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CONTACT: Rainer Kattel, kattel@staff.ttu.ee; Wolfgang Drechsler, drechsler@staff.ttu.ee; Erik S. Reinert, reinert@staff.ttu.ee

Capitalist Dynamics: A Technical Note

Erik S. Reinert, The Other Canon Foundation, Norway & Tallinn
University of Technology, Estonia

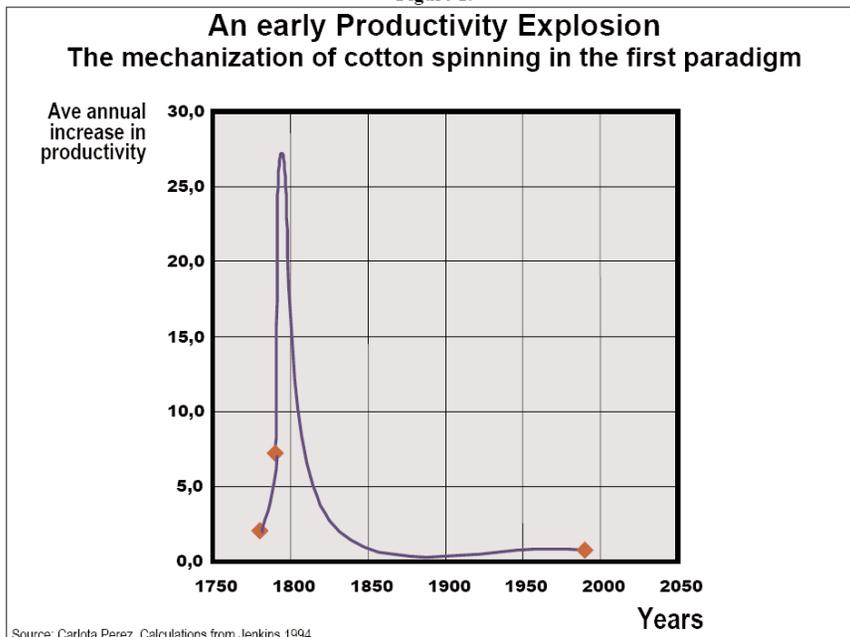
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Carl Menger, the founder of the Austrian School of Economics, had the ambition that economics should be a 'map of the forces at work'. Standard textbook economics ('neo-classical economics') takes as its starting point a metaphor of 'equilibrium' based on the state of the physics profession in the 1880s. This force towards equilibrium is, however, only one of many forces at work. The most fundamental feature of capitalism is change, and this change is only poorly reflected in standard economics. Financial crises are just one of the many things that happen in real life, but cannot happen in standard textbook economics. From the standpoint of Joseph Alois Schumpeter (1883-1950), Austrian economist and Harvard economics professor who spent much time at Harvard Business School, 'equilibrium' is the opposite of economic development. Equilibrium theory therefore fails to reflect many of the mechanisms of industrial and economic dynamics that create economic welfare. This note attempts to outline some of these forces.

Productivity explosions

What from a long-term perspective may look as relatively smooth curves of economic development are in reality the result of explosive productivity changes in a small number of industries. Figure 1 shows an early such 'productivity explosion' from a breakthrough innovation: that of cotton spinning in the late 1700s when annual labour productivity rose with more than 25% annually for a brief period.

Figure 1.

