Global Growth Centres 2020

DBR’s Foresight Model for Evaluating Long-term Growth
DB Research: Deutsche Bank’s Think Tank

- Analyses the economic, societal, political and technological environment of the DB group…

- … with a long-term perspective and interdisciplinary scope…

- … using a broad spectrum of concepts and tools…

- …and following a foresight approach, knowing that all forecasts are conditional.

- Contributes to the strategy and decision-making of top management

- Intensively communicates with peers, plays an active role in public debate and strengthens DB’s brand
Global growth centres 2020: goals

- Target: growth rate of gross domestic product (GDP) in the period 2006 to 2020 (per capita and overall)

- 34 countries: 21 rich countries and 13 emerging markets

- Value added: combination of quantitative and qualitative elements

- Quantitative element: drivers influence GDP directly. Uses state-of-the-art empirical methods to model the links between drivers and GDP in the econometric equation.

- Qualitative element: broad-based interdisciplinary trend analysis to improve forecasts of drivers. Structural breaks are captured.
**Formel-G: Foresight Model for Evaluating Long-term Growth**

- **Ultimate target**: GDP

- **Econometric equation**:
  - Population growth
  - Investment ratio
  - Human capital
  - Openness

- **GDP drivers**:
  - Trend cluster 1
  - Trend cluster 2
  - Trend cluster ...
  - Trend cluster 6

- **Systematic selection**: by scope, impact, predictability, then clustering

- **Generally relevant societal, economic and tech trends**:
  - Derived through own screening, cooperation with other experts

- **Generally relevant GDP drivers**:
  - Derived through own data analysis, scientific literature
First step: identify drivers of economic growth

- **Theoretical** relationship with GDP growth

- **Empirical** relationship is both statistically and economically significant (our panel estimates)

- **Time series** must be available (Central and Eastern Europe therefore not included)

- Includes information not covered by any of the other drivers (collinearity)
Driver: Level of GDP per capita?

Real GDP per capita in PPP

- USA
- Ireland
- Norway
- Canada
- Switzerland
- Denmark
- Australia
- Belgium
- Japan
- Netherlands
- Sweden
- Austria
- Finland
- France
- Germany
- Italy
- UK
- New Zeal.
- Spain
- Portugal
- Greece
- Korea
- Argentina
- Chile
- Mexico
- Malaysia
- Brazil
- Thailand
- Turkey
- China
- Indonesia
- India

Source: OECD und WDI

- Conventional wisdom: „poor countries grow more strongly than rich ones“
- But no empirical evidence for assumption of absolute convergence. Will not use that idea
- Growth centres exist among rich and poor countries
- => There is no automatism! Growth requires „hard“ work
Driver investment ratio

- Our measure: real investment as % of real GDP
- More capital input with a given labour input boosts labour productivity
- Decreasing marginal returns
- On average: seems to be bounded between 10% and 40%

DBR’s Foresight model for evaluating long-term growth
Our measure: average years of education of the population aged 25 to 64 (OECD Data)

- Quality of labour input: Ability to generate and apply new knowledge

- Growth of human capital relevant for per-capita GDP growth (not: level of human capital). Use log-log specification

- Correlates positively with economic freedom, life expectancy, R&D expenditure
Our measure: foreign trade in % of GDP corrected for population and price differences.

- Exchanging goods and ideas with other countries promotes learning. Plus: Increasing competitive pressure boosts efficiency of companies.
- Trade based on comparative advantage does not raise GDP.
- Change in openness leads to change in GDP.
Pooled Mean Group Panel Estimation (PMG)

\[
\Delta \ln y_{i,t} = -\phi_i \left( \ln y_{i,t-1} - \theta_1 \ln s^K_{i,t} - \theta_2 \ln h_{i,t} + \theta_3 n_{i,t} - \sum_{j=4}^{m} \theta_j \ln V^j_{i,t} - a_{m+1}t_i - \theta_{0,i} \right) \\
+ b_{1,i} \Delta \ln s^K_{i,t} + b_{2,i} \Delta \ln h_{i,t} + b_{3,i} \Delta n_{i,t} + \sum_{j=4}^{m} b_{j,i} \Delta \ln V^j_{i,t} + \epsilon_{i,t}
\]
**Formel-G: Foresight Model for Evaluating Long-term Growth**

Ultimate target: GDP

- **GDP drivers**
  - Population growth
  - Investment ratio
  - Human capital
  - Openness

- **Econometric equation**

- **Systematic selection** by scope, impact, predictability, then clustering

- **Total of 21 trends incorporated in Formel-G, aggregated in 6 coherent trend clusters**

- **Generally relevant societal, economic and tech trends**
  - Derived through own screening, cooperation with other experts

- **Systematic selection** by theoretical and empirical relevance

**DBR’s Foresight model for evaluating long-term growth**
Second step: forecast the drivers until 2020

- **First stage: Extrapolation.** Past development determines future course of each driver (exception: population growth, which uses UN data)

- **Second stage: Cross-check.** Correct extreme developments systematically (only required for investment ratio and human capital)

