Nowcasting Manufacturing Value Added across countries: The present and the future

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1United Nations Industrial Development Organization, Vienna

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Outline

1. The UNIDO databases
2. Nowcasting MVA
3. Metadata and the operational framework
4. Summary and conclusions
Outline

1. The UNIDO databases
2. Nowcasting MVA
3. Metadata and the operational framework
4. Summary and conclusions
UNIDO databases

- Cover the manufacturing sector
- Refer to economic statistics, mainly production and trade related, not technological or environmental data
- Include statistical data from the annual observation within the quality assurance framework (no experimental or one-time study data)
- Official data supplied by NSOs (abided by the resolution of UN Statistics Commission)
- Further details: http://stat.unido.org
- Follow the UNIDO Quality Framework (Upadhyaya and Todorov, 2019)
Main data sources

Information about the domestic production
By ISIC at 3- or 4-digit level (readily available at the National statistical offices).

1. Employment (number of employees)
2. Compensation of employees
3. Gross output
4. Intermediate consumption
5. Value added
6. Gross fixed assets at the end of the reference year and the gross fixed capital formation
7. Index numbers of industrial production
Main data sources (2)

Foreign trade statistics
Available from e.g. UN COMTRADE.

1. Export of manufactured goods
2. Import of manufactured goods

For an overall assessment of the performance of the manufacturing sector in relation to the economy as a whole, data are needed on the following indicators:

1. Population
2. Gross domestic product (GDP)
3. Manufacturing value added (MVA)
UNIDO industrial statistics databases: summary

- **INDSTAT DB**
- **MINSTAT DB**
  - by ISIC and by country
- Number of establishments
- Number of employees
- Number of female employees
- Wages and salaries
- Gross output
- Value added
- Gross fixed capital formation
- Index numbers of industrial production

- **MVA DB**
  - by country
  - GDP at current prices
  - GDP at constant prices
  - MVA at current prices
  - MVA at constant prices
  - Population

- **MVA DB**
  - by country
  - GDP at current prices
  - GDP at constant prices
  - MVA at current prices
  - MVA at constant prices

- **IDSDB**
  - by ISIC and by country
  - Output = Y
  - Import = M
  - Export = X
  - Apparent consumption = C

\[ C = Y + M - X \]
Manufacturing Value Added

- **MVA** is the key indicator of a country’s industrial production
- Published in UNIDO’s *International Yearbook of Industrial Statistics*
- Main data source is *National Accounts Main Aggregates Database* of UNDESA
- Data missing for many countries and years
- A time-gap of at least one year (between the latest year and current year)
  - Using data from other sources
  - Nowcasting methods to fill in the missing data up to the current year
Overall growth trends of world MVA by selected country groups at constant 2015 prices
### Table 1.1

**DISTRIBUTION OF WORLD MVA AMONG SELECTED COUNTRY GROUPS, 2005-2019**

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a/ Excluding non-industrialized EU economies.
b/ Provisional.
c/ Estimate.
Using MVA estimates: Competitive Industrial Performance (CIP) index

\[ \text{CIP Index} = \prod \]

\begin{itemize}
  \item **first dimension:** Capacity to produce & export manufactures
    \begin{itemize}
      \item Indicator 1: MVAp\(c\)
        Manufacturing Value Added per Capita
      \item Indicator 2: MXp\(c\)
        Manufacturing Export per Capita
    \end{itemize}
  \item **second dimension:** Technological deepening and upgrading
    \begin{itemize}
      \item Composite (Indicator 3-4): Industrialization Intensity
        \[ \text{INDint} = \frac{\text{MHVAs} + \text{MVAs}}{2} \]
      \item Composite (Indicators 5-6): Export Quality
        \[ \text{MXQual} = \frac{\text{MHXs} + \text{MXs}}{2} \]
    \end{itemize}
  \item **third dimension:** World Impact
    \begin{itemize}
      \item Indicator 7: ImWMVA
        Impact of a country on World MVA
      \item Indicator 8: ImWMT
        Impact of a country on World Manufactures Trade
    \end{itemize}
\end{itemize}
Using MVA estimates: Monitoring SDG 9 indicators