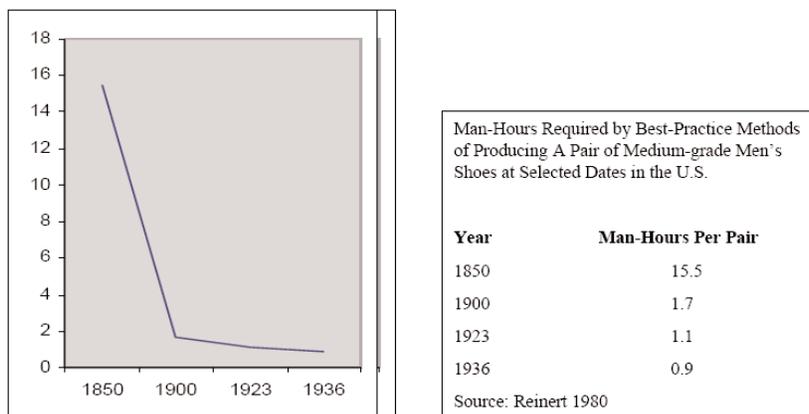


At the time the common sense of economics was for nations to attempt to get industries behaving like this inside their borders. Productivity explosions create a system of triple rents: profits are high, wages rise, and the government tax-base grows. In its essence colonialism was a system that prohibited such production activities — industry in general — from being carried out in the colonies. At the time of this early productivity explosion, this prohibition of manufacturing was a main motive for the United States' independence in 1776.

Today we are experiencing a similar productivity explosion in the computer industry. Moore's Law tells us that, since the late 1970's, the capacity of the computer chips doubles roughly every 18 months, creating an upward curve like the one of the cotton industry in the 1700s.

Also the activities, even technologically pedestrian ones, that are near the productivity explosion may achieve triple rents. The task of cutting and preparing cables to the computer industry grew up geographically close to the computer industry itself when volume was low and prices not a big issue. Based on the growing demand, however, even low-tech industries may achieve economies of scale and run down the learning curve (see Figure 2).

Figure 2. Learning Curve of Best-Practice Productivity in Medium Grade Men's Shoes', United States 1850-1936.



As German economist Friedrich List pointed out in 1841, English economists tended to explain economic progress as a result of free trade rather than as the result of 'productivity explosions', thus 'confusing the carrier with the cause'. The trade theory disregarded the industrial revolution by

operating only with labour hours, no capital, no skills, no technology, and no entrepreneurship. List's comment still applies to standard textbook economics.

Learning Curves and Experience Curves.

One classical article in Harvard Business Review is called 'Profit from the Learning Curve'. The learning curve is a productivity explosion seen from a different angle, measuring the explosive growth in labour productivity as a declining curve in labour units per unit of output (Figure 2, and Figure 3 middle).

