



# Research Prospectus

**STP510 - 2022 Fall**

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# Outline

1. Phenomenon
2. Research Gap and Research Questions
3. Hypothesis
4. Analytical Framework



# Innovation Paradox

**Innovation paradox:** high investment in science and technology does not guarantee higher innovation performance → there are significant elements of innovation-based economic performance unexplained (Lundvall, 2016)

NIS Literature	Innovation Paradox Literature
Institutional, interactive learning, actors network	Scale effects paradox (Jones, 1995), business strategy innovation paradox (Haour, 2004), SMEs innovation paradox (Ortega-Argiles et al, 2009), Open innovation paradox (Bogers, 2011)
Process dynamics	<ul style="list-style-type: none"> <li>• Sectoral: Fogel's innovation paradox (Fogel, 1964), IT paradox (David, 1990; Macdonald et al, 2000; Solow, 1987), Biotechnology growth-innovation paradox (Baker, 2003)</li> <li>• Regional: Regional innovation systems paradox (Christopherson and Clark, 2007), European regional innovation paradox (Fragkandreas, 2013)</li> <li>• National: European paradox (EC, 1995, Dosi et al. 2006), Swedish paradox (Edquist and McKelvey, 1998; Ejermo et al., 2011), Norwegian innovation paradox (Gronning et al, 2008), French innovation paradox (Liu and Laperche, 2015)</li> </ul>
MNCs and developing countries	Periphery innovation paradox (Kattel and Primi, 2012), Developing nations innovation paradox (Cirera and Maloney, 2017)



# Innovation Paradox

- Innovation paradox phenomenon does not only occur in developed Western countries, there are signs that such paradox might happen in latecomer countries as well (ICBS, 2015)
  - middle income trap (Lee, 2013a, 2013b, 2019)
- Many factors have been considered in explaining the underlying causes of innovation paradoxes, including different modes of system failures (Malerba, 2009) or methodological insufficiency (Edquist, 2011; Lundvall, 2013).




# System Failures (Malerba, 2009)

- System perspective links the learning, competences and heterogeneity of actors to the relations and interactions among them → both static and dynamics
- Failures can take place in 3 ways
  - #1 - Missing key elements: A key element/node is missing, or has limited competences or has low absorptive capabilities.
  - #2 - Missing connections: Connections among heterogeneous agents and complementary activities are not present.
  - #3 - Misalignment among actors: During the change of existing innovations or in the emergence of new systems, there are mismatches or misalignments among actors within an established system which is undergoing transformation, or because a new innovation system may fail to emerge and develop.



## System Failures - European Paradox

#1 Missing key elements	<ul style="list-style-type: none"> <li>• inadequate investment on research toward innovation, poorly adapted education and training systems, financial systems avoid innovation, bureaucratic legal and regulatory environment (EC, 1995)</li> <li>• insufficient science and technology knowledge base and corporate innovation capability for industrial exploitation (Dosi et al, 2006, Herranz and Ruiz-Castillo, 2013)</li> <li>• lack of staffs with experience in industry (Conti and Gaule, 2011)</li> <li>• weak absorptive capacity of European high-tech firms (Dedrick and Kraemer, 2015)</li> </ul>
#2 Missing connections	<ul style="list-style-type: none"> <li>• lack of connections among firms, lack of science-industry interaction (EC, 1995)</li> <li>• inefficiency and inabilities of the European science system in generating inventions and patents due to less systematic and professional management of knowledge and intellectual property by European universities (Jacobsson et al, 2013)</li> <li>• Europe's ICT science base has a smaller fraction of research papers involving intra-firm cooperation and a smaller fraction of public-sector research papers resulting from internal cooperation. Despite being at the international scientific frontier, the ICT research lacks a strong involvement of EU industry (Tijssen and Van Wijk, 1999)</li> </ul>
#3 Misalignment among actors	<ul style="list-style-type: none"> <li>• the financial and regulatory sectors were slow to response to the need of innovation (EC, 1995)</li> <li>• the institutional infrastructure of the EU being unprepared to face the challenges posed by the advent of new technologically-oriented scientific fields, therefore Europe excels in mostly mature scientific fields, whereas the US science system excels in newly emerging fields (Bonaccorsi, 2007)</li> <li>• socio-cultural factors hinder the commercialization of new scientific knowledge in Europe, lack of entrepreneurship hinders the positive effects of investments in new knowledge on economic growth (Audretsch and Keilbach, 2008, Audretsch, 2009)</li> </ul>



