Innovation and Translational Research as Key Drivers of New Structural Economics – European Perspectives on China’s Global Development Narrative

Alexander G. Welzl

The 28th International Development Forum, Peking University, China
April 3rd, 2019
Premier Li Keqiang‘s keynote speech at Boao Forum for Asia 2019
Boao, Hainan Province, March 28, 2019
– a quote of his speech (source China Daily, March 30-31, 2019):

„After years of fairly fast growth, Asian countries now face the challenge of shifting from old drivers of growth to new ones, and we must rely on innovation to foster the latter. (...) we (...) must tap into our advantages in human capital (...) to intensify cooperation on innovation. (...) We need to (...) clear the way for the unimpeded flow of factors of innovation resources and outcome, setting the stage for the steady progress of Asia's innovation-driven development.“
China‘s Innovation Performance
- A Legacy of Millennia of Development


- The first pottery was made during the Palaeolithic era. Pottery dating from 20,000 years ago was found at the Xianrendong Cave site in Jiangxi province, making it among the earliest pottery yet found.

- Porcelain was a Chinese invention and is so identified with China that it is still called "china" in everyday English usage. On some Chinese definitions, the first porcelain was made in Zhejiang province during the Han dynasty (206 BC – 220 AD).
Part of the 'Chinese Dream‘
- The Dawn of the Quantum Era

It was on **Monday, 16 August 2016** when a new era was ushered in:

**Quantum satellite MICIUS was launched at 1:40 local China time** from “the launch pad 603 located at LC43 complex at the Jiuquan space centre in Jiuquan, north-west China.”

“The scientist who first proposed the idea to the European Space Agency (ESA in 2001 is University of Vienna physicist Anton Zeilinger.”

Prof. Anton Zeilinger today is the President of the Austrian Academy of Sciences.

Geopolitics of Knowledge
- a ‘Long-run’ Game and the Big Picture

Article in ‘The Diplomat’, February 2018:

“China’s bet on knowledge is already paying off; but this game, which requires lots of strategic thinking and stamina, is to be played in the long run.

(…) China’s approach to knowledge is already bearing fruit in terms of making foreign policy. A collection of topics as cognitively sophisticated and even futuristic as the exploration and use of outer space, (…) information technology and connectivity, (…) quantum physics (…) and so on, have become the bread and butter of Chinese career diplomats, thus catering to the country’s most urgent present and future needs.”

Source: The Diplomat, February 27, 2018
National Innovation Systems, Translational Research and Innovation Performance
At the opening press conference of the World Economic Forum (WEF) 2012 Klaus Schwab – founder and President of WEF - claimed a shift from capitalism to talentism with human capital and innovation power becoming countries’, cities’ and companies’ major competitive asset:

“Capital is being superseded by creativity and the ability to innovate — and therefore by human talents — as the most important factors of production.”

Against Backdrop of Global Economic Crisis: New Model of Man in Economics

**Macroeconomic Theories, their Main Ideas and Model of Man:**

- **Neoclassic/Neoliberalism**
  - homo-economicus (man follows economic goals only & in a fully rational manner),
  - efficient markets (invisble hand of the market),
  - mathematically driven interpretation of (economic) reality,
  - neglect of non-rational and intangible aspects of economic reality and value creation.

- **Behavioural Economics**
  - Man driven by 'animal spirits' (trust, sense of fairness, ethical behaviour and corruption, money illusion, narrations),
  - public rules and regulation for markets necessary ('leavening hand of wise policy'),
  - qualitative & quantitative elements of interpretation, integration of non-rational and intangible aspects of economic reality and value creation.

Source: Animal Spirits (Akerof, Shiller/2009)
1st Lecture on China’s NIS at Austrian University - started at UASTW in September 2018

- Title „From ‘Made in China‘ to Created in China‘
- Lecturer: Alexander G. Welzl
- Focus on National Innovation System (NIS) of PR China, corporate management of innovation and creativity in Chinese firms/Chinese owned enterprises doing business in Austria and CEE, BRI
- Guest lectures from CEOs of Chinese companies & scholars
Collaboration with Chinese Academy of Social Sciences (CASS), Beijing: started June 2018

- Kick-off Meeting with Prof. Huang Ping (CASS, Beijing /China), UASTW Rector Schmöllebeck and Alexander G. Welzl at UASTW in Vienna/Austria on June 4, 2018

- start of a long-lasting cooperation of mutual interests
Evolution of Innovation Concepts I: from Closed Innovation to Ecosystems

