

All the Way to the Top: Innovation, Growth, and the Role of the State

Reda Cherif and Fuad Hasanov

International Monetary Fund

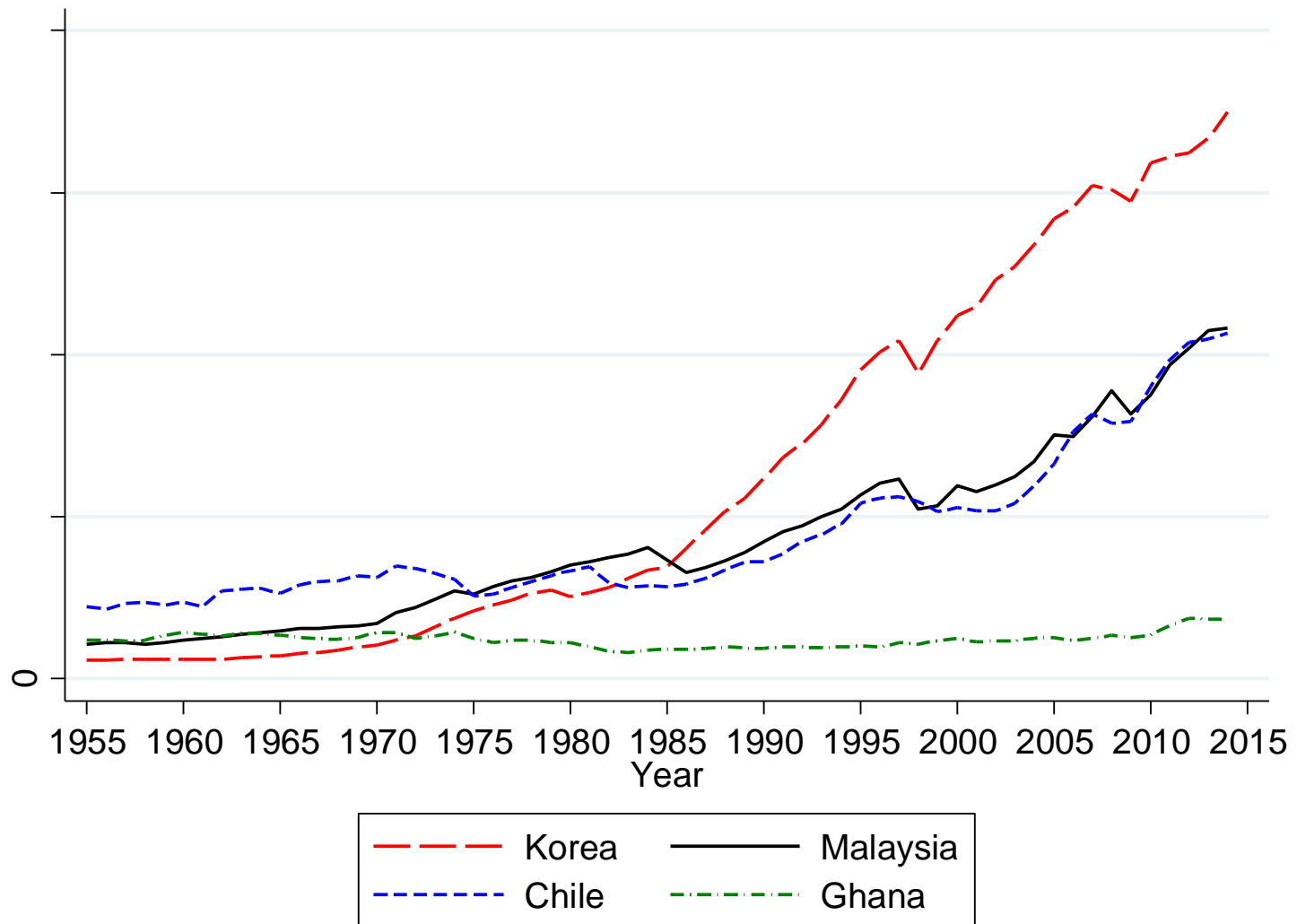
November 29, 2017

DISCLAIMER: THE VIEWS EXPRESSED HEREIN ARE THOSE OF THE AUTHORS AND SHOULD NOT BE ATTRIBUTED TO THE IMF, ITS EXECUTIVE BOARD, OR ITS MANAGEMENT.

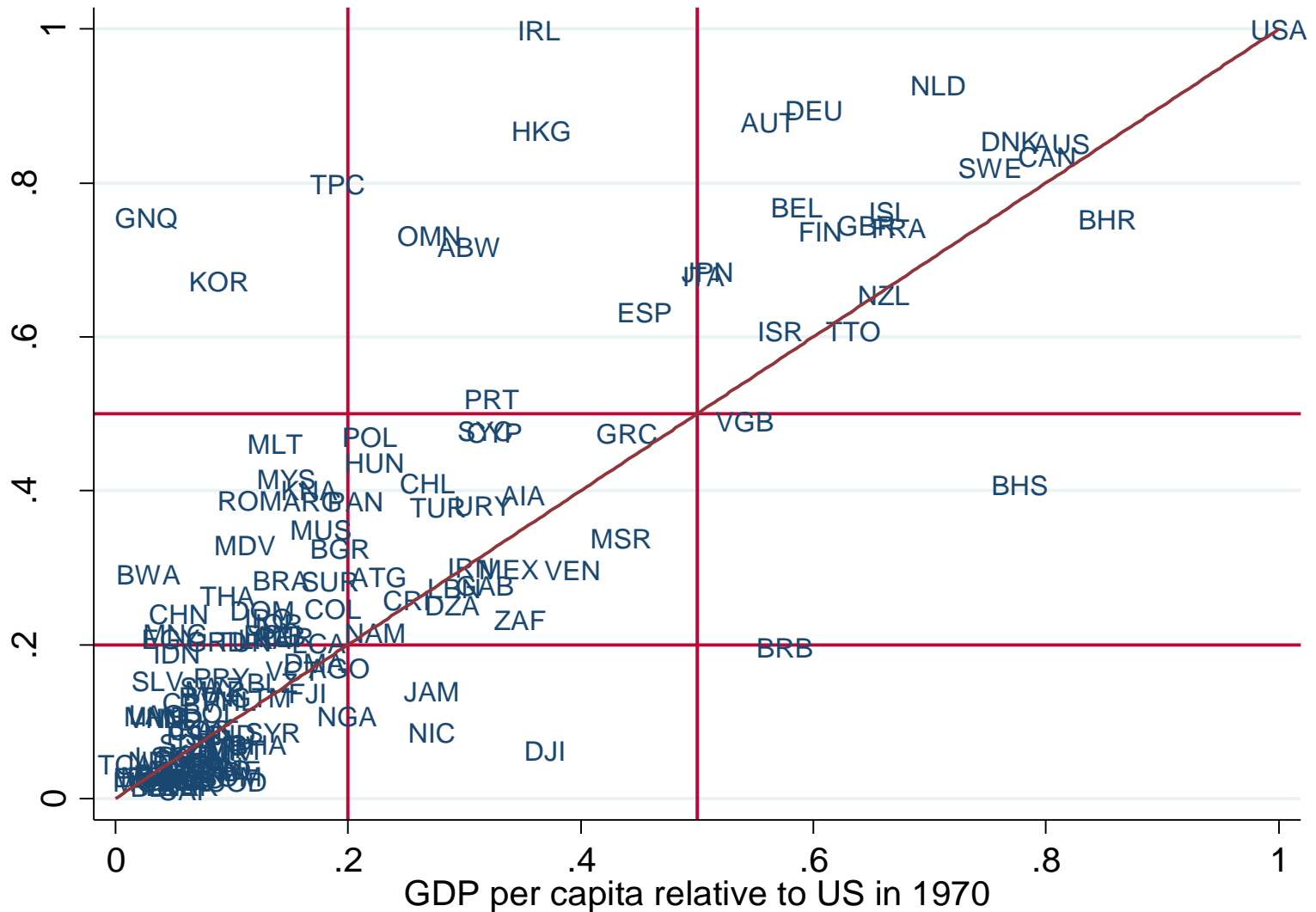
Will Singapore be around in 100 years? I am not so sure. Whatever the choices are, I am absolutely sure that if Singapore gets a dumb government, we are done for. This country will sink into nothingness.