Based on its mandate, UNIDO focuses on the SDG9

**Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation**

- **Target 9.2**
  - 9.2.1 Manufacturing value added (share in GDP, per capita)
  - 9.2.2 Manufacturing employment, in percent to total employment

- **Target 9.3**
  - 9.3.1 Percentage share of small scale industries in total industry value added
  - 9.3.2 Percentage of small scale industries in loan or line of credit

- **Target 9.4**
  - 9.4.1 CO2 emission per unit of value added

- **Target 9.5**
  - 9.b.1 Percentage share of medium and high-tech (MHT) industry value added in total value added
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A good nowcasting method is not only a method with a low mean absolute error, but it also needs to satisfy the following three requirements:

- **R1.** The nowcasts produced by the method are little influenced by revisions of single observations in the data.
- **R2.** The nowcasts should be plausible given the past values of MVA.
- **R3.** The nowcasting method should not only be accurate on average, but also accurate for all countries.
Nowcasting MVA

- GDP data are available up to the current year:
  - For earlier years the actual GDP values are used
  - For the most recent one or two years the GDP values are derived from the nowcasts of GDP growth rates reported in the *World Economic Outlook of IMF* (see Artis, 1996)
- MVA—a time-gap of at least one year: nowcasting
- MVA is strongly connected to the GDP
- ⇒ this suggests to nowcast MVA on the basis of the estimated relationship between contemporaneous values of MVA and GDP
- We want a parsimonious nowcasting model (Marcellino (2008) has shown that in general simple linear time series models can be hardly beaten if they are carefully specified)
Nowcasting MVA—the model

- We consider models based on the following general representation of MVA:

\[ MVA_{i,t} = MVA_{i,t-1}(1 + gMVA_{i,t}) \]

where the MVA growth rate is modelled as

\[ gMVA_{i,t} = a_i + b_i gGDP_{i,t} + c_i gMVA_{i,t-1} + e_{i,t} \]

and \( e_{i,t} \) is white noise.

- This general model can be specialized down to four different models (see Boudt, Todorov and Upadhyaya, 2009)
Nowcasting MVA—Outliers (example)
Nowcasting MVA—estimation

- The standard OLS estimator may be biased because of
  - violation of the assumption of exogeneity of the regressors with respect to the error term
  - presence of outliers in the data
- What are outliers?
  - atypical observations which are inconsistent with the rest of the data or deviate from the postulated model
  - may arise through contamination, errors in data gathering, or misspecification of the model
  - classical statistical methods are very sensitive to such data
- For this reason we also consider a robust alternative to the OLS estimator, namely the MM-estimator
Nowcasting MVA

![Graphs showing correlation between Yearly GDP growth and Yearly MVA growth.](Image)
Nowcasting MVA—MM-estimator

- Robust methods: produce reasonable results even when one or more outliers may appear in the data
- The MM-regression estimator is a two step estimator:
  - First step—S estimates
  - This estimate is used as a starting value for M-estimation where a loss function is minimized that downweights outliers
- Has a high efficiency under the linear regression model with normally distributed errors
- Because of the S initialization it is highly robust
- For details see Maronna et al. (2006)
- R code available in package robustbase
Nowcasting MVA—assessment

- Pseudo out-of-sample nowcast accuracy comparison between the methods (6 models and 2 estimator choices, 12 in total)
  - Mean Absolute Percentage Error (MAPE)
  - The proportion of observations for which the Absolute Percentage Error (APE) exceeds 10% and 20%