## System Failures - Swedish Paradox

#1 Missing key elements	<ul style="list-style-type: none"> <li>• R&amp;D is mainly spent by a few large multinational firms, lack of production capability in high-tech fields (Edquist and McKelvey, 1998)</li> <li>• Sweden seems to be unable to diversify its economic structure (Ejermo and Kander, 2006)</li> <li>• Swedish firms display low rate of value-adding innovations, Swedish industry is more competitive in adopting existing product innovations than in creating ones. (Marklund et al, 2004)</li> </ul>
#2 Missing connections	<ul style="list-style-type: none"> <li>• Scientists are generally uninterested in sharing the benefits accruing from their research (Granberg and Jacobsson, 2006)</li> <li>• Despite high survival rate and the increasing birth rate of both high-tech and both knowledge-intensive business services firms, Sweden still lags behind in the creation of new firms and in the contribution of these firms to the restructuring and renewal of the economy, due to entrepreneurial, networking and knowledge transfer problems (Bitard et al, 2008)</li> <li>• Swedish MNEs tend to conduct most of their R&amp;D activities in Sweden, while the end-product of R&amp;D effort is produced elsewhere (Henrekson and Jakobsson, 2001, Edquist and McKelvey, 1998)</li> </ul>
#3 Misalignment among actors	<ul style="list-style-type: none"> <li>• Swedish paradox is the outcome of structural problems in the NIS: lack of firms' incentives to exploit product innovation due to national economic problems in terms of high unemployment, decreasing industrial outputs and low government budget (Edquist and McKelvey, 1998)</li> <li>• Swedish academic system performs exceptionally well in terms of both international scientific collaboration and academic entrepreneurship. However, Swedish incentive structure and institutional framework provides far less encouragement for academic entrepreneurship than that of the US (Henrekson and Rosenberg, 2001; Goldfarb and Henrekson, 2003)</li> <li>• Macro-economic factors and policies in the 1980s and 1990s have reinforced further the significance of MNEs in the economy (Marklund et al, 2004)</li> </ul>



# Criticism


- The innovation paradox findings mostly analyze structural and systemic problems within national innovation systems in European countries.
- However, despite various attempts to explain European and Swedish paradox phenomena, the current literature fails to reach a consensus regarding the causes of innovation paradox.



## 2. Research Gap and Research Questions

### Criticism on NIS: How do National Systems of Innovation Differ? (McKelvey, 1991)

Porter	<ul style="list-style-type: none"><li>• Definition of technology as material objects and blueprint knowledge can give a misleading view of the <u>nature of technological development and transfer</u>, and misleading view of the actions of firms and nature of economic activities</li><li>• Using firms as the main level of analysis is problematic → higher level of analysis is necessary</li></ul>
Freeman	<ul style="list-style-type: none"><li>• The <u>process and problems of actual development of technology</u> has not been taken under consideration despite radical technological change being the focus of the analysis.</li><li>• The mechanisms within nations for social innovation and adjustment to radical technology is unclear, especially regarding actor's cost evaluation</li></ul>
Lundvall	<ul style="list-style-type: none"><li>• Most empirical works are <u>ad hoc without clear or adequate theoretical explanation of the mechanisms involved</u>.</li></ul>
Nelson	<ul style="list-style-type: none"><li>• Firms are portrayed as passively responding to exogenous circumstances</li><li>• Lack of <u>analysis on technological competition</u></li><li>• Missing multi-dimensionality of the technology selection process</li></ul>



### Criticism on NIS: The State and National Systems of Innovation: A Sympathetic Critique (Vertova, 2015)

- (1) *The definitions are so broad that they can encompass almost everything.*
  - Concept of institutions encompasses almost everything, which is not useful in identifying the NSI key elements and the features affecting them.
- (2) *It is not clear if the NSI concept is a descriptive or a normative tool.*
  - Freeman's approach is normative, Lundvall is mixed, Nelson is more descriptive.
  - Statistical data are collected and used as proxies to measure all NSI elements → theoretical tools become normative for policy suggestions.
- (3) *Although all definitions share the central role played by institutions, the state and its policy are not explicitly mentioned.*
  - Macroeconomic dimension is not taken into proper consideration,
  - State roles' are geared toward firm's innovative activities, although they should have very different social tasks.
  - Private firms are considered to be the best and only agents of innovative activities, which might not be true.



