Article

WTR 2012;1:186-191 http://dx.doi.org/10.7165/wtr2012.1.3.186

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S&T Theories and National Competitive Advantages in South Korea

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Abstract : To understand South Korea's economic success several contending paradigms have emerged, ranging from a neo-classical explanation to a statist perspective, and Schumpeterian structuralism. The Korean miracle can be seen as a product of multiple factors involving the strategic choice of export-led growth, timely and active human-capital investment, business activism, and individual innovative ideas.

However, South Korea needs more complex and innovative ideas to continue its both economic growth and S&T Development. The ideas of Schumpeterian structuralist needs to be more emphasized. Changing state-society relations and subsequent policy choice are greatly influenced by the industrial life cycle. The industrial life cycle is closely related to the historical sequencing and diffusion of technology. The complex mixture of statist-market-Schumpeterian structuralist perspectives could lead more technologically advanced society in South Korea.

Keyword : S&T Theories, statism, market perspective, Schumpeterian structuralism, mixture of state-market-Schumpeterian structuralism, technology of international competitiveness

1. INTRODUCTION

Technology development in South Korea has not been solely determined by market factors. Private firms are the most important agent of technological innovation, but the scope and nature of their innovation are fundamentally facilitated or constrained by prevailing science-technology-policy. Such policy belongs to the realm of public policy, which is an outcome of interactions among government, business, and Schumpeterian structuralism. Thus it is important to delineate the determinants of S&T policy before assessing the impact of technological development on economic performance. How, then, can we explain the dynamics of S&T development in general? There are at least three contending models in the South Korean context.

Considering recent both dynamics complex of S&T, South Korea is required to add more innovative theories or ideas to the existing paradigms. In order to explore innovative theories South Korea needs to consider fusion of knowledge related to S&T fields.

2. CONTENDING MODELS OF SOUTH KOREA'S S&T POLICYMAKING

2.1 Market Perspective

The market model is the most widely accepted way of understanding policy choice and the development of science and technology in the United States and Western Europe countries. The perspective holds that science-and technology development is shaped primarily by private firms. According to Michael Porter, private firms strive to cope with cut-throat market competition (Porter 1990). In order to survive tight competition, firm devise corporate strategies involving product and process innovation, market protection or expansion, and organizational flexibility. Of these, product and process innovations are key to market success by

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World Technopolis Review

providing differentiated products with more-cost-efficient production. In other words, product and process innovations are essential for enhancing productivity. These innovations are by and large a function of technological improvement and adaptation. Thus development in science and technology is shaped by the dynamics of market forces such as the changing configuration of domestic and international competition as perceived and adapted to by private firms. As with economic growth, the evolution of science and technology is determined by the market and its agents, namely private firms.

In this perspective, government policies on science and technology are at best marginal, residual, and even counterproductive. The market is construed as being the most efficient allocator of scarce resources. Government intervention in firms' behavior through regulatory, promotional or protectionist policies can undermine the private sector's addictiveness and innovation, resulting in the distortion of science-and-technology development. The distortion results not only from government's limited access to information on linkages between market demands and technology, but also from its inefficient and biased allocation of scarce resources in the name of S&T policy. What the government can do in terms of public policy is to create an environment conducive to creative innovations of science and technology by the private sector. As Branscomb argues(1993), a set of science-and-technology development. However, the nature and direction of S&T strategies should be decided by private firms, not by government bureaucrats. When the government, which is not well grounded in market realities, determines S&T policy and tries to dictate private firms' behavior, it is bound to fail at enhancing technological development for international competition. On the contrary, demand-side articulation, namely the interests and preferences of private firms, should determine science-and technology policy. Private firms are most sensitive to market demands and, therefore, best positioned to direct technology development and innovation. S&T policy should reflect the real market needs of the private sector.

In a similar vein, proponents of the market model argue that the management of new constraints emerging from domestic and international competition should be left solely to private firms. The raison d'etre of firms is to survive and expand; whose which fail to do so should be phased out. Artificial efforts by the government to protect declining firm, to promote growing ones, and to coordinate firms in transition are not only inefficient, but ultimately futile. Thus technological innovation and development are natural outcomes of private firms' struggle for corporate survival and expansion, not of government's industrial and technology policies. It is for this reason that corporate technology strategy, rather than government S&T policy, should be the primary unit of analysis in understanding technological development, as well as the rise and decline of international competitiveness.

Several scholars, mostly neoclassical economists, have applied the market model to Korea, and have drawn two sets of observations (Dahlman et al 1987). First, Korea's industrial success has resulted primarily from private firms' absorption, assimilation, and innovative of foreign technology. Second, government policy on science and technology has been largely market-conforming and facilitative, rather than interventionist, by providing such public goods as physical infrastructure, macro economic stability, manpower supply through an effective educational system, and demand-articulated research-and development funds. On the basis of these observations, the market model asserts that state-led growth and technological development in Korea is more a myth than a reality. The role of the Korean government in economic growth and S&T development has been exaggerated.