Centralized, inward-looking innovation
Closed Innovation

Externally focused, collaborative innovation
Open Innovation

Ecosystem-centric, cross-organizational innovation
Innovation Networks

Sources: Chesbrough (2003), Forrester (2004), von Hippel (2005)
Evolution of Innovation Concepts II: from Gated Communities to Openness

Novel Value Creation in the Digital Age: Intangible Investment/Assets - Sources of Growth

Infineon’s ‘Brainport’ Approach - creating an innovative Environment for talented Knowledge Workers

Only the combination of a sum of different, specific factors characterises a ‘Brainport’ like Infineon Austria and creates its competitiveness!
The Quest for a evidence-based, innovation-driven and systemic Governance Approach
Innovation-driven Governance: Requirements & Framework Conditions

- National / Regional intangibles
  - Openness
  - Education
  - Public R&D
  - Knowledge Pool
  - Human Resource Pool
  - Creative Culture
  - Product Market Reg.
  - Labour Market Reg.
  - IPR Regime
  - Reporting Standards
  - National Accounts/GDP

- Diffusion/Mobility
- Firm-level intangibles
  - Intangible investment
  - Development/Control
  - Intellectual Assets Accumulation
  - Commercialisation
  - Value Creation

New Value Creation Patterns Challenge Governments & Performance Cultures

Performance Management - the Austrian Approach

**Outcome Orientation**

- Managing public administration based on its contribution towards achieving outcomes in society (performance management)

**Key Pillars**

- Performance management: the budget presents the political goals and objectives, which are measured and reported
- Outcome orientated impact assessment
- Implemented in 2 steps (2009/2013) and laid down in the constitution

*Source: Austrian Federal Chancellery, 2015*
The Austrian Federal Performance Model

**Objective:** Improved road safety

- Increased traffic volume
- Weather conditions

**Public administration/service providers**

- Personnel, financial and other resources
- Setting up a multiphase driver education system
- Designing an awareness-raising campaign
- Drawing up proposals for measures to prevent accidents based on the analysis of accident data and patterns

**Activities**

- A regulation on multiphase driver education
- An awareness-raising campaign on "drunk driving"
- Defining and implementing accident prevention measures in cooperation with external actors

**Outcome**

Fewer traffic accidents involving injuries on Austrian roads

*Source: Austrian Federal Chancellery, 2015*
The Stakeholders and Adressees

- Parliament & the interested public
- Government & ministers
- Public administration

Source: Austrian Federal Chancellery, 2015
Chinese Government I: New Requirements for the Development of NIS in the New ERA

The two-stage development plan

from 2020 to 2035

Join the ranks of leading innovative countries

from 2035 to the middle of the 21st century

Become a great modern socialist country that is prosperous, strong, democratic, culturally advanced, harmonious, and beautiful.

Source: CASTED/MOST, 2018
Chinese Government II: the Evolutionary Direction of China’s National Innovation System

The vision of innovative, coordinated, green, open and shared development

Knowledge production
- Provision of institutional support to basic research and applied research
- Strategic scientific and technological contingent

Knowledge allocation
- Supporting the development of new industries and industrial integration
- Improvement of the allocation efficiency for a better share of development fruits

Source: CASTED/MOST, 2018
Decision Tools for Geoeconomics & Geopolitics – the Hyperglobe I

- Tactile hyperglobes: visualization of the digital image on a physical globe body in real space – spherical display for visualization of any big data over time!

- One is in front of a real (scale-downed) 3d-model of the earth. Like being an astronaut and looking from outer space on earth, or in other words: “Oh, my God! Look at that picture over there! Here’s the Earth coming up. Wow, is that pretty!” (Frank Borman, commander Apollo 8)

Hyperglobe-Research-Group at the Department of Geography and Regional Research (University of Vienna, Austria)
'Floating Tsunami Debris (2011-2012)', Category 'Ecology'
http://globoccess.at/fr/showroom
China‘s Digital Silk Road in Space and on the Ground
Some Major New Silk Road Projects - a Spatial Overview (OeNB 2018)

Source: Barisitz, Partl (OeNB) 2018

Alexander G. Welzl | 28th NSE IDF at Peking University, Beijing, April 3rd 2019
From right to left: Prof. Aihua Qin (CASS, Beijing & visiting scholar at UAS Technikum Wien),
Alexander G. Welzl
From left to right: Hui Du (UNOOSA & China National Space Administration/CNAS), Ian Freeman (UNOOSA, Head of Director’s Office of Simonetta Di Pippo), Prof. Aihua Qin (CASS, Beijing), Alexander G. Welzl
Belt & Road Spatial Information Corridor - China National Space Administration