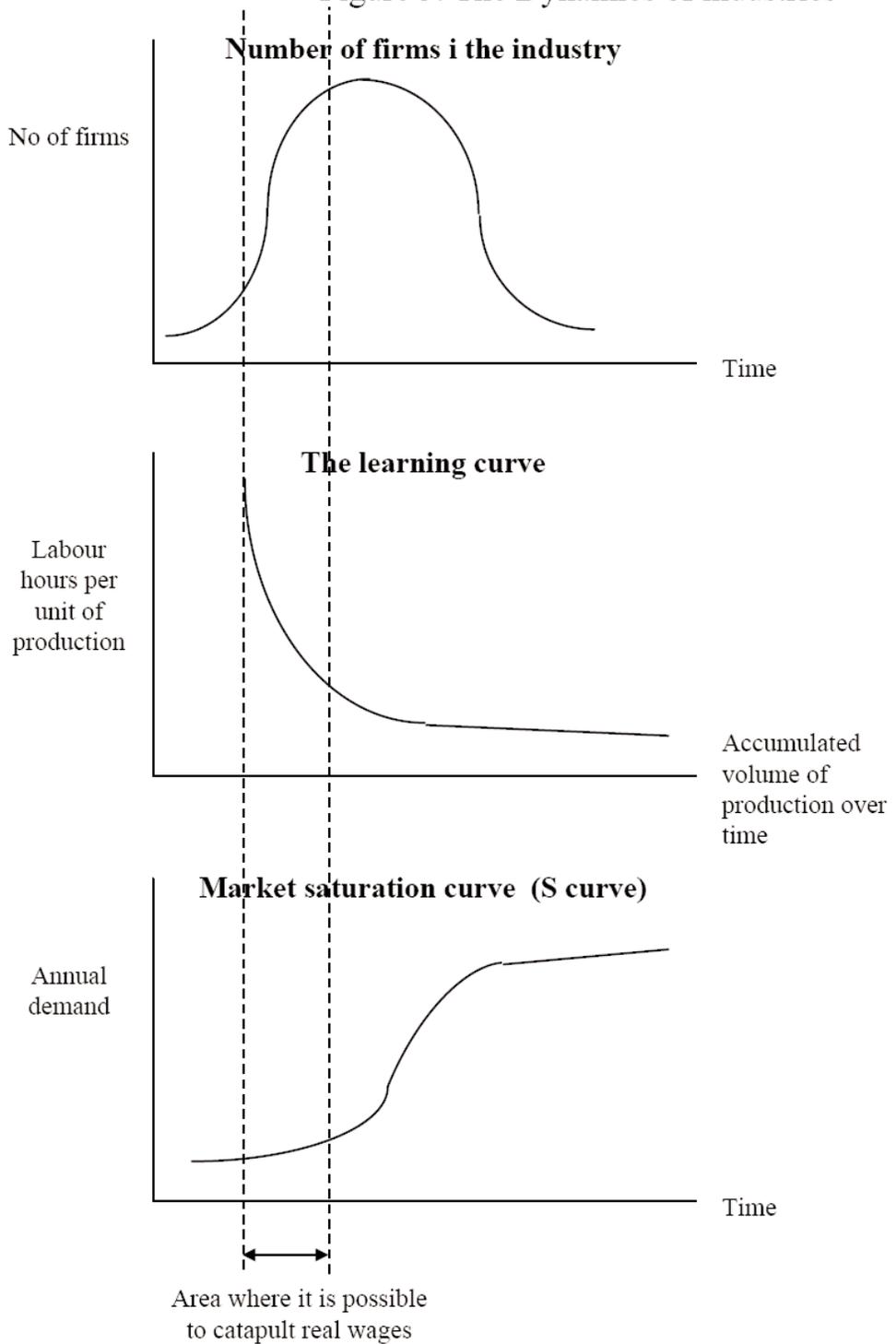
Starting in the 1970s Boston Consulting Group (BCG) developed the same concept using total costs, not labour hours, on the left axis, and called this an 'experience curve'. Learning curves and experience curves have very important implications for competitive behavior between firms.

Ray Vernon and Louis Wells, two professors at Harvard Business School, developed a life cycle theory of international trade. One implication of this theory is that rich countries export when the learning curve is steep, but become importers when the learning curve flattens out. In other words, within the manufacturing sector poor countries tend to specialize where the learning curve is flat. Since the Terms of Trade (export prices compared to import prices) between rich and poor countries often have stayed the same, this means that the rich countries are able to take out as 'triple rent' most of the fruits of technical change. Former industrial policy was based on the idea that a nation was better off being slightly less efficient in an industry subject to a steep learning curve than specializing in industries with limited or no learning potential.

Industry Concentration

The number of firms in an industry goes through a cycle as technologies mature (Figure 3, top). Initially the number of firms in the market grows: at one time there were more than 200 car manufacturers in the United States and more than a dozen match factories in Norway. Some decades later there were four (4) car manufacturers left in the United States and one match factory in Norway (today none).

Figure 3. The Dynamics of industries



Market Saturation Curve (S-curve)

Normally a steep learning curve is associated with a sharp increase in demand (Figure 3, bottom). When the mobile industry starts growing no one has cellular phones and the market saturation curve takes on the form of an 'epidemic curve' like in medicine. Flat to start with and flat towards the end, but with steep growth in the middle. When the curve flattens out the replacement market becomes the dominant segment, and product differentiation increases ('adding bells and whistles').

The close relationship between technical change and increasing demand is called Verdoorn's Law after a Dutch economist.

