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Is «Normal» Capacity Utilisation a Technology Driven Variable? Analyses with Macro and Micro Data from Business Tendency Surveys

Analyses with Macro and Micro Data from Business Tendency Surveys

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Is ‘Normal’ Capacity Utilisation a Technology Driven Variable? Analyses with Macro and Micro Data from Business Tendency Surveys

Matthias Bannert, Richard Etter, Michael Graff, Martin Wörter
Overview

- Introduction
- Empirical analyses
  - Findings from an international panel data set
  - Findings from Swiss micro data
    - Capacity utilisation from survey data
    - Purging the business cycle from NormCapU
    - Sectoral analyses
    - A tentative explanation
- Conclusions
Introduction

- The rate of capacity utilisation (CapU) is an element of the business cycle – relates to stress on the capacity to produce goods and services
- Technical bottlenecks indicate inflationary pressure and vice versa
- Bottleneck can be diagnosed only, if ‘normal’ can be identified
- The ‘normal’ rate of capacity utilisation (NormCapU) is probably not a stationary variable – historical average not helpful
- We try to identify the level of NormCapU from international and Swiss data
Two Null-Hypotheses

H0₁: The average rate of capacity utilisation is constant.

H0₂: The rate of capacity utilisation considered as ‘normal’ is constant.

Yet: Recent decades witnessed rapid technological progress that in principle allows for change in logistics (e.g. just-in-time production).

- Average capacity utilisation could be higher than same decades ago

If there was a pronounced trend in the average level of capacity utilisation that cannot be attributed to the business cycle, it would be reasonable to conclude that what is considered normal would be adjusted accordingly.
Empirical analyses (1)

Findings from an international panel data set
Data

- Data from business tendency surveys (BTS), 1970 – 2013
- Quantitative question on capacity utilisation
  - CapU; source, OECD
- Control variable for business cycle BC: output gap (2012 ff: annual)
  - OG; sources: Ecfin, OECD MEI

Annual frequency, 47 countries, 44 years, N = 2068

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>StdDev</th>
<th>n</th>
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<td>98.0</td>
<td>78.2</td>
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<td>1138</td>
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<td>OG</td>
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<td>14.8</td>
<td>-0.34</td>
<td>3.1</td>
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- Panel is highly unbalanced – balanced N = 896
The OG panel: all countries
The CapU panel: all countries
The CapU panel: $\text{CapU}_t$ box plots
The CapU panel: by category
The CapU-OG panel: cross-correlation
The CapU-OG panel: regressions

- Purging average CapU from the BC

\[ \text{CapU}_{it} = \alpha_i + \beta \text{OG}_{it} + \gamma \text{OG}_{it} \times \text{Trans}_i + \varepsilon_{it} \]

- \( \alpha \): country fixed effects
- Trans: transformation economy 0/1-variable
- \( \varepsilon \): CapU purged from BC
The CapU-OG panel: regressions

- CapU as a function of time

\[ \text{CapU}_{it} = \alpha + \beta t + \varepsilon_{it} \]

\[ R^2 = 0.04 \]
\[ N = 1138 \]
\[ \beta = -0.15 \ (t = -7.02) \]
CapU_{it} = \alpha_i + \beta OG_{it} + \gamma OG_{it}^* Trans_i + \varepsilon_{it}

<table>
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<td></td>
<td>OG .659</td>
<td>.042</td>
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<td></td>
<td>Interact_OG_Transform -.208</td>
<td>.100</td>
<td>-.046</td>
<td>-2.076</td>
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</table>

N = 896, constant $\alpha_i$: Germany
CapU purged: $\varepsilon_t$ box plots
Full panel: $\varepsilon_{it} = \alpha - 0.05 \, t \, (-7.02)$
Balanced panel: $\varepsilon_{it} = \alpha + -0.19 \, t \, (-8.03)$
Discussion of results

- Sample mean for CapU = 78.%
- Considerable variation, heterogeneity pronounced
- Regressing international data on linear time trend
  - significantly negative slope
- Average of the rate of capacity utilisation is highly cyclical.
- Purge CapU from cyclical component, represented by output gap
- Panel fixed effects regression confirms negative time trend of CapU, even if we include
  - country fixed effects
  - a transaction country dummy and interactions with it
- $H_{01}$ and $H_{02}$ rejected
Discussion of results (ctd)

- Pronounced heterogeneity → results probably not too informative
  - Sampling effects in earlier years
  - Transformation economies start from low levels of CapU, increasing swiftly
- Case studies more informative
- Turn to this now
Empirical analyses (2)

Findings from Swiss Micro data
Overview

- Capacity utilisation from survey data
- Combination of data on micro level: NormCapU
- Other data on cycle from same BTS
- Purging the business cycle from NormCapU
- Sectoral analyses
- A tentative explanation
Capacity utilisation from survey data

- KOF quarterly industry BTS for Switzerland (CH)
- Capacity utilisation
  - Qualitative (too low, just right, too high)
  - Quantitative (5 percent points)
- Select firms answering *just right*
- Average for these firms $\rightarrow$ NormCapU
- Purge cycle with data from BTS survey, 1st PC from balances of
  - Incoming orders compared to same month previous year
  - Orders books compared to previous month
  - Production compared to previous month
  - Production compared to the same month of previous year
  - Assessment of the order backlog
Capacity utilisation CH

