

High-Tech Industries in a Time of Global Crisis with Special Reference to East Asia

Abstract

The point of departure for an economic statistical analysis of industrial racing patterns is that the technological frontier is in fact a reasonable indicator of the evolving state of knowledge (technical expertise) in the industry. At any point in time the “industry technology frontier” (ITF) indicates the degree of technical sophistication of the most advanced products (systems) in the industry.. Firm level technology frontiers (FTF) are constructed analogously and indicate at any point in time the extent of the technical sophistication achieved by any firm until that point in time. The study focusses on the evolution of the Japanese firm and industry level technology frontiers vs. Korea and China.

We present several cases of knowledge-based industries for which we proceed to construct statistical indicators reflecting racing patterns in those industries, in particular information and communication technologies (ICTs).. These industries form major components of a knowledge-based network economy with increasing returns and structural growth potential. Statistical indicators reflecting technology racing in those industries provide intrinsic information on knowledge leadership positions, competitive advantage and the level of wealth and welfare creation in the economies involved.

The data set is comprised of product groups (systems)by major Japanese, Korean and Chinese enterprises in those industries from the onset of the financial/economic crisis in 2008, assembled from and cross-checked by a range of historical sources, field studies and expert opinions.

A statistical profiling of technological evolution and innovation is achieved for three major knowledge-based industries as they relate to competitive racing and rivalry among leading firms. Among the performance criteria to be assessed are frequency of frontier pushing, technological domination period, innovations vs. imitations in the race, innovation frequency when behind or ahead, nature of jumps, leapfrogging or frontier-sticking, inter-jump times and jump sizes, race closeness measures, and interfrontier distance.

Objectives

1. to identify the technological evolution and performance of knowledge based industries on a comparative scale
(Japan, Korea and China)

2. to apply novel statistical indicators of technological performance across regions, sectors and industries based on observed and predictable racing patterns in those industries.
3. to benchmark those indicators across regions and to characterize emerging parameters on competitive performance in respective markets
4. to prepare the use of these indicators for regular policy evaluation in a context of a policy system of science and technology policies and innovation markets
5. to build a comprehensive set of instruments to improve the choice of strategic options for policy makers (in shaping economic growth) and industries alike within the framework of global competition

Focus of Study

In the context of this study we define 'race' as a continual contest for technological superiority among some subset of firms within a well defined industry (classification). Under this conceptualisation a race is characterised by a number of firms whose FTF's remain 'close' together over a period of 10 to 14 years. The distinctive element is that firms engaging in a race have FTF's substantially closer together than the FTFs of any firms not in the race. A statistical analysis should reflect that a race, as defined, may or may not have different firms in the leadership position at different times, may be a tighter race at some times than at others, and in general, may exhibit a variety of forms of industrial behaviour.

We present three cases of high technology industries for which we demonstrate the construction of statistical indicators reflecting racing patterns in those industries, (1) biotechnology/pharmaceuticals, (2) semiconductors/computers and telecommunications equipment. We choose those industries because they are identified as the major components of a technology based network industry reflecting the cutting edge of the science / technology frontier in the world economy. Statistical indicators reflecting the technology race in those industries provide intrinsic information on knowledge leadership position, competitive advantage and level of welfare and wealth creation in the economies involved. Thus, they will be of significant value to policy analysis of economic growth and development. The data set is comprised of product offerings by major Japanese ,Korean and Chinese firms in those industries from the period

1990-2004, assembled from and cross-checked by a range of historical sources, field studies and expert opinions.

Methodology.

Based on previous work on economic modelling of innovation races, we look for clusters of firms whose FTFs remain close enough throughout the 14 years period (formal measures of closeness are defined and measured). We identify at least 2 races in progress in the industries throughout the 14 years of duration. One comprises the world frontier race in each of those industries, the other the national frontier race (Japan, Korea, China) which technically would constitute a subfrontier to the world frontier. Since the data set by no means exhaust the firms in the industry, it is certainly easier to accept that these are the significant technological races in progress. The technology frontier of the firms in a particular race (that is ITF) is constructed in a manner similar to the individual FTFs. Essentially, the maximal envelope of the FTF's in a particular race constitute the ITF for that race. So the ITF indicates, as a function of calendar time, the best achievable performance by any firm in the race.

Expected Project Results

Based on this study an analysis will show how dynamic competition evolved in the past and what competition in the future could look like, whether the rate of technological advancement in the industry has changed over the last 14 years, and whether divergence or convergence of frontier and catchup races deserves attention. Furthermore, there are at least two interesting issues regarding the rate of technological advancement. The first relates to the efforts of the firms over time, and the second relates to the translation of these efforts into results.

1. The project entails a novel and unique statistical profiling of industry racing behaviour for selected high technology industry cases.
2. The results will yield valuable, policy relevant information on the level of technological frontiers for Japanese, Korean and Chinese enterprises, in leading edge, high growth and structurally dynamic industries in view of major competition at the world frontier under a persistent cyclical business downturn
3. Unlike other (statistical) indicators (such as patent statistics) referring to the degree of competitiveness among industries, regions and countries concerned, the proposed measures cover behavioural, dynamic movements in respective industries, and therefore are able to lend intrinsic predictive value to crucial economic variables relating to economic growth and wealth creation.

4. The results are likely to provide strategic support for industrial and technology policy and sources for macroeconomic policies in a global competitive context and enable policy makers to identify strengths and weaknesses of relevant players and their environments in those markets.
5. The statistical indicators derived can be adapted and extended to other high growth and fast developing industries

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