Lee Kuan Yew

What is the Grail of Development?



Almost Half-Century of Development



Are Asian Miracles Outliers?

“Much of the real world is controlled as much by the tails of distributions as [by] means or averages...by the exceptional not the common place; by the catastrophe, not the steady drip...we need to free ourselves from ‘average’ thinking.”

- Phil Anderson, Nobel laureate in physics

What Do Economists “Know” About Growth and Innovation?

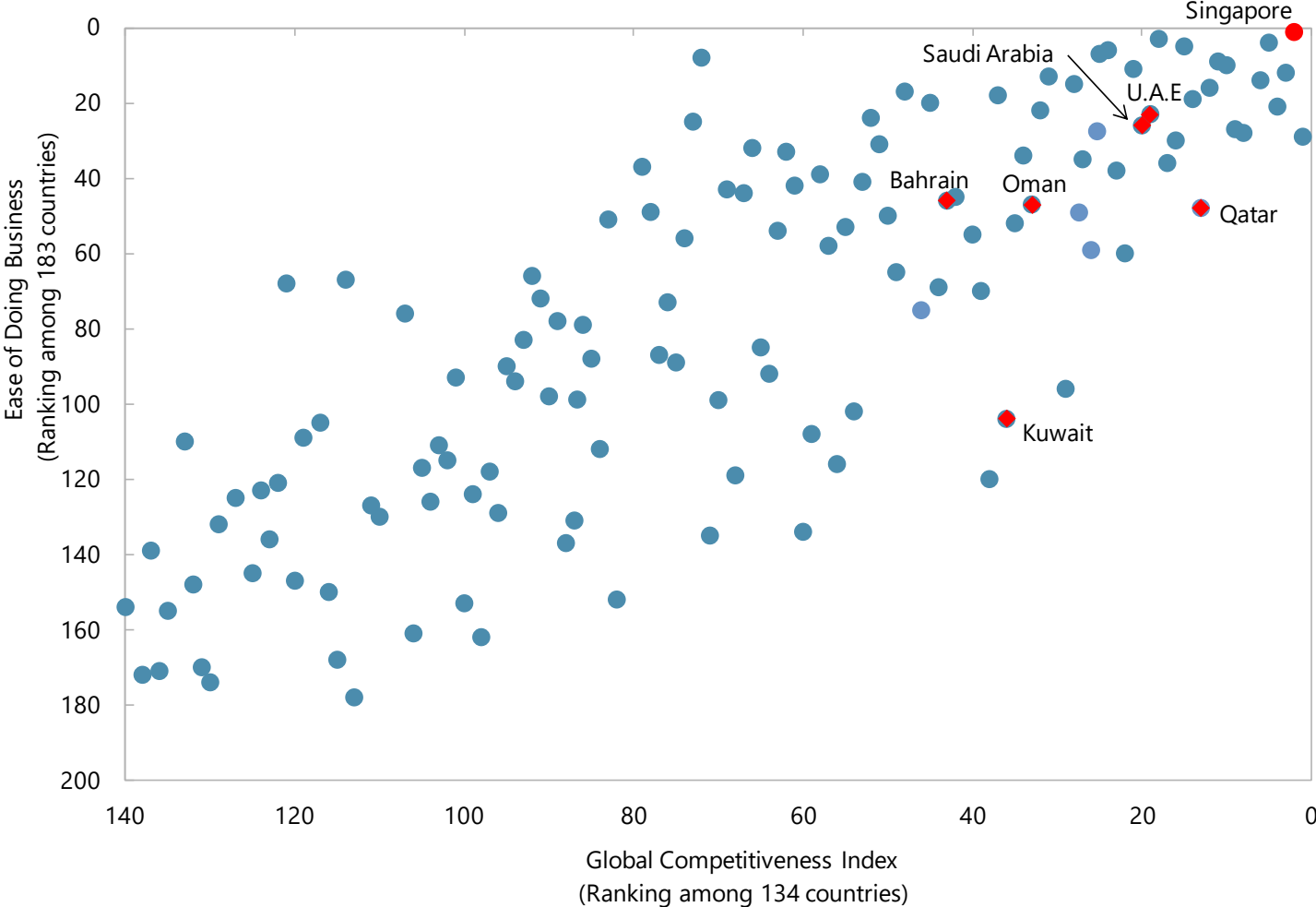
- The lack of sustained growth relates to productivity slowdowns and innovation-driven growth is key to sustaining productivity gains
- Important to switch from investment-based strategy to innovation-based strategy before reaching a certain level of development (Acemoglu, Aghion, and Zilibotti 2006)
- This involves continuously introducing new goods and tasks and moving up the “quality ladder” (Lucas 1993 and Aghion and Howitt 1992) and to do this, the country must be a large exporter (Lucas 1993)
- Empirically, export sophistication is an important determinant of long-run growth – Hausmann, Hwang, and Rodrik (2007) and Cherif and Hasanov (forthcoming)

Standard Growth Policy Advice May not be Sufficient

- Standard policy prescription includes macroeconomic stability, minimum state intervention and an enabling environment conducive to investment in both physical and human capital (e.g. *Breaking the Oil Spell* by Cherif, Hasanov and Zhu 2016)
- It consists in tackling “government failures” (Rodrik 2005)
- The Gulf Cooperation Council (GCC) countries have improved in most of these dimensions but relative economic improvement has not materialized

Tackling “Government Failures”

Doing Business vs. Global Competitiveness Index, 2013



“Market failures” are the Binding Constraints

- High scores in infrastructure quality and other business quality indicators (e.g. tax, regulation, competition, and trade) in the GCC and much better than in relatively successful oil exporters
- Firms choose to produce non-tradables over tradables
- The “market failures” necessitate government intervention, i.e. *the leading hand of the state* to create a dynamic export sector

Creating a Dynamic Export Sector

- Export orientation vs. import substitution/non-tradables
- Domestic capabilities vs. portfolio diversification (e.g. Norway in the 1970s vs. petrochemicals/metals in other oil exporters)
- Sophisticated exports vs. agriculture and services such as tourism and finance
- Beyond vs. within comparative advantage (e.g. Korea/Malaysia vs. Chile)

The Leading Hand of the State

- Direct intervention: to encourage/create domestic firms in the targeted new industries (e.g. electronics in Taiwan Province of China)
- Indirect intervention: to help firms develop while learning new tasks (e.g. Singapore, SBIR and BNDES)
- Enforce market discipline: despite the support received, firms must export and are subject to fierce competition (e.g. Korea)