- **Third stage: Trend analysis.** The reliability of the forecasts is increased by modelling structural breaks and assessing a broad range of information (applied to all four drivers)

Calculate GDP forecasts using the econometric equation
Selecting the trends that will shape future growth

- Basis: **40 DBR trends** from the five categories
  “The individual and society“, “Institutions and political environment“, “Organisational forms and markets“, “Innovation and technology“ and “Natural resources“

- Likely to be significant for future economic growth => **21 trends**. But too many possible links to the drivers

- Therefore we assessed the reciprocal effects among all 21 trends in a cross-impact matrix. The result is **6 consistent clusters**
# The cross-impact matrix

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</thead>
<tbody>
<tr>
<td><strong>Arbeitsmigration nimmt zu</strong></td>
<td>3 0 2 -1 1 1 3 1 0 0 1 0 -1 1 1 0 0 0 0 0 0</td>
<td><strong>Urbanisierung steigt</strong></td>
<td>2 2 1 0 1 2 1 0 0 0 0 0 1 1 0 0 0 0 0 0</td>
<td><strong>Frauen gewinnen im Erwerbsleben an Bedeutung</strong></td>
<td>1 1 1 0 1 0 1 2 1 0 1 0 0 0 0 0 0 0 0 0</td>
<td><strong>Potential für soziale Reibung steigt</strong></td>
<td>0 -1 0 0 3 0 0 1 0 0 -1 2 0 0 1 0 0 0 0 0</td>
<td><strong>Industriearbeitern überaltert</strong></td>
<td>2 0 1 2 0 3 3 0 1 1 0 1 0 0 1 1 0 0 0 0</td>
<td><strong>Bedrohung durch internationalen Terrorismus wächst</strong></td>
<td>-1 -1 0 3 0 0 0 1 0 3 0 0 -1 1 -1 1 0 0 0 0</td>
<td><strong>Gesundheitssektor wächst</strong></td>
<td>1 1 2 0 2 0 0 1 1 2 1 1 0 1 0 0 1 2 1 0</td>
<td><strong>Karrierewege und Arbeitsumfelder werden flexibler</strong></td>
<td>2 1 3 0 -1 0 0 2 0 0 0 1 0 1 0 1 0 0 0 0</td>
<td><strong>Wissensintensive Dienstleistungen gewinnen an Bedeutung</strong></td>
<td>1 1 2 0 0 0 1 1 0 0 1 1 0 2 1 0 2 0 0 0 0</td>
<td><strong>Organisations- und Marktprozesse werden virtualisiert</strong></td>
</tr>
</tbody>
</table>
Deutsche Bank Research’s trend map

Opening of work and society

- Urbanisation rises
- Labour migration increases
- Career paths and work environments become more flexible
- Women gain more importance in employment

Restriction of growth

- Potential for social frictions rises
- Threats from international terrorism increase
- Natural resources become scarcer

Process virtualisation in networks

- Links between humans and machines strengthen
- Electronic networks become more pervasive and perform better
- Virtualisation of organisational and market processes
- Transnational companies gain increasing importance
- Global institutions gain more influence

Global networking in business and politics

- Knowledge-intensive services gain in importance
- Services are increasingly provided across borders
- Markets are deregulated on national basis

Conquest of smallest structures

- Biotechnology becomes central growth area
- Micro and nanotech. become important fields of innovation

Enlarging scope of life

- Health sector grows
- Populations are ageing

DB Research trend map

The trends that will shape the global economy in the next two decades

The individual and society

Organisational forms and markets

Institutions and political environment

Innovation and technology

Natural resources

Trend cluster
Trend analysis: changes in the speed of trend clusters

- Trends describe **long-term changes in the environment**
  *society, economy, technology; time horizon > 20 years*

- **Country experts** assess speed of trends

- A relevant impact on our growth analysis comes from the **changes in the speed** of trend clusters *unchanged speed (1990-2020) included in the baseline forecast*

![Graph showing trend analysis changes in speed of trend clusters](image)
Impact of trends on drivers

DBR’s Foresight model for evaluating long-term growth

Trend cluster 1
Enlarging scope of life (India)

1990 2005 2020

Trend cluster 2
Trend cluster …
Trend cluster 6

Driver Population growth
Driver Investment ratio
Driver Human capital
Driver Trade openness

Econometric equation

GDP
The growth ranking for 2006 to 2020

**DBR’s Foresight model for evaluating long-term growth**

**Deutsche Bank Research’s** *Formel-G “Foresight Model for Evaluating Long-term Growth”*

- Asian economies lead the growth ranking: India, Malaysia and China

- Within the EU-15 range from 1.3% (Netherlands) to 3.8% (Ireland) average annual GDP growth in 2006-20