### Research Gap: National Innovation Paradox in System Perspective

- Despite the vast number of studies attempting to explain the causes of innovation paradoxes, most of them were based upon certain factors related to innovation systems literature.
    - Macroeconomic factors (Marklund et al, 2004)
    - R&D funding allocation issues (EC,1995; Edquist and McKelvey, 1998)
    - Structural weaknesses in corporations and science-industry interaction (Dosi et al, 2006; Granberg and Jacobsson, 2006)
    - Insufficient innovation and entrepreneurial capacity (Kattel and Primi, 2012; Argyropoulou et al, 2019)
    - Sectoral differences (Edquist and McKelvey, 1998; Ejermo et al., 2011; Gronning et al., 2008)
- This induces some challenges in illustrating the causal relationship, as well as difficulties in describing the clear contrasting characteristics while comparing different cases.



### Research Gap: The Latecomer Context

- The contrast between advanced countries and latecomers provides an interesting case to study the different innovation phenomena.
  - Latecomer countries, due to their limited resources (Mathews, 2002), tend to pursue a distinctive developmental path to catch up with the developed countries.
  - The unique developmental features of latecomers have been illustrated by many scholars, including the imitation to innovation model (Kim, 1997), OEM-OBM-ODM (Hobday, 1995), technology users to technology generators (Choung et al., 2000), leapfrogging (Lee and Lim, 2001).
  - These studies emphasize the catch-up strategies based on the reverse product life cycle, in which latecomers first enter the product value chain by adopting the mature technologies, gradually accumulating the technological capabilities that subsequently enable them to improve upon the advanced countries' technologies.



# National Learning

- Learning and more particularly knowledge production are important elements during this process.
- Knowledge production strategies can reflect the process of resource endowment in different innovation system contexts (Nelson and Rosenberg, 1993).
- We can speculate that knowledge production analysis is useful not only in explaining the differences in catch-up strategies (Glanzel et al, 2007), but also in contrasting different innovation paradox phenomena.



# Objective and Question

- Objective: study and compare the different innovation paradox phenomena between advanced countries and latecomer countries, based on the patterns of knowledge production and knowledge commercialization at the aggregate level.
- In particular, to investigate how the national knowledge production and commercialization patterns illustrate the innovation paradox phenomenon, we posit two research questions:
  - RQ1: What are the differences between the knowledge production and knowledge commercialization patterns in latecomer and advanced countries?
  - RQ2: How are the innovation paradox patterns in latecomer countries different from the paradox patterns in advanced countries?



## Swedish innovation paradox

- Swedish innovation paradox (Edquist, 2008): low productivity or efficiency of Swedish national innovation systems despite very high investments in R&D and innovation effort.
  - The paradox occurs because of
    - (1) obstacles to technology transfer from R&D to commercialization due to lack of knowledge inputs, supporting policies, and services for firms
    - (2) problematic sectoral allocation of R&D due to insufficient supporting systems
    - (3) exploitation of Swedish R&D abroad due to internationalization
  - The less-than-expected consequences were observed in a low level of value-added and moderate success in the evolution of labor productivity.
- In Edquist's study, the impacts of knowledge inputs were illustrated based on the sources of the inputs, i.e., public and private funding, and how these inputs, along with the insufficient provision of policy constituents, contribute to the unimpressive results in different sectors.



## Innovation Paradox: Advanced vs. Latecomer

- However, to understand how failure in learning contributes to lower innovative productivity, we need to understand more deeply the path-dependent knowledge production and commercialization patterns embedded throughout the development process.
- Latecomers
  - Latecomers end to enter the value chain by acquiring mature technologies. In order to absorb and improve upon these technologies, they focus on process innovation through engineering and applied science-based research.
  - Patenting is important to protect their intellectual assets and fasten the commercialization process to quickly gain value from their newly improved technologies.
- Advanced countries:
  - Facing less pressure on capitalizing from the newly produced scientific knowledge and technology, they can spend more time and effort on the research stage,
  - These countries can improve more substantially in knowledge production than in knowledge commercialization.