65 countries along the ‘Belt & Road’:

- East Asia & ASEAN: 10 countries
- West Asia: 18 countries
- South Asia: 8 countries
- Central Asia: 5 countries
- Commonwealth of Independent States: 7 countries
- Central and Eastern Europe: 16 countries

Source: CNSA 2018
Belt & Road Spatial Information Corridor - Components & Applications

Source: CNSA 2018
Belt & Road Spatial Information Corridor - Current Cooperation with BRI-Countries

Source: CNSA 2018
Space Capacity Building in Developing Countries - Contribution by Spatial Information Corridor

Source: CNSA 2018
Contributions in Developing Countries - Major Tasks in the Coming 5 Years

- to enhance the basic capacities of its space industry,
- to strengthen research into key and cutting-edge technologies,
- to implement manned spaceflight, lunar exploration, the Beidou Navigation Satellite System, high-resolution earth observation system, new-generation launch vehicles and other important projects,
- to launch new key scientific and technological programs and major projects, complete, by and large, its space infrastructure system, expand its space applications in breadth and depth, and further conduct research into space science, promoting the integrated development of space science, technology and applications.

Source: CNSA 2018
From Space…. to the Ground
- Evidence for Rising Quantum Business

Some of the more recent headlines:

- **China Opens 2,000-km Quantum Communication Line**, Oct 09, 2017
- **Beijing-Shanghai Quantum Link a 'New Era'**, Sep 30, 2017
- **Huangzhou-Area - a hotspot of commercialisation of quantum communication**: with companies like Hangzhou Shenzhou Quantum Communication Technology Co.Ltd., China Quantum Communications Inc. etc.

“In October 2015, **Zhejiang Shenzhou Quantum Communication Technology Co., Ltd. was founded in Tongxiang**. Taking this opportunity, Tongxiang is establishing the **Quantum Information Technology Industrial Park (QITIP)**, jointly with the Institute of Geology and Geophysics of Chinese Academy of Sciences (CAS), University of Science and Technology of China and Tongji University, to strengthen local quantum technology R&D capacities, aiming to lead the development of quantum industry in China.”

*Source: CAS (2017)*
The Quantum Quest
- Spending Compared Globally (2015)

No small effort
Estimated annual spending on non-classified quantum-technology research, 2015, €m

Source: McKinsey

*Combined estimated budget of EU countries

National spending

World 1,500 (estimate)
Translational Research & Innovation - China’s Performance in Comparison

<table>
<thead>
<tr>
<th>Quantum computing</th>
<th>Quantum cryptography</th>
<th>Quantum sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States 295</td>
<td>China 367</td>
<td>United States 105</td>
</tr>
<tr>
<td>Canada 79</td>
<td>United States 233</td>
<td>China 104</td>
</tr>
<tr>
<td>Japan 78</td>
<td>Japan 100</td>
<td>Germany 25</td>
</tr>
<tr>
<td>Britain 36</td>
<td>Britain 50</td>
<td>Japan 18</td>
</tr>
<tr>
<td>China 29</td>
<td>Malaysia 31</td>
<td>Britain 12</td>
</tr>
<tr>
<td>Australia 26</td>
<td>South Korea 27</td>
<td>Canada 6</td>
</tr>
<tr>
<td>Germany 22</td>
<td>Germany 24</td>
<td>Israel 6</td>
</tr>
<tr>
<td>South Korea 11</td>
<td>France 15</td>
<td>France 5</td>
</tr>
<tr>
<td>Israel 9</td>
<td>Australia 14</td>
<td>Australia 3</td>
</tr>
<tr>
<td>Finland 7</td>
<td>Canada 11</td>
<td>South Korea 2</td>
</tr>
<tr>
<td></td>
<td>Italy 11</td>
<td>Russia 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Taiwan 2</td>
</tr>
</tbody>
</table>

Source: The Economist - Technology Quarterly
Translational Research & Innovation - China's Performance in QKD

Quantum-key distribution
Patent applications by country*

China
United States
Japan
Europe
South Korea
Malaysia

Sources: UK Intellectual Property Office; European Commission

*By location of corporate headquarters
Towards Commerzialisiation in Quantum Technologies
Translational Quantum Research and Quantum Technology Applications I

**QUANTUM COMPUTING COULD SOON ACCELERATE ADVANCES IN PHARMA AND CHEMICALS**

Companies are already experimenting with quantum simulations to speed up drug discovery and design more powerful molecules.