- The Analysis is based on all 200 countries
  - Aggregates of all countries
  - Splitting the sample into the countries for which the share of MVA in GDP is below/above its median value
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| Year | EU a/ | Other | East Asia | West Asia | North America | Others | Percentage share in world total MVA (at current prices) | Region groups Development groups Least Developed Countries |
|------|-------|-------|-----------|-----------|---------------|--------|-----------------------------------------------|------------------------------------------------|------------------|
| 2009 | 23.7  | 3.3   | 15.4      | 0.4       | 19.9          | 2.1    | 1.9   | 25.0          | 2.2   | 6.1          | 15.4          | 17.4 | 1.7               | 0.7           |
| 2010 | 21.7  | 3.4   | 16.5      | 0.5       | 18.7          | 2.1    | 1.9   | 26.5          | 2.1   | 6.6          | 16.4          | 18.3 | 1.7               | 0.7           |
| 2011 | 21.4  | 3.7   | 15.5      | 0.5       | 17.5          | 2.1    | 1.8   | 28.9          | 2.2   | 6.4          | 16.3          | 20.7 | 1.7               | 0.6           |
| 2012 | 19.5  | 3.7   | 15.4      | 0.5       | 17.8          | 2.0    | 2.0   | 30.9          | 2.0   | 6.2          | 16.0          | 22.5 | 1.9               | 0.7           |
| 2013 | 19.9  | 3.6   | 13.5      | 0.5       | 17.8          | 2.0    | 2.0   | 32.3          | 2.2   | 6.2          | 15.9          | 24.1 | 2.0               | 0.7           |
| 2014 | 20.1  | 3.4   | 13.0      | 0.5       | 17.6          | 1.9    | 2.1   | 33.3          | 2.1   | 6.0          | 15.4          | 25.3 | 2.0               | 0.8           |
| 2015 | 18.8  | 2.8   | 12.9      | 0.5       | 18.7          | 1.8    | 2.0   | 35.0          | 1.9   | 5.6          | 15.0          | 26.7 | 2.0               | 0.8           |
| 2016 | 19.1  | 2.6   | 13.9      | 0.4       | 18.3          | 1.8    | 1.8   | 34.9          | 2.0   | 5.2          | 14.7          | 26.4 | 1.9               | 0.9           |
| 2017 b/ | 19.0  | 2.7   | 13.2      | 0.4       | 18.0          | 1.8    | 1.7   | 35.9          | 2.0   | 5.3          | 15.0          | 27.1 | 1.8               | 1.0           |

a/ Excluding non-industrialized EU economies.
b/ Provisional.
c/ Estimate.
Metadata in the online database INDSTAT

Selected Dataset: INDSTAT 2 2019, ISIC Revision 3.

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Metadata for Switzerland/Value added/2017/15 Food and beverages

Special note UNIDO Estimate
Data transformation at UNIDO Statistics

The main objective of data transformation is to convert national data into an international statistical product. National data inherently differ by currency, national adaptation of industry classification, reference periods, etc.

- **Stage 1**—responses to national questionnaires. Detection and if possible correction of obvious reporting errors
  - Used for pre-filling the following edition of the questionnaire
  - Data are considered official

- **Stage 2**—incorporation of published national data.
  - Inconsistent data are corrected using supplementary information from national publications
  - Published in International Yearbook of Industrial Statistics
  - Data are considered official
Operational framework: stages

- **Stage 3**—disaggregation of data. Data are adjusted to eliminate the departures from the level of ISIC aggregation
  - using national and international sources
  - using supplementary data

- **Stage 4**—automatic disaggregation and interpolation. Missing data are estimated applying related proportion or interpolation whenever applicable
  - For ISIC Revision 3, 2-digit only

- **Stage 5**—estimation of provisional data for the latest years.
  - Selected variables only
Outline

1. The UNIDO databases
2. Nowcasting MVA
3. Metadata and the operational framework
4. Summary and conclusions
Summary and conclusions

• UNIDO Statistics mandate: maintain global industrial statistics databases

• To allow cross-country comparison of the current industrial economic situation, nowcasts of manufacturing value added are needed

• We considered nowcast methods that exploit the relationship between MVA and GDP and the fact that accurate nowcasts of current GDP are available from external sources. Best performance is achieved when using
  ▶ Stationary variables (eg growth rates)
  ▶ Robust estimation procedures
  ▶ Rolling estimation window for robustness to structural breaks

• Data quality framework
References I

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