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**Formel-G: Ranking of GDP growth 2006-20**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>GDP growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>India</td>
<td>5.5</td>
</tr>
<tr>
<td>2</td>
<td>Malaysia</td>
<td>5.4</td>
</tr>
<tr>
<td>3</td>
<td>China</td>
<td>5.2</td>
</tr>
<tr>
<td>4</td>
<td>Thailand</td>
<td>4.5</td>
</tr>
<tr>
<td>5</td>
<td>Turkey</td>
<td>4.1</td>
</tr>
<tr>
<td>6</td>
<td>Ireland</td>
<td>3.8</td>
</tr>
<tr>
<td>7</td>
<td>Indonesia</td>
<td>3.5</td>
</tr>
<tr>
<td>8</td>
<td>Korea</td>
<td>3.3</td>
</tr>
<tr>
<td>9</td>
<td>Mexico</td>
<td>3.2</td>
</tr>
<tr>
<td>10</td>
<td>Chile</td>
<td>3.1</td>
</tr>
<tr>
<td>11</td>
<td>USA</td>
<td>3.1</td>
</tr>
<tr>
<td>12</td>
<td>Argentina</td>
<td>3.0</td>
</tr>
<tr>
<td>13</td>
<td>Spain</td>
<td>2.8</td>
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<tr>
<td>14</td>
<td>Brazil</td>
<td>2.8</td>
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<tr>
<td>15</td>
<td>Canada</td>
<td>2.4</td>
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<tr>
<td>16</td>
<td>France</td>
<td>2.3</td>
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<tr>
<td>17</td>
<td>Norway</td>
<td>2.1</td>
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<tr>
<td>18</td>
<td>New Zealand</td>
<td>2.1</td>
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<td>19</td>
<td>Austria</td>
<td>2.1</td>
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<td>20</td>
<td>Portugal</td>
<td>2.0</td>
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<td>21</td>
<td>UK</td>
<td>1.9</td>
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<td>22</td>
<td>Sweden</td>
<td>1.8</td>
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<td>23</td>
<td>Greece</td>
<td>1.7</td>
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<td>24</td>
<td>Denmark</td>
<td>1.7</td>
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<td>25</td>
<td>Italy</td>
<td>1.6</td>
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<td>26</td>
<td>Belgium</td>
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<td>31</td>
<td>Japan</td>
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<td>32</td>
<td>Russia</td>
<td>0.7</td>
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<tr>
<td></td>
<td>South Africa</td>
<td>No data for education</td>
</tr>
</tbody>
</table>
Population growth shows wide range of changes

- **Quantity** of labour supply
- More people allow for higher levels of GDP overall
- Rapid growth in India and USA (partly immigration)
- Shrinking population in Italy, Switzerland and Japan

### Population growth 2006-2020

<table>
<thead>
<tr>
<th>Country</th>
<th>Growth Rate</th>
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<tbody>
<tr>
<td>Malaysia</td>
<td>0.5%</td>
</tr>
<tr>
<td>India</td>
<td>0.7%</td>
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<tr>
<td>Turkey</td>
<td>1.2%</td>
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<tr>
<td>Ireland</td>
<td>1.1%</td>
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<tr>
<td>USA</td>
<td>1.0%</td>
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<tr>
<td>Thailand</td>
<td>0.6%</td>
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<td>China</td>
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<td>Canada</td>
<td>0.4%</td>
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<td>UK</td>
<td>0.3%</td>
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<tr>
<td>France</td>
<td>0.2%</td>
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<tr>
<td>Austria</td>
<td>0.1%</td>
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<tr>
<td>Germany</td>
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<td>Spain</td>
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<tr>
<td>Sweden</td>
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<td>Japan</td>
<td>-0.5%</td>
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<tr>
<td>Switzerland</td>
<td>-0.4%</td>
</tr>
<tr>
<td>Italy</td>
<td>-0.6%</td>
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</tbody>
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Baseline forecast (UN) or Add-on from trends

% yoy, p.a.

Sources: UN, Deutsche Bank Research
Investment rates to decline from high level in China

- India to see increases from low level; China downward adjustment
- Spain and UK witness solid upward momentum
Rising human capital is a key reason for Asia’s growth

<table>
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<tr>
<th>Country</th>
<th>Baseline forecast</th>
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<tr>
<td>Switzerland</td>
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Recall: Growth of human capital relevant for per-capita GDP growth (not: level of human capital)

- India and China see rapid growth from low levels
- Baseline shows near stagnation in Germany

Source: Deutsche Bank Research
Trade opening is second reason for Asian success

**Openness: Total change 2005-20**

- Turkey
- China
- India
- Spain
- Thailand
- Ireland
- USA
- Malaysia
- France
- Canada
- Austria
- Germany
- Switzerland
- Japan
- Sweden
- Italy
- UK

**Recall:** Change in openness leads to change in GDP

Rapid opening in China and India is crucial for their strong GDP growth

Source: Deutsche Bank Research
Centre of economic gravity moves to Asia

China will close in on US GDP level by 2020 in PPP terms

India to become third-largest economy around 2010, surpassing Japan

Germany and Japan in relative decline

Total GDP according to Formel-G

Source: Deutsche Bank Research
Still very low level of per-capita GDP in China and India

- China’s level of GDP per capita is today roughly equal to that of Japan in 1960 – before Japan really started to conquer the global markets.

- DBR’s analysis suggests:
  - China and India will continue to narrow the gap
  - They will produce ever more sophisticated products

Source: Deutsche Bank Research