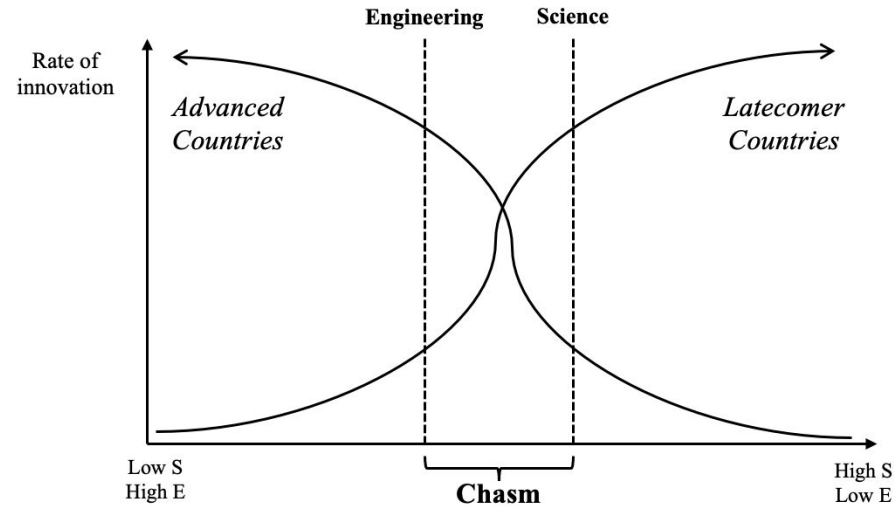


## Innovation Paradox: Advanced vs. Latecomer

- Therefore we speculate that the differences in innovation paradox patterns between advanced countries and latecomers are reflected in
  - Advanced countries tend to build scientific knowledge first
    - → there is a shortage of engineering research, which results in lower commercialization
  - Latecomers focused more on producing engineering for process improvement
    - → the accumulated knowledge stock might be insufficient to produce higher impact basic research
    - → lower knowledge production efficiency despite a high commercialization rate.

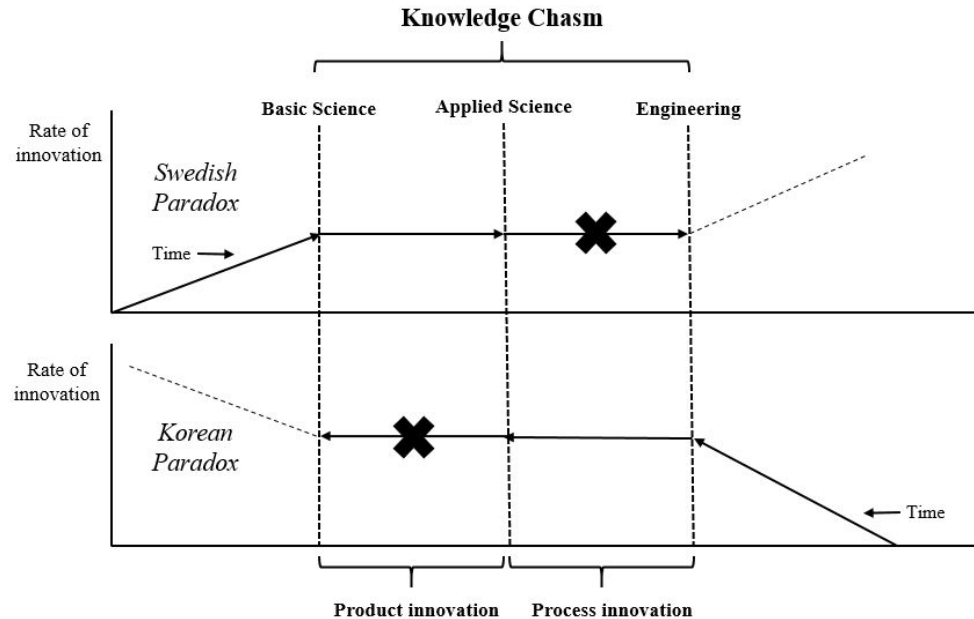
### 3. Hypotheses

## The Knowledge Chasm



### 3. Hypotheses

# The Knowledge Chasm





# Analytical Framework

- Contrasting two notable cases - Swedish paradox and Korean paradox, from 1996 to 2020.
- Methodology:
  - (1) describe different knowledge production patterns based on knowledge production and knowledge commercialization
  - (2) contrasting the innovation paradox characteristics by analyzing different knowledge production parameters
- Data:
  - innovation input (World Bank, OECD for statistics on R&D expenditure and labor)
  - scientific and technological production (Scopus for scientific publication, USPTO for technological patenting activities)
  - innovation output (US Comtrade for trade data, World Bank for high-tech export data)