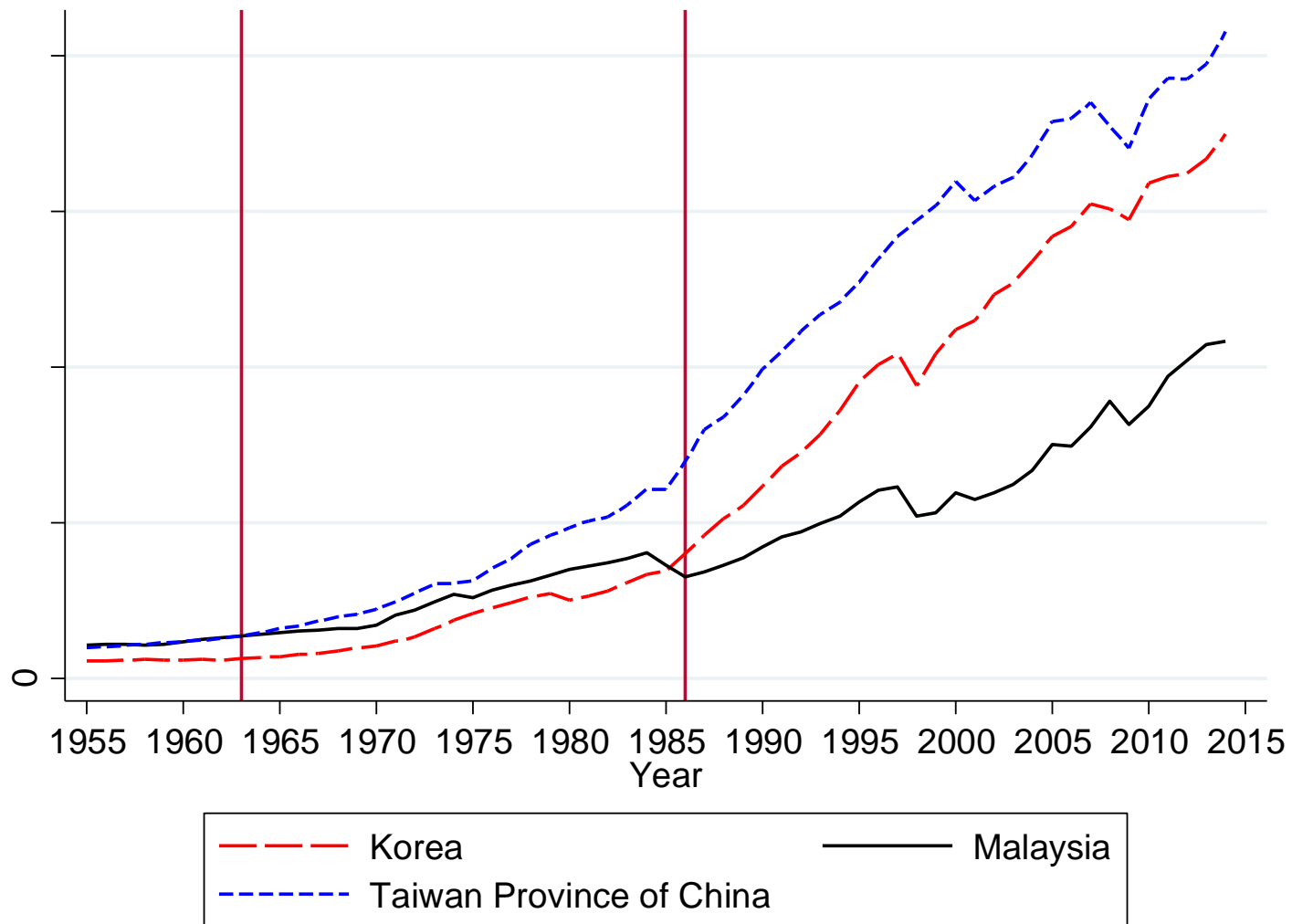
Automotive: Malaysia vs. Korea

- Malaysia's Proton car
 - Established in 1985 and reached annual production of 500,000 cars
 - Lack of innovation, vested political interests, and mismanagement
- A few key elements for the success of Hyundai
 - The push to export from the outset
 - “Move first, then learn and adjust” strategy (huge annual production targeting the US, own dealership network and investment in advertisement)
 - Large state support with strict accountability
 - High R&D spending and own engine produced in 1991
 - Competition across several chaebols in international markets

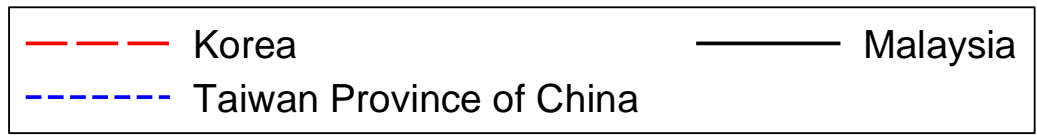
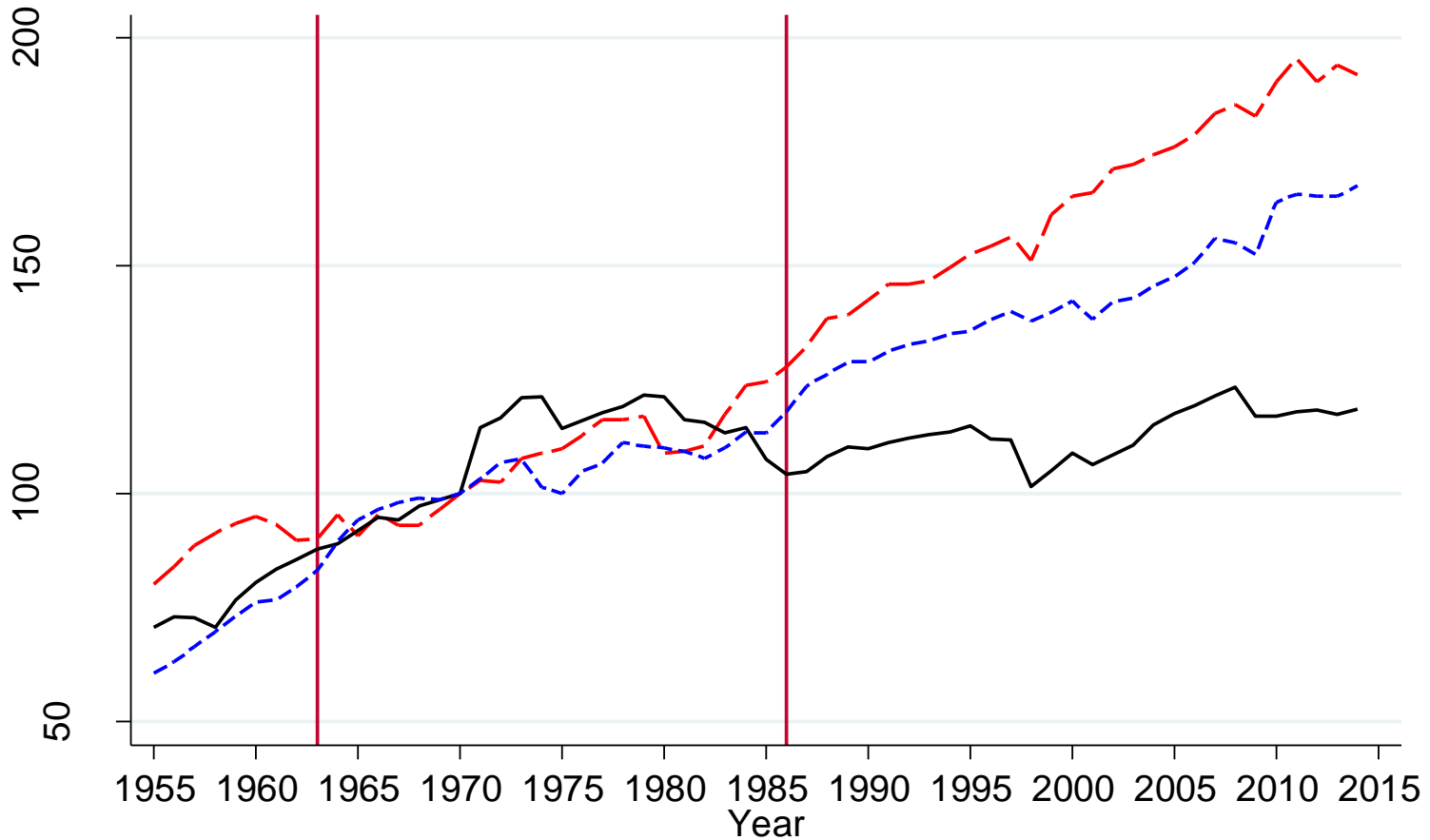
Trapped in the Middle vs. Asian Miracles