- Structural break in KOF microdata in 1999q2
- Regression (stepwise, tolerance p = 0.2)

\[ \text{NormCapU}_{it} = \alpha + \beta \text{BCycle}_{it} + \gamma \text{D1999Q2}_t + \delta \text{BCycle}_{it} \times \text{D1999Q2}_t + \varepsilon_i \]

- BCycle: 1st PC from 5 BTS balance series
- \( \varepsilon \): NormCapu purged from cycle
- \( i \): Total manufacturing or 2digit branches
NormCapU vs CapU, CH
NormCapU vs CapU, CH

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
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<td>78.19</td>
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<td>AverageCapU</td>
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<td>74.74</td>
<td>87.26</td>
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<td>Valid N (listwise)</td>
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BCycle: PC extraction

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<th>Component</th>
<th>Initial Eigenvalues</th>
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<td>Total</td>
<td>% of Variance</td>
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<td>3.739</td>
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<td>2</td>
<td>.807</td>
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<td>3</td>
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<td>3.143</td>
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<td>5</td>
<td>.046</td>
<td>.915</td>
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Stepwise regression → purged NormCapU, CH

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<th>t</th>
<th>Sig.</th>
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<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
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</tr>
<tr>
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<tr>
<td>(Constant)</td>
<td>84.566</td>
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<td>386.059</td>
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<tr>
<td>D1999Q2</td>
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<td>.311</td>
<td>-0.593</td>
<td>-8.158</td>
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<tr>
<td>2</td>
<td></td>
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<tr>
<td>(Constant)</td>
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<td>BCycle</td>
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<tr>
<td>(Constant)</td>
<td>84.610</td>
<td>.181</td>
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<td>BCycle</td>
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<td>-0.448</td>
<td>.260</td>
<td>-0.157</td>
<td>-1.723</td>
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NormCapU, standardised, low-pass filtered
Purged NormCapU, standardised, low-pass filtered
NormCapU, & purged, standardised, low-pass filtered
### Analyses by branches

<table>
<thead>
<tr>
<th>Branch</th>
<th>NACE Rev. 1, text</th>
<th>Acronym</th>
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</thead>
<tbody>
<tr>
<td>15</td>
<td>Manufacture of food products and beverages</td>
<td>Food</td>
</tr>
<tr>
<td>17</td>
<td>Manufacture of textiles</td>
<td>Textile</td>
</tr>
<tr>
<td>18</td>
<td>Manufacture of wearing apparel</td>
<td>Apparel</td>
</tr>
<tr>
<td>20</td>
<td>Manufacture of wood and of products of wood</td>
<td>Wood</td>
</tr>
<tr>
<td>21</td>
<td>Manufacture of pulp, paper and paper products</td>
<td>Paper</td>
</tr>
<tr>
<td>22</td>
<td>Publishing, printing and reproduction of recorded media</td>
<td>Print</td>
</tr>
<tr>
<td>24</td>
<td>Manufacture of chemicals and chemical products</td>
<td>Chemical</td>
</tr>
<tr>
<td>25</td>
<td>Manufacture of rubber and plastic products</td>
<td>Plastic</td>
</tr>
<tr>
<td>26</td>
<td>Manufacture of other non-metallic mineral products</td>
<td>Non-metal</td>
</tr>
<tr>
<td>27</td>
<td>Manufacture of basic metals</td>
<td>Metal</td>
</tr>
<tr>
<td>29</td>
<td>Manufacture of machinery and equipment</td>
<td>Machine</td>
</tr>
<tr>
<td>33</td>
<td>Manufacture of medical, precision and optical instruments</td>
<td>Precision</td>
</tr>
</tbody>
</table>
Is NormCapU a technology driven variable?

- Explorative analyses
  - Patent activity → proxy for technical change
    - Applications for *patent families* by branches
      - 1983 to 2009
      - Except Print (22)
  - Working hypothesis: technological activity may increase NormCapU
    - In certain sectors
    - Relationship not necessarily linear
Innovation regressions

- Recapitulation
  \[ \text{NormCapU}_{it} = \alpha + \beta \text{BCycle}_{it} + \gamma \text{D1999Q2}_t + \delta \text{BCycle}_{it} \times \text{D1999Q2}_t + \varepsilon_{it} \]
  - \( \varepsilon \): NormCapU purged from cycle

- Innovation regressions
  - Pooled
    \[ \varepsilon_{it} = \alpha_i + \beta \text{Patents}_{it} + \gamma \text{Patents}^2_{it} \]
  - By branch
    \[ \varepsilon_t = \alpha + \beta \text{Patents}_t + \gamma \text{Patents}^2_t \]

Evidence from Swiss Micro Data
Innovation regressions

- Pooled

\[ \varepsilon_{it} = 87.8^* + 0.002^* \text{ Patents}_{it} - 0.000007^* \text{ Patents}^2_{it} \]

\[ R^2 = 0.51, \; N = 1154 \]
Branch 15: Food
Branch 20: Wood
Branch 26: Non-metal
Branch 27: Metal
Branch 29: Machine
Branch 33: Precision
Summary and Conclusions

- Which rate of capacity utilisation is “normal”?  
- Constant, increasing or decreasing?  
  - Prior assumption: up rather than down  
- Main findings  
  - Capacity utilisation considered normal is not constant.  
  - Last few decades → decreased rather than increased.  
    - Reject H₀₀ and H₀₁  
  - Technical change → higher level of NormCapU  
    - Pronounced differences across branches