The market perspective suffers from several shortcomings, however, when applied to the Korean case. First, it does not take into serious account the historical, structural, and political context (Lew 1992). By attributing technology development to the profit-and survival-driven activities of private firms and by overestimating their role in technological choice and development, the market model commits the fallacy of over-simplification. Technology is essentially knowledge and its application. Knowledge is cumulative, embedded in the historical trajectory of the science-and-technology community. Furthermore, technology cannot be separated from the social, political, and economical exogenous in its determinations, nor unproblematic in its acquisition. Moreover, the choice of a particular technology is not automatically given by relative factor prices and the assumption of profit maximization. The so-called "induced innovation" school is an example of this (Binswanger), where no account is taken of the complex process of technological development and economic growth (Kim H. 1988). Finally, the market model presents a grossly distorted picture of Korean reality. In the history of economic growth and technological development in Korea, the state has been the key actor, while private firms have been directed, guided, and disci-

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plined by the state (Amsden 1989). The Korean state today remains prominent in science and technology, though its role is substantially diminished when compared to the situation of the 1960s, 1970s, and early 1980s.

Currently, market perspective is changing in Korea. The Korean industry has been criticized because of its selfish and anti-social activities. Both Korean media and people demand Korean industry contribute to social harmony in terms of redistribution of welfare. Elena Panaritis introduced the concept of social entrepreneur in the 2010 European Conference on Innovation and Entrepreneurship, she gives an impact to Korea (Panaritis 2007). Korean entrepreneurs tries to absorb the idea of social entrepreneurship into their business activity in terms of entrepreneur education and social network (Cho 2010).

2.2 Statist Perspective

We have so far examined market, structural dynamics, and the international system as determinants of policymaking and development of science and technology. These models are quite useful in grasping the dynamics of technological development, but fundamentally limited by failing to pay attention to the role of the state. Most developing countries, including Korea, are characterized by mixed economies in which the state plays an important role in shaping macroeconomic stability, industrial and technological development, and the patterns of development strategies. Market factors are simply input variables which are filtered through the state machinery and then translated into a set of policies, not only because of the relative weakness of the private sector in capital, information, and infrastructure, but also because of underdeveloped market mechanisms which constantly require state intervention. Even structural dynamics cannot bypass the state. Technological innovation and sequential development of industrial sectors are not necessarily dictated by historical, structural forces built in the national economy. In many cases, they are guided by the state through a set of incentives and disincentives. In other words, the state can modify or redirect the trajectory of sequential technological dynamics through policy interventions. Equally important is that the international system does not unilaterally determine the political -economic destiny of the peripheral states. A set of constraints and opportunities emanating from the international system are filtered through the state, resulting in diverse outcomes depending upon state responses.

Likewise, the state can be construed as being the key variable in elucidating the dynamics of technological development and related patterns of science and technology policymaking. This is especially so in the case of East Asian countries, and most particularly Korea. A growing number of scholars, who may be labeled developmental statists, have argued that economic development in Korea has been a function of efficient and effective state intervention and entrepreneurship (Balassa 1981). Developmental statists have assumed that the Korean state is autonomous and strong: "autonomous" in the sense that economic policymaking is insulated from contending social and political pressures; and "strong" in the sense that the state has been able to mobilize resources (e.g., capital) to devise a rich pool of policy instruments, and to implement state objectives and subsequent policies effectively.

Armed with autonomy and strength, the Korean state has devised a master plan of economic development and industrialization (effectively intervened in markets--in some cases distorting prices) (Amsden 1989) and disciplined and orchestrated the private sector. Sometimes, in Korea side-effect of strong state surfaced. The close connection between big businesses and politicians have been major obstacles to improve Korean economy. Instead of fair competition, big businesses demanded government special treatments for their own company. Because of this kind of corruption, some influential politicians and figures and businessmen can get benefits in the sacrifice of ordinary people.

The statist paradigm has extensively applied to the study of overall economic development and industrial policy in Korea. Amsden regards Korean state as entrepreneur, banker, and shaper of the industrial structure. The state mot only actively promotes the growth of the business groups, it also disciplines their use of subsidies and other supports, rewarding those who use subsidies efficiently with further help and withdrawing support from those who do not (Kim J. 1989). Wade reveals that the autonomy of Korean bureaucracy has set up effective economic policies on several important industrial sectors such as automobile, chemical and electronics industries (Wade 1990).

In the era of technological innovation, the state's role needs to be limited. The Finland model can be applied to South Korea. The characteristic of Finland's innovative state system is that S&T penetrates into every parts of state such as economy, industry, education, and arts. The whole Finland society is integrated based upon the idea of innova-

tion; the connection between industry and colleges is more consolidated, the creative application of knowledge and information is more activated, and the innovative environment of R&D is more promoted (Sung 2010). Now, Korean government should try to overcome the mind of developmental statism which is no more effective in the innovation era.

2.3 Schumpeterian Structuralism

A major critique of the market perspective can be found in its failure to elucidate the structural and historical foundation of