- A middle-income country like Malaysia has tackled most of the known “government failures”
- It enjoys a relatively highly skilled labor force, good infrastructure and business environment...especially compared to Korea in the 1970s and 1980s
- The divergence between the Asian miracles and Malaysia is instructive about the key differences in terms of innovation policies

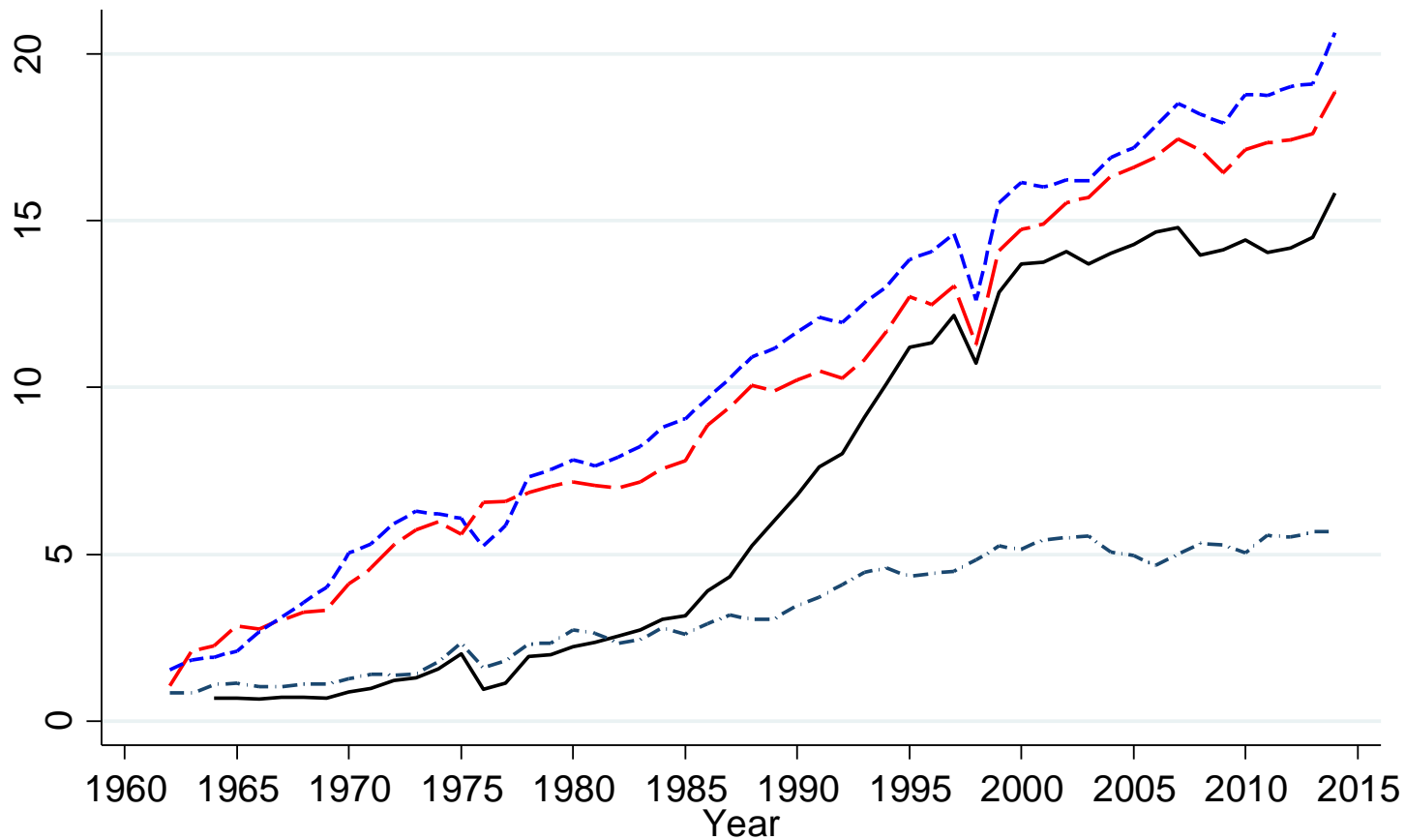
The Asian Miracles vs. Malaysia



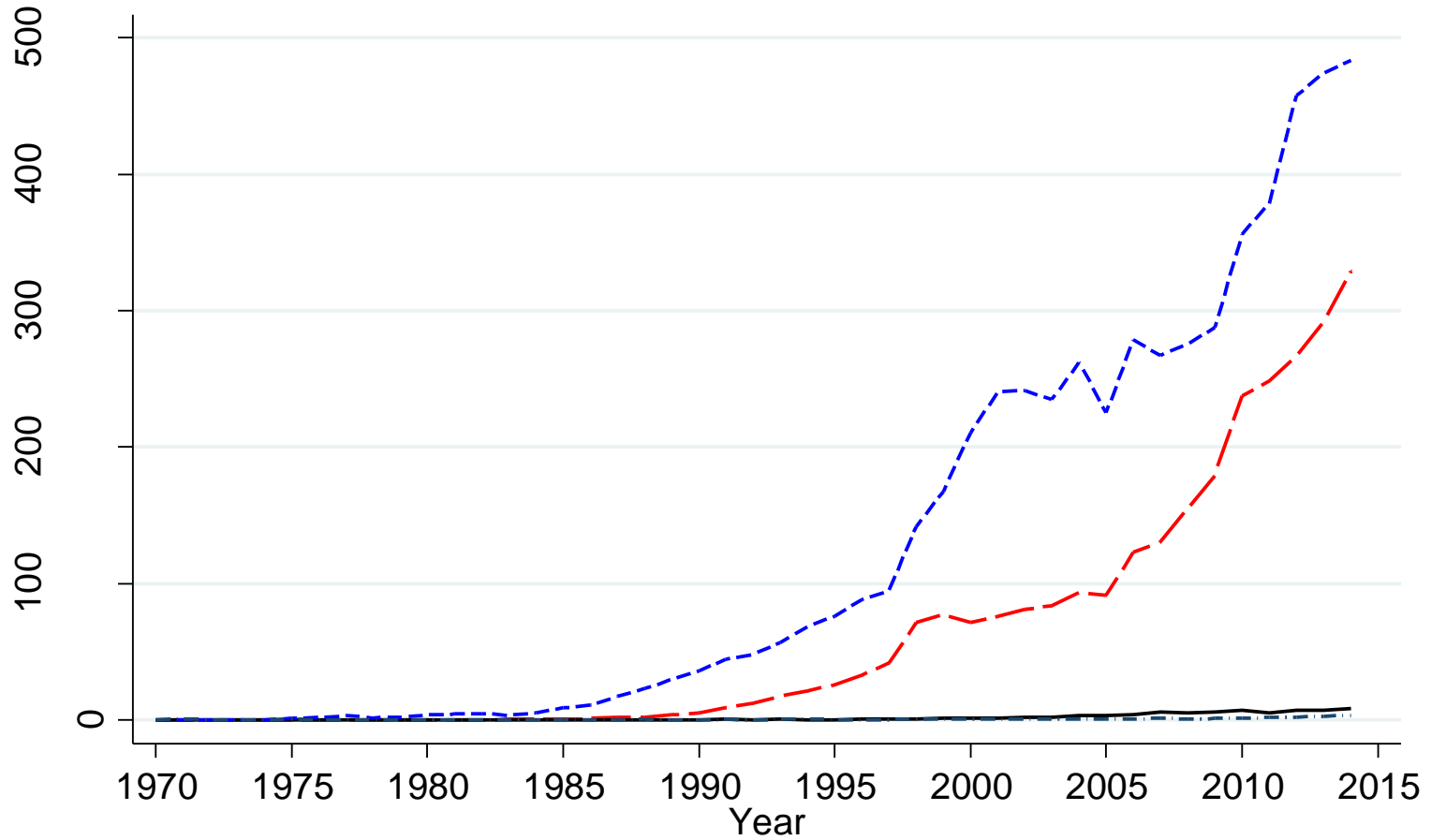
Malaysia's Total Factor Productivity has been Lagging



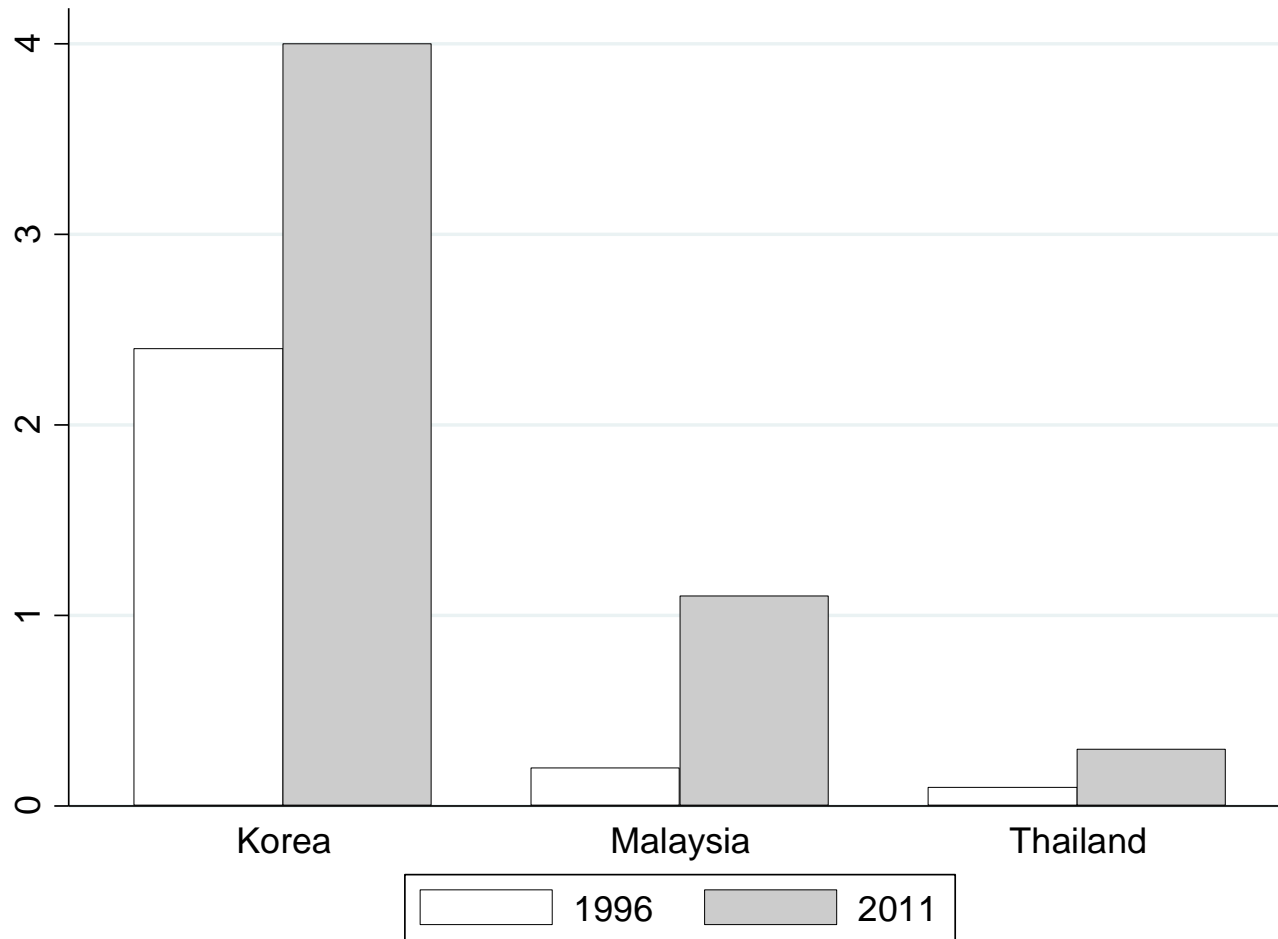
But Export Sophistication Improved Substantially