The Quality Index of Economic Activities

Figure 4 attempts to make a fluid classification system for economic activities sorted according to their abilities to create triple rents (high profits, high wages, large tax base). Black, on the top, marks a situation of temporary monopoly from a new innovation. White, at the bottom, marks a situation of 'perfect competition' which is the 'ideal' situation in neo-classical economics with 'normal' or no profit. The problem is that economic theory only defines well pure black (monopoly) and pure white (perfect competition), while very few activities stay long in any of these positions. Industrial dynamics take place in the various shades of gray areas where theory has little precise to say.

The gravity in the system (from black to white) is produced by imitators of the original idea and general productivity developments, and under some circumstances — as when a patent expires — the fall can be very fast (the price of a medicine may suddenly fall by 90%). Some innovations, like the container, are born towards the white end, but the container was important to other industries because transportation costs were reduced.

The various factors that create gravity and gravity-resistance are listed in Figure 4. The position of a nation's export activities, at what level (at what shade of grey), in Figure 4 will be highly determinant for the real wages of that nation. Baseballs for the US national sport have not experienced innovation in the final assembly operations for a century. This is still 100% manual work. The world's most efficient baseball producers are in Haiti and Honduras, where their wages are between US Dollars 0.50 and 1.00 an hour. The wages in the national service sector, the librarians or the firemen of Haiti, will have wages in line with the producers in the export sector. The world's most efficient producers of golf balls, on the other hand, are in New Bedford

Massachusetts, where the average industrial wage is US Dollars 14 per hour. Golfballs are a high-tech product that needs to be located near the engineers.

When Haiti exports baseballs to the United States and imports golf balls, the country exchanges 28 hours of labour (at 50 cents an hour) for one hour of labour in the United States (at 14 dollars an hour). These mechanisms are not captured in international trade theory, since this theory operates on the basis of bartering labour hours — all of the same quality — alone.

The case of baseballs and golf balls is an extreme one, but the very same forces are at work with Norway's relationship to the rest of the world. Businesses — and nations — stay wealthy only through continuous innovation, the welfare state must be a Schumpeterian welfare state in order to survive. Remaining at the same level of profits or real wages requires continuous innovations. Or, as one of the characters in Alice in Wonderland says: 'This is how fast you have to run here in order to stand still'.