**Source:** BCG (2018)

**DRUG DEVELOPMENT TIMES COULD SPEED UP BY 20%**

**DRUG APPROVAL RATES COULD DOUBLE**

**GLOBAL HIGH-PERFORMANCE COMPUTING MARKET IN 2018**

$10B

**ESTIMATED QUANTUM COMPUTING MARKET IN THE US PHARMACEUTICAL INDUSTRY**

$15B to $30B
Translational Quantum Research and Quantum Technology Applications II

HOW QUICKLY COULD QUANTUM COMPUTING TAKE OFF?
Adoption will vary by industry and by the speed with which complex problems must be solved.

Consensus forecasts for the peak adoption rates of quantum computing:

- 80% applications requiring a significant speed advantage
- 50% applications requiring a moderate speed advantage
- 25% applications requiring an undetermined speed advantage

Source: BCG (2018)
THE QUANTUM COMPUTING MARKET WILL EVOLVE IN THREE OVERLAPPING GENERATIONS

1. FIRST GENERATION 2018–2028
   - Engineers develop quantum computers for specific low-complexity applications

2. SECOND GENERATION 2028–2039
   - Quantum computers perform faster than classical computing in applications such as molecular simulation, R&D, and software development

3. THIRD GENERATION 2031–2050
   - Quantum computers achieve the scale to perform advanced simulations for modeling and problem-solving

Source: BCG (2018)
EXHIBIT 2 | Complex Molecule Discovery in Pharma R&D Could Be a $15 Billion to $30 Billion Market Opportunity

**QUANTUM COMPUTING HAS APPLICATIONS THROUGHOUT THE PHARMA VALUE CHAIN**

**DRUG DISCOVERY**
- More potential drug leads produced faster
  - Higher number of launches
  - Lower cost

**CLINICAL TRIALS**
- Clearer trial outcomes with higher-quality leads
  - Higher approval rate

**LAUNCH**
- Higher share in indications from higher quality; faster R&D allows longer use of patent
  - Higher revenue per drug

**HIGHER MOLECULE DISCOVERY AND APPROVAL RATES DRIVE THE VALUE PROPOSITION**

- **$200 billion**
  - 2027 branded pharma net income in US

1. **$10 billion**
   - ~5%–10% boost in potential drug opportunities from faster discovery

2. **$5 billion**
   - Cost advantage from reducing discovery phase (15%–20% of R&D time)

3. **$100 billion**
   - ~1.5x–2x higher approval rate; low-weight molecules match current higher approval rates of biologics

4. **$50 billion**
   - Revenue per drug boosted from higher quality drugs gaining share (5%–20%) and longer time in market (3%) with patent due to faster R&D

5. **$15 billion**
   - Estimated opportunity size (Incremental value x 10% willingness to pay)

Sources: Statistica reports; Wired; Lawrence Livermore National Laboratory; Motherboard; Fierce Biotech; expert interviews; BCG analysis.

1 Assumes 7% CAGR in line with historical trends, 30% net margin, and 75% of total pharma market branded. 2 Reduces ~25% of drug discovery, itself 15% to 20% of R&D, which represents ~17% of revenue.

Source: BCG (2018)
Europe’s Quantum Flagship Embarked from Vienna in Dezember 2018

Number of project proposals (left) and accepted projects (right) per area in the first Quantum Flagship call

Source: European Commission (2018)
Powershift in the 21st Century

Not a question for an oracle:

Whoever controls quantum information technology in the coming decades will have hegemonial power in geoeconomics and geopolitics of the 21st century.

Source: en.wikivoyage.org
Peace is not everything
But without peace everything is nothing

Willy Brandt
Former German Chancellor
Q & A
Alexander G. Welzl

Lecturer
International Campus &
Master Program Innovation and Technology Management (MTM)

Fachhochschule Technikum Wien | University of Applied Sciences
Technikum Wien
Hoechstaedtplatz 6, 1200 Wien, AUSTRIA/EUROPE
M: +43 660 2629020
E: alexander.welzl@technikum-wien.at
I: https://www.technikum-wien.at/en/
Thank you for your attention!

www.technikum-wien.at