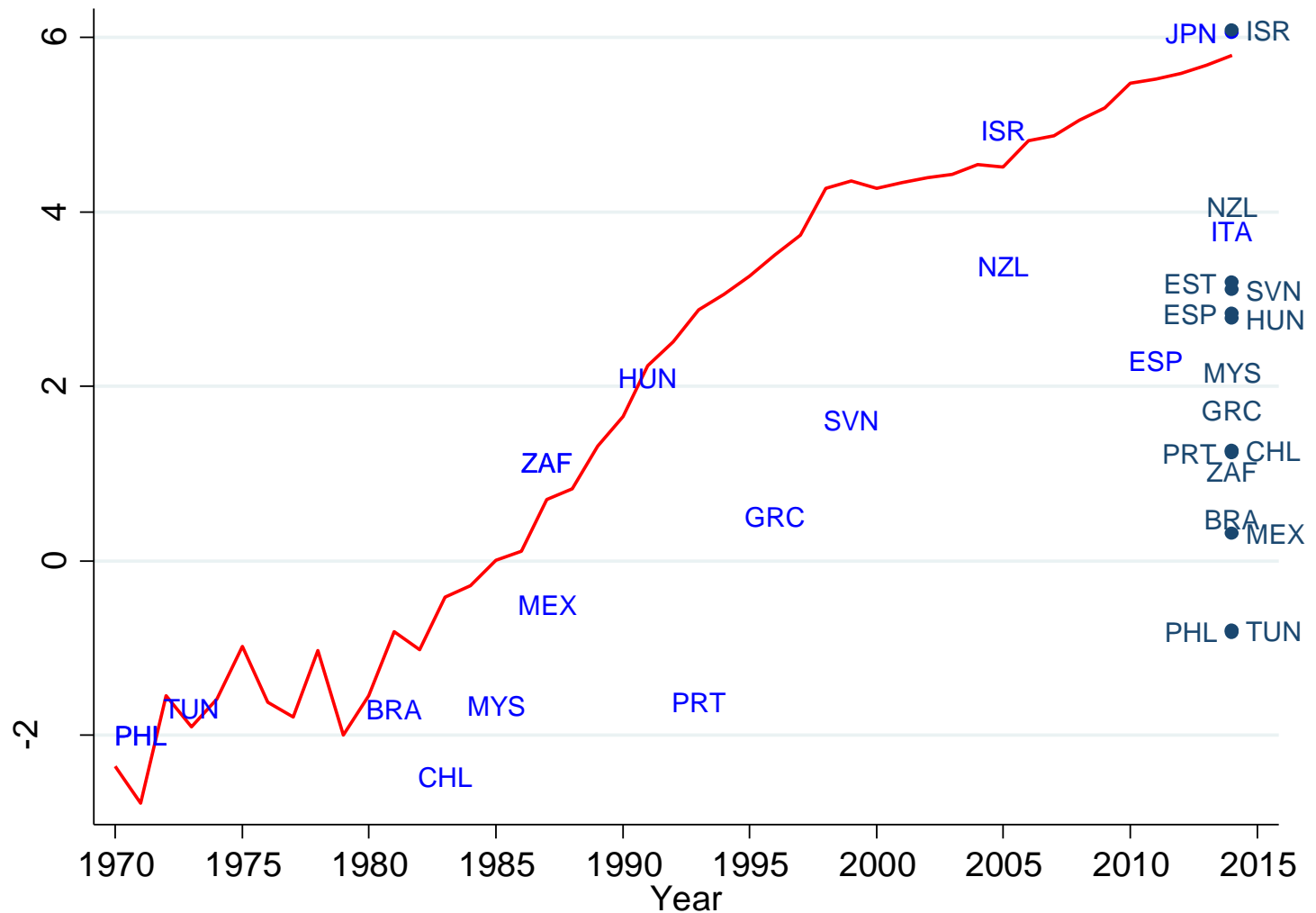
The Missing Element



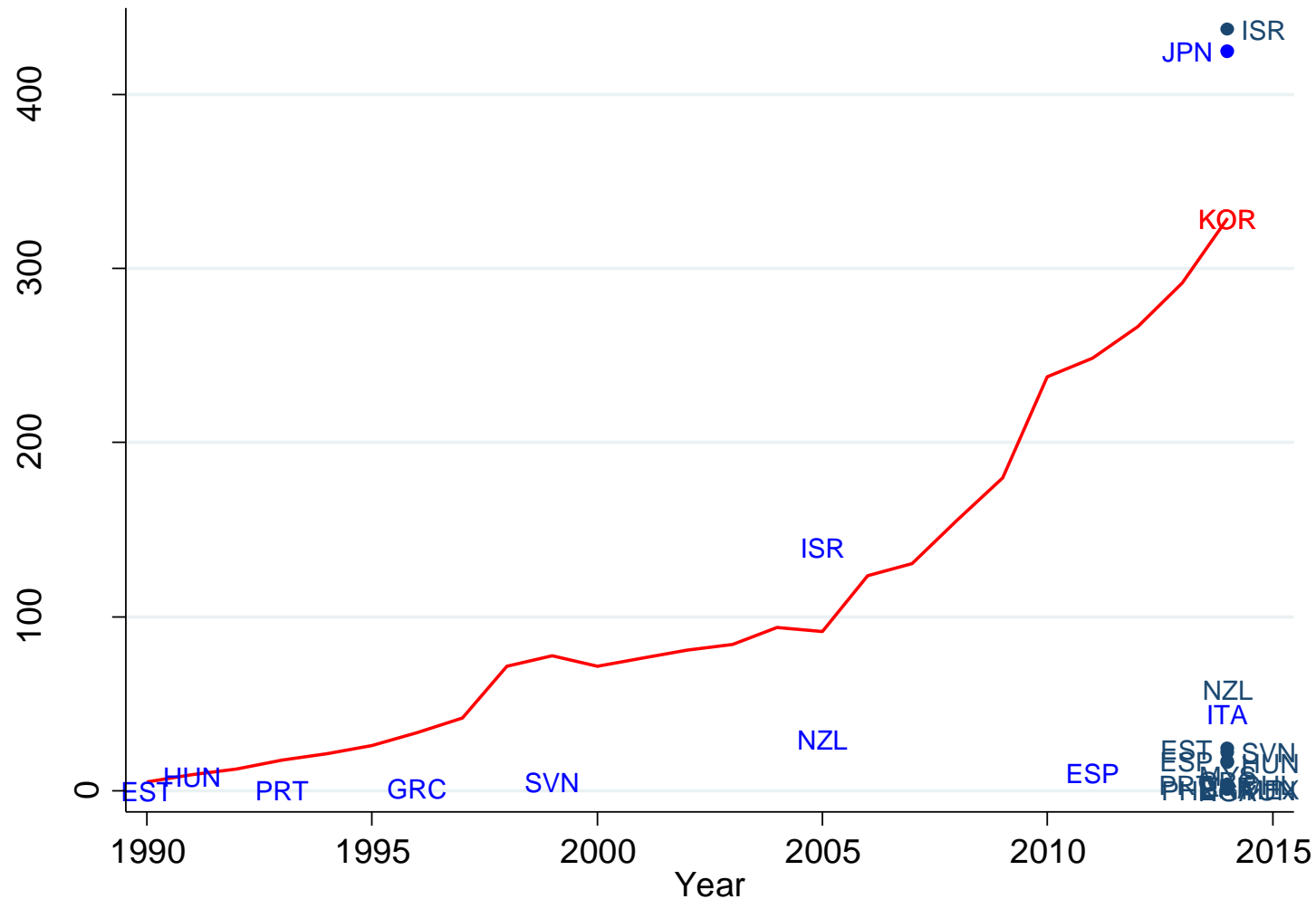
Relatively Small R&D Spending



Patents Granted: When Korea Overtook Other Countries

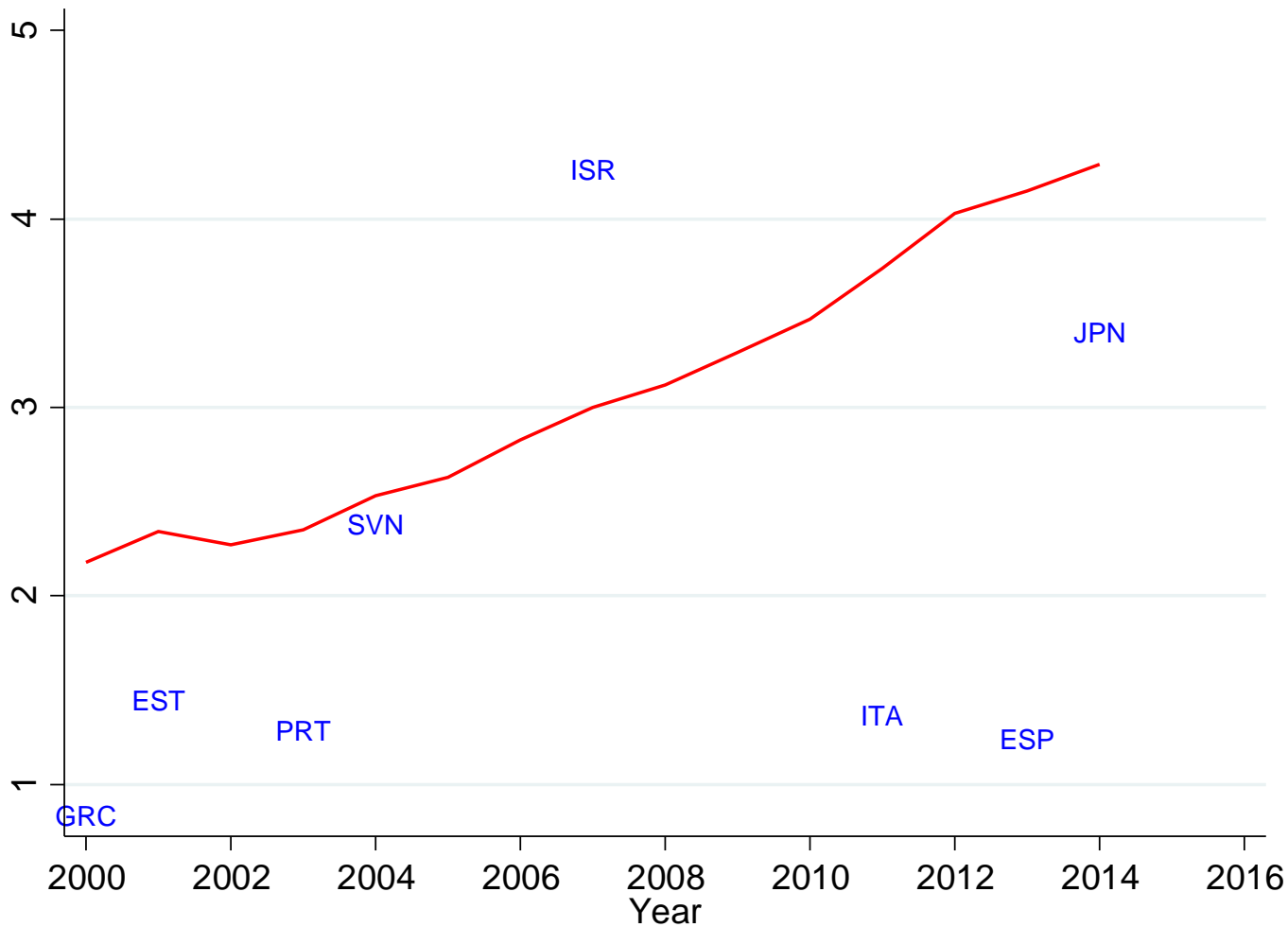


Patents Granted: The Gaps are Large in Magnitude

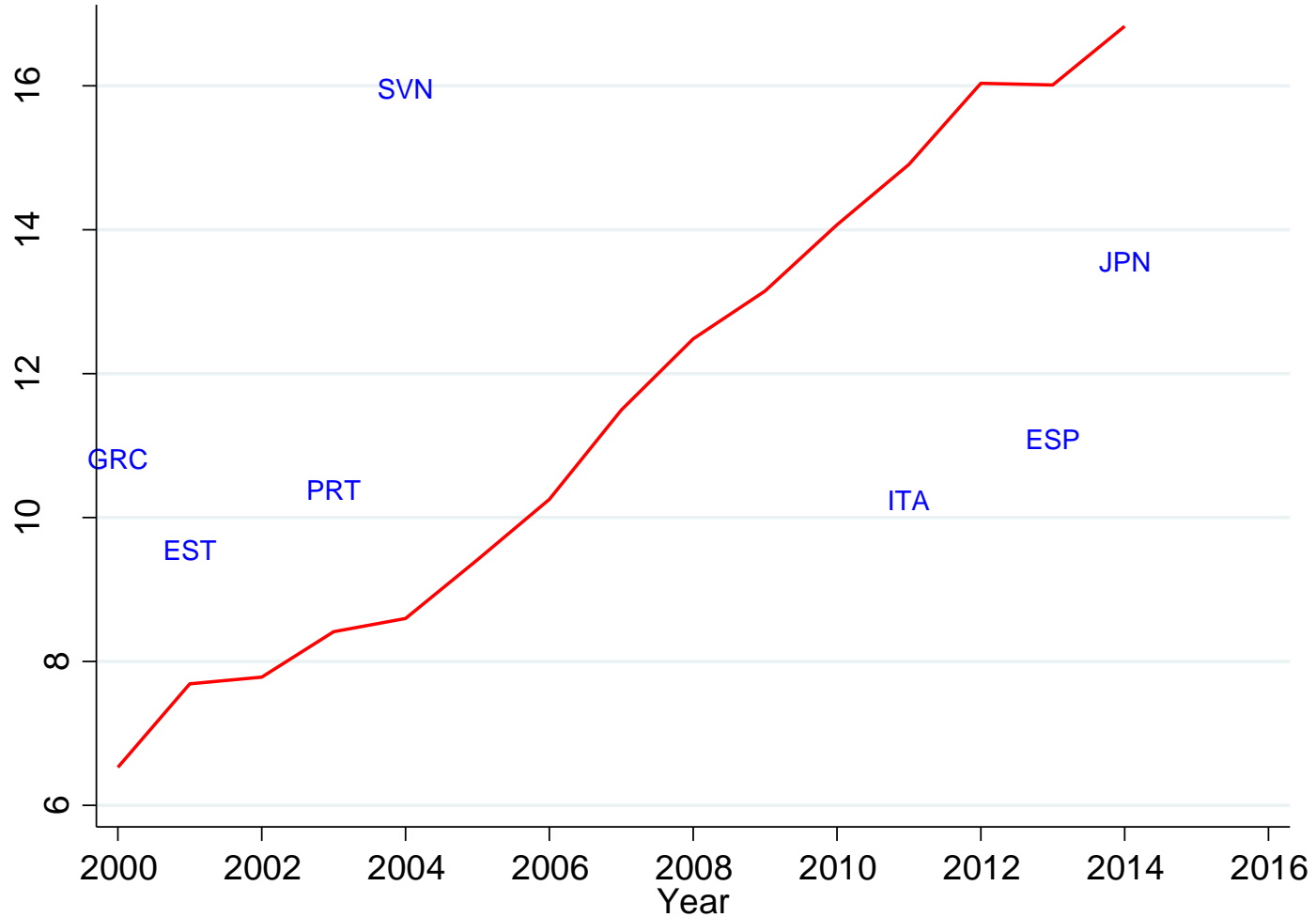


R&D Spending:

When Korea had the same income as others in 2014



Researchers per Million People: When Korea had the same income as others in 2014



Malaysia's Technology Diffusion in Electronics

- Attempts at technology diffusion from MNCs:
 - The Industrial Master Plan of 1986-95 but aborted in favor of liberalization and FDI
 - Technology parks in the 1990s
 - Vendor Development Program for local suppliers
- Local technology creation is largely missing
- Many local firms did not meet requirements to get incentives from the state and lacked high value added production
- R&D intensity was lacking in local firms