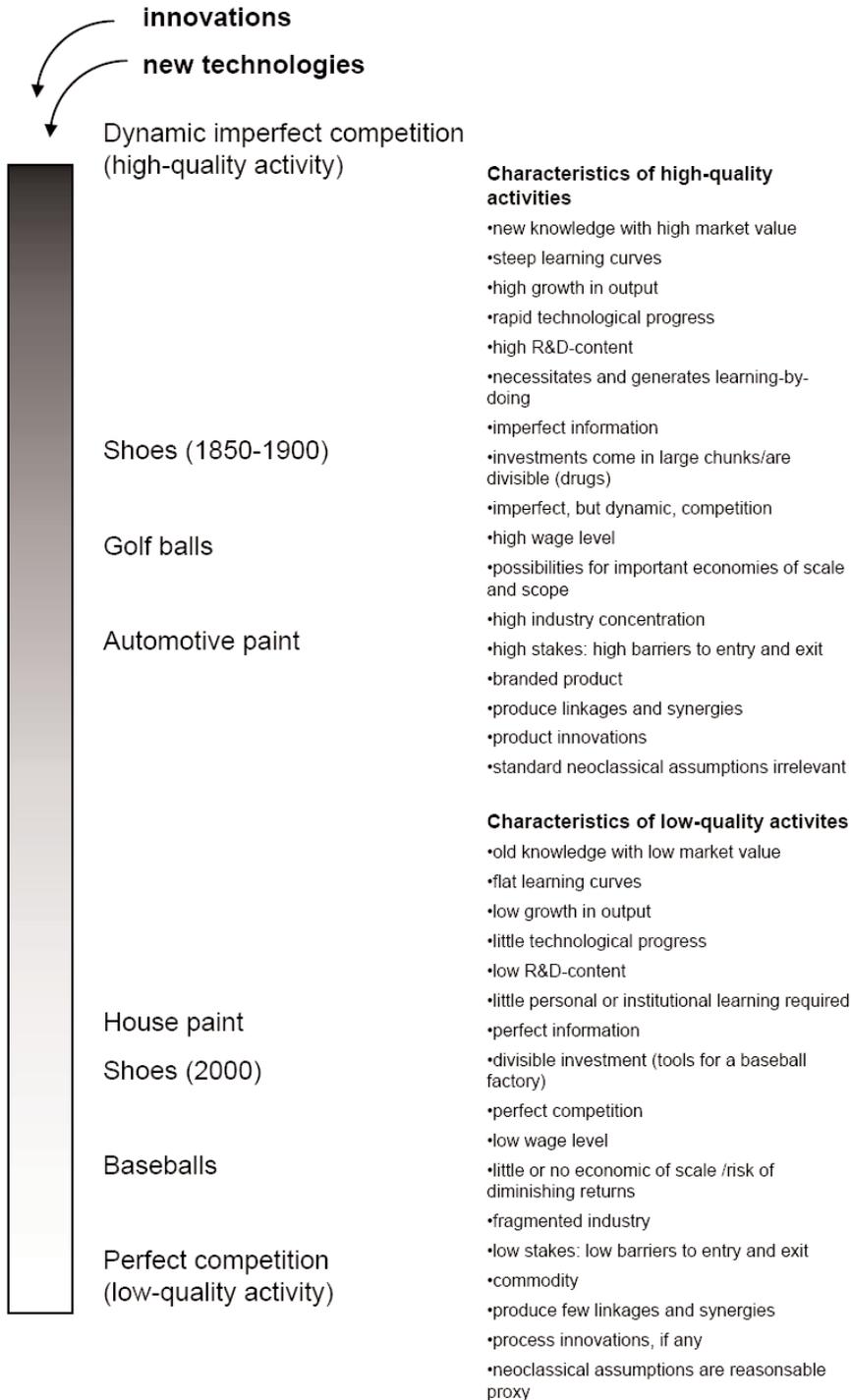
Figure 5 (Chart 16) shows the 'quality index' of economic activities as it looked in practice in 51 industrial sectors in the United States from 1899 to 1939. Note the fantastic productivity explosion in the automotive industry and the miserable performance — e.g. of the glove and leather sector. Note also Verdoorn's Law at work: the relationship between 'high growth in output' and rapid decrease in 'wage earners per unit' (i.e., the slope of the learning curve).

The Gestation Period for Innovations

Technologies differ on a variety of axis, and accordingly what US economist Moses Abramowitz called 'the factor bias of economic growth' also varies. The building of railroads was extremely intensive in 'capital without skills'. The coming science-based techno-economic period is likely to be extremely extensive in 'knowledgeable capital'.

The factor bias of technologies also shows other peculiarities. The Fordist mass production paradigm made national catching up with the leader nations through reverse engineering (the Japanese pulling a US car apart and creating an improved version) a viable option. The coming science-based paradigm will be dominated by patents and copyrights and will make reverse engineering impossible or illegal. Since few nations have positive balances of payments in patents, royalties and copyrights, this is likely to worsen world income distribution.

Fig. 4: The Quality Index of Economic Activities



LABOR AND RELATED QUANTITIES

Chart 16
 INDIVIDUAL MANUFACTURING INDUSTRIES
 Change in Physical Output, Wage Earners Employed, and
 Wage Earners Employed per Unit of Product, 1899-1937

