) + α Y</td>
</tr>
<tr>
<td>o.w. financial assets (t-1) - X</td>
<td>o.w. bank debt(t-1) + α Y</td>
</tr>
<tr>
<td>Other Assets(t0)</td>
<td>Other Liabilities(t0) + (1-α) Y</td>
</tr>
</tbody>
</table>

Pre-tax profit / loss (t)

Profit tax(t)

Indirect method: profit / loss after tax - cap. prod. (I3) + depreciation (I9) + tax

Cash-flow investment (t)

Fire sales (X)

Cash-flow financing (t)

Debt finance (Y)

Cash-flow operations (t)

endogeneously calculated, tax rate 15%

After-tax profit / loss (t)

Cash & Bank(t-1) + CF(t)

w.o. bank debt(t-1) + α Y

w.o. financial assets (t-1) - X

Other Liabilities(t0) + (1-α) Y

Profit & Loss Statement (t)

Income(t0)

Expenses(t0)

Δ Expenses (t)

Δ Income(t)
All AT mitigating measures aimed at corporates are included in the model

**Capital injections via grants and subsidies**
- Fixed-cost support (FKZ)
- Fixed-cost support 2 (FKZ II)
- Revenue compensation (November)
- Revenue compensation (December)
- Loss compensation
- Short-term work
- Sector-specific measures

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available (EUR bn)</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>8 Gov.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Gov.</td>
<td></td>
<td></td>
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<tr>
<td>11 Gov.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.8 + 0.5 Gov.</td>
<td></td>
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**Long-term deferrals of payment obligations**
- Credit guarantees
- Debt moratoria

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<tbody>
<tr>
<td>16 Gov./Banks</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>n.a. Banks</td>
<td></td>
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**Short-term deferrals of payment obligations**
- Reduction of corporate tax advance payments
- Deferral of social security contributions
- Delayed insolvency filing due to deferral

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<tr>
<td>n.a. Social Sec.</td>
<td></td>
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**Changes to the insolvency regime**
- Temporary change to the insolvency law
- Suspended bankruptcy filings by the public sector

- Gov. | | |
- Social Sec. | | |

*EUR 12 bn is the earmarked total for fixed-cost support, revenue- and loss compensation (of which EUR 9.9 bn paid-out in the model)
**Actual long-term liquidity support
Overview of the insolvency model with mitigating measures

**Profit & Loss Statement (t)**

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**Relaxed insolvency def.**

ignores equity trigger (temp.)

**Filing moratorium**

ignores liquidity trigger (temp.)

**Shock to turnover**

**Debt moratorium (1/2)**

reduces interest expenses

**Deferment of taxes**

reduces profit tax

**Profit tax(t)**

**Deferment of social security contributions**

improves cash-flow

**Cash operations (t)**

**Debt (Y)**

**CF via indirect method**

**Fixed cost grants**

increases equity & CF

**Sector specific measures**

all lead to increased equity

**Cash-flow investment (t)**

**Cash-flow financing (t)**

**Debt finance (Y)**

**Credit guarantees**

increases CF via new loans

**Debt moratorium (2/2)**

reduces debt repayments

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**Credit guarantees**

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**Debt moratorium (2/2)**

reduces debt repayments

**Cash-flow operations (t)**
Insolvency model results from three different calculations (1/2)

Aggregate model insolvency rates with and without mitigating measures 2020H1-2021H1

Without mitigating measures

With mitigating measures

Please note that results deviate from previous publications as the latest model calibration has served as the basis for all three calculations.
Insolvency model results from three different calculations (2/2)

Impact of the mitigating measures on the aggregate insolvency rates 2020H1-2021H2

2020H1
(June 2020)

2020H2
(Dec 2020)

2021H1
(June 2021)

Please note that results deviate from previous publications as the latest model calibration has served as the basis for all three calculations.
Conclusion

• Our corporate insolvency model is highly stylized and relies on several heroic assumptions. Calibrations on the (implicit) behavior of firms is done in order to replicate historic insolvency rates. This obviously leaves ample room for future improvements.

• Regarding results, so far we have slightly overestimated insolvency rates during the COVID-19 pandemic. Nevertheless, we were able to provide valuable input to internal and external policy discussions from all three angles we set out to pursue (the macroeconomic, the fiscal policy and the micro and macro prudential perspective).

• Most importantly, we were able to both, assess the efficiency and efficacy of mitigating measures as designed by the Austrian government (with early observations later confirmed by actual use of individual measures by Austrian firms) and shed light on the impact of frictions regarding their implementation.

• Finally, we were able to use model output for further OeNB analyses, foremost in the area of top-down stress testing (both, as part of OeNB’s regular top-down solvency stress tests and our first climate risk stress test – the latter of which by expanding the insolvency models functionality).
Danke für Ihre Aufmerksamkeit

Thank you for your attention

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OeNB
References