Electronics: In the Footsteps of Taiwan

Province of China

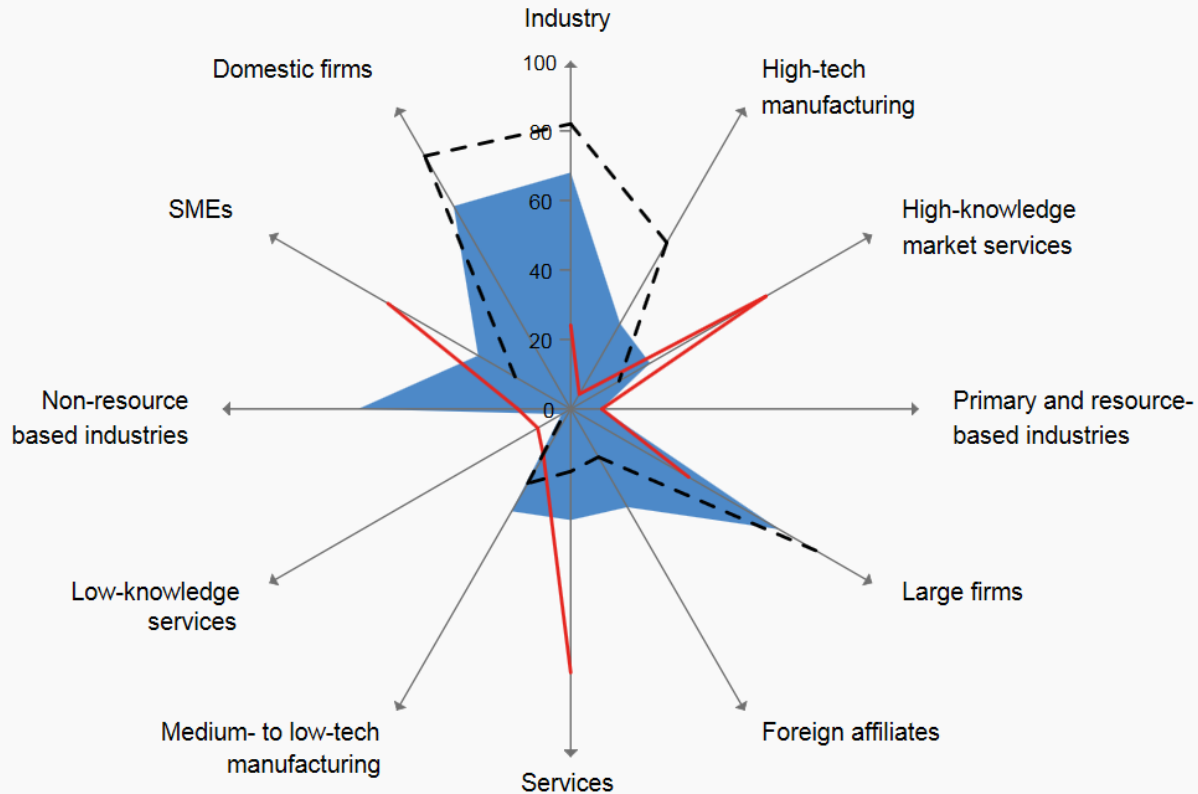
- A few key elements
 - A focus on SMEs and linkages with MNCs
 - Public research institutes to create technology
 - Massive investment in skills
 - Leap to the frontier at an early stage
 - Industrial Technology Research Institute (ITRI) set up in 1973 to lead the effort
- “Spin-offs” and the state as a venture capitalist
 - Technology sharing agreement or license with a US firm
 - Staff sent for training in the facilities of the US partner firms
 - Experimental production units set up within the institute
 - About 50 percent of capital provided and even initial production took place at the institute
- Technology frontier reached within a decade by late 1980s

Who Does Private R&D?

Structural composition of business R&D

Percentage of business R&D expenditure (BERD), 2009

■ OECD median — Estonia - - - Compare to



The State as a Venture Capitalist

- Who does R&D in innovative economies?
 - Mostly large domestic firms in high-tech manufacturing
 - Manufacturing and software/scientific services represent 90% of total R&D in the US
 - Pharmaceuticals and electronics industries are about 15 times more R&D intensive than services
- Specializing in producing/exporting complicated stuff should lead to higher R&D and innovation...
- ...but how do you get into these sectors?
- Venturing into these sectors with purpose-specific policies

Changing Incentives for Firms

- Purpose-specific investment in skills and infrastructure
- Funding and business support using development banks, public venture capital funds, and export promotion agencies (e.g. Finland)
- University-centered innovation: applied sciences, start-up incubators, research and development centers, and University-Industry partnerships (e.g. EPFL in Switzerland)
- Industry clusters (e.g. Biopolis in Singapore)

The Rise of Nokia

- Nokia started as a paper mill company (joint venture later with rubber and cables companies)
- Government procurement played an important role in ICT cluster development (e.g. Post and Telecommunication Operator)
- Parallels with Taiwan Province of China: STPC-STAG; ITRI-Tekes; ERSO-VTT
- 7-8% of Nokia's R&D in 80s and 90s from Tekes (excluding partnerships)
- From late 90s to 2010, Nokia's R&D was around 1% of GDP (about 1/3 of total R&D)

University- Centered Innovation: EPFL

- Large investment in basic and applied research in Universities, including through Swiss National Foundation and Commission for Technology and Innovation
- Strong collaboration with industries: CTI on a national level, Innovation Park at EPFL
- Policies to attract foreign talent (professors and PhD/masters students)
- Supporting legal framework for technology transfers (early 1990s for ETH System) and various funding instruments (e.g. Innogrants) and startup support at Innovation Park

Industry Clusters: Singapore's Biopharma

- In early 2000s, Biopharma was identified as one of the “pillars” of Singapore’s manufacturing
- Ministerial Committee for Life Science was set up to coordinate the initiative
- Purpose specific investment to solve coordination failures:
 - Research institutes
 - Partnerships with industry
 - Skills (PhD fellowships abroad, technicians...)
 - Biopolis (physical hub for Biomedical research)
 - Funding instruments
 - Legal framework (e.g. clinical trials and stem cells)

Changing Incentives for Workers

- Improving education quality through
 - Early childhood education programs (Heckman 2008)
 - Teacher quality enhancement programs
 - Training institutes, apprenticeships, and technical schools
 - Importance of study abroad programs and research institutions
- Changing social attitudes
 - Developing economies: “Saemaul Undong”-type social development program (Cherif, Hasanov, and Zhu 2016)
 - Advanced economies: Encourage entrepreneurship and risk taking

Concluding Remarks

- The key is exporting activities of domestic firms and local technology creation
- Picking sectors/missions rather than firms while preserving competition and “creative destruction”
- To create local technology, a focus on competing in international markets, climbing the value added ladder and moving to frontier technology early on, while enforcing market discipline and accountability is needed
- Invest in purpose-specific skills and infrastructure and change incentives for firms and workers

Creativity always comes as a surprise to us; therefore we can never count on it and we dare not believe in it until it has happened. In other words, we would not consciously engage upon tasks whose success clearly requires that creativity be forthcoming.

Albert Hirschman

“The Principle of the Hiding Hand”