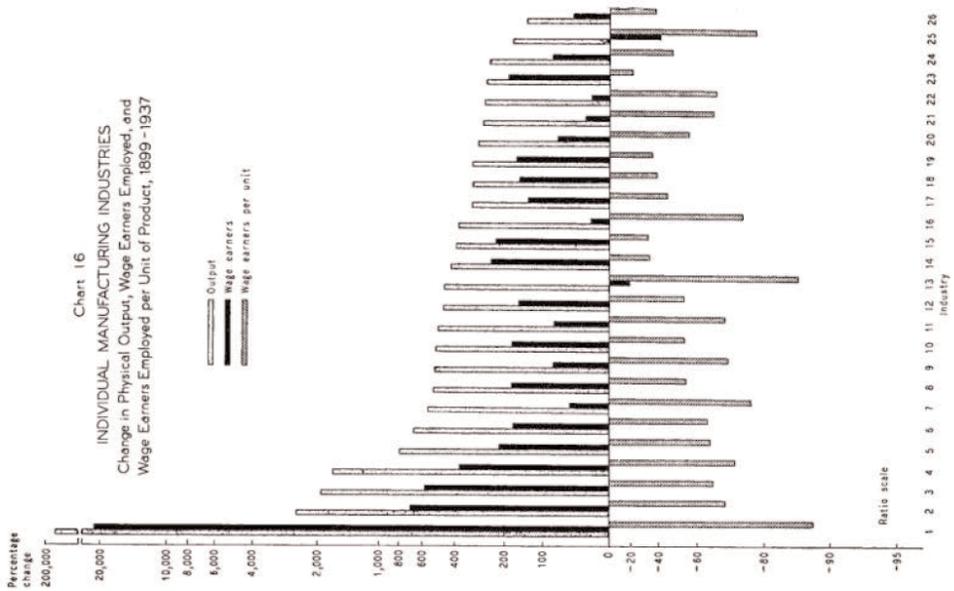
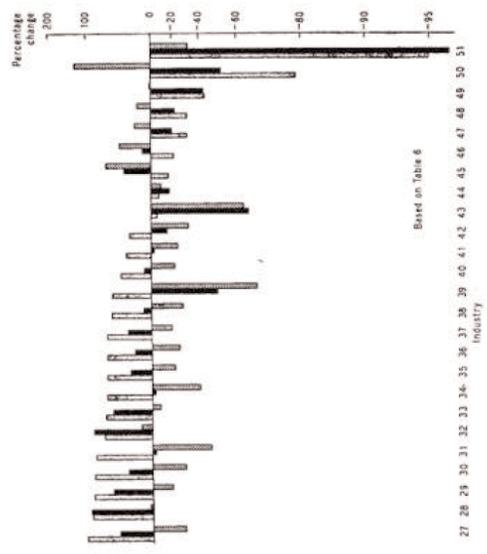


Figure 5.

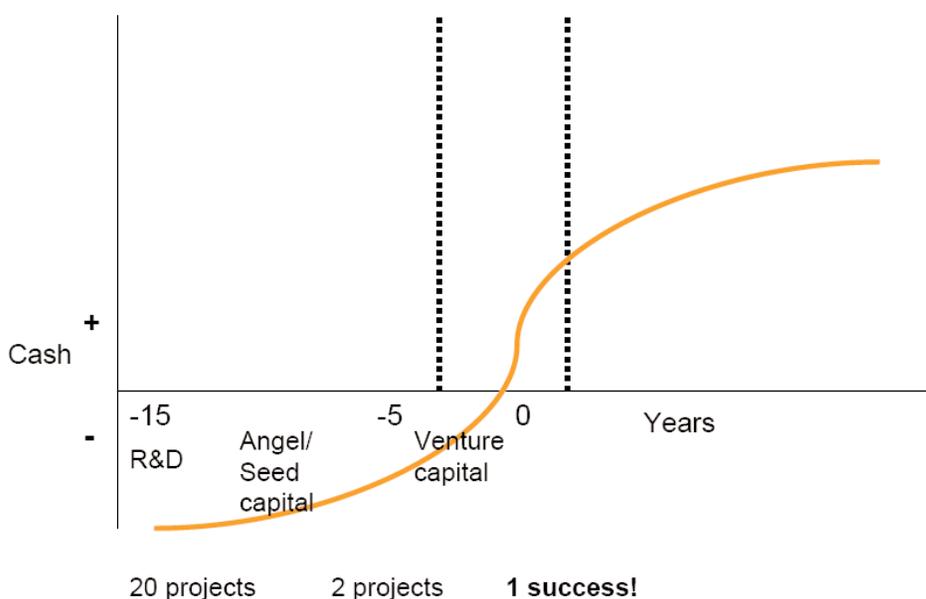
- INDUSTRY
- 1 Automobiles, incl. bodies and parts
 - 2 Chemicals, industrial, incl. compressed gases and naph
 - 3 Petroleum refining
 - 4 Beet sugar
 - 5 Fruit and vegetable, canned
 - 6 Glass
 - 7 Paper and pulp
 - 8 Silk and rayon goods
 - 9 Textiles, mill
 - 10 Printing and publishing, total
 - 11 Buttery, cheese and canned milk
 - 12 Rice
 - 13 Cigars
 - 14 Beer and beverages
 - 15 Canned goods
 - 16 Coal-mining products
 - 17 Zinc
 - 18 Liqueurs, distilled
 - 19 Steel-mill products
 - 20 Tanning and dye materials
 - 21 Copper
 - 22 Explosives
 - 23 Wood-distillation products
 - 24 Bricks
 - 25 Miscellaneous products
 - 26 Jute goods
 - 27 Cotton goods
 - 28 Hats, wool-felt
 - 29 Shoes, leather
 - 30 Fire sugar
 - 31 Salt
 - 32 Meat packing
 - 33 Canned products
 - 34 Leather
 - 35 Woolen and worsted goods
 - 36 Liqueurs, malt
 - 37 Shoes, rubber
 - 38 Carpets and rug, wool
 - 39 Paper products
 - 40 Cordage and twine
 - 41 Gloves, leather
 - 42 Hats, fur-felt
 - 43 Chewing and smoking tobacco
 - 44 Flour
 - 45 Ships and boats
 - 46 Cars, railroad
 - 47 Lumber-mill products
 - 48 Appending and resin
 - 49 Lard
 - 50 Licorices
 - 51 Carriages, wagons and sleighs



Based on Table 6

The gestation period from invention to innovation (i.e., when the invention reaches the market) also varies considerably from one techno-economic paradigm to another. The IT-paradigm made relatively short times between a conceptual idea and a 'killer application' possible. The coming science-based paradigm will require large amounts of skilled and patient capital, as in Figure 6. A typical product takes 15 years from inception to positive cash flow. Here various forms of capital are needed, R&D capital, angel capital, seed capital and venture capital.

Figure 6. The time-lags of the coming paradigm



Out of an initial pool of 20 projects, only one is likely to be a success after 15 years. Venture capital typically enters only 5 years before positive cash flow, when there are 2 projects left of the original 20, when the success rate is 50 per cent vs. the 5 per cent for the investor who starts in year 0 (positive cash flow) minus 15.

Observers of US industrial policy noted that a growing public participation in the national innovation system started already several years ago. Sovereign Wealth Funds as well as the huge financial reserves that many nations have accumulated are likely to become heavily involved in this new version of capitalism. The state will no longer be the enemy it used to be seen as during the Cold War years, but more like economic historians

describe early capitalism in Venice 500 years ago: Venetian wealth was built on a symbiotic relationship between private entrepreneurship and the activities of the state. And as with Venice 500 years, national hegemonies are unfortunately still going to be decided by 'economies of scale in the use of force' as Venice' foremost historian, Fredrik Lane put it. Economic power and military power will continue to be two sides of the same coin.

Conclusion: Strategies in a Turbulent Capitalism

In all its simplicity, Boston Consulting Group's 'Product Portfolio Matrix' (Figure 7) provides a navigational map, a résumé of the forces at work, which can be used by companies and nations alike. It was a key tool when this author, as part of US consulting group Telesis, advised the Irish Prime Minister's Office on the country's industrial policy in 1980. The core strategic element consists of the flow of funds from the lower left corner, the 'cash cows', to the potential new winners, the 'question marks' of the upper right hand corner. Ireland managed to ride down the steepest learning curve of our time, harnessing the productivity explosion of the IT-revolution. The next one will be different. Figure 6, the former figure, represents a description of what will be going on inside the upper right hand corner in the next techno-economic paradigm.

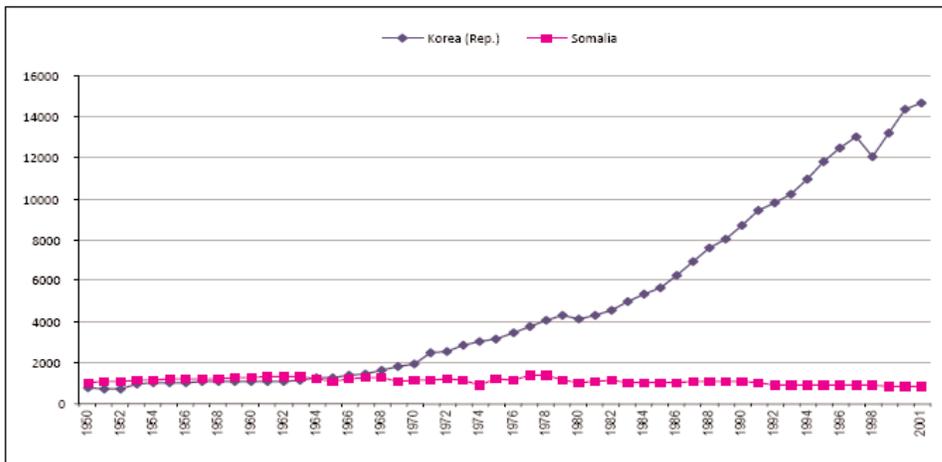
Figure 7. BCG Product Portfolio Matrix.

		Relative Market Share	
		High	Low
Market Growth Rate	High	Stars	Question Marks
	Low	Cash Cows	Dogs

It is important to understand the many forces of capitalism. To a large extent the wealth and poverty of nations are formed by the 'forces at work' – using Menger's term – depicted in the graphs in this technical note. In the tradition of Carl Menger and UK economist Nicholas Kaldor this note sees 'degrees of imperfect competition', caused by technological change and increasing returns, to be a determining element in explaining differences in national wealth. If we wish to explain the difference in GDP per capita between Somalia and Korea – where Somalia was a richer country than Korea until this writer was a teenager (Figure 8) – the main explanatory variables are found in these same forces.

Figure 8. Somalia vs. Korea.

Korea (Rep.)-Somalia, GDP per Capita 1950-2001



Source: original data extracted from Angus Maddison, OECD, Paris, 2003

Working Papers in Technology Governance and Economic Dynamics

The Other Canon Foundation, Norway, and the Technology Governance program at Tallinn University of Technology (TUT), Estonia, have launched a new working papers series, entitled "Working Papers in Technology Governance and Economic Dynamics". In the context denoted by the title series, it will publish original research papers, both practical and theoretical, both narrative and analytical, in the area denoted by such concepts as uneven economic growth, techno-economic paradigms, the history and theory of economic policy, innovation strategies, and the public management of innovation, but also generally in the wider fields of industrial policy, development, technology, institutions, finance, public policy, and economic and financial history and theory.

The idea is to offer a venue for quickly presenting interesting papers – scholarly articles, especially as preprints, lectures, essays in a form that may be developed further later on – in a high-quality, nicely formatted version, free of charge: all working papers are downloadable for free from <http://hum.ttu.ee/tg> as soon as they appear, and you may also order a free subscription by e-mail attachment directly from the same website.

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26. Erik S. Reinert, *Capitalist Dynamics: A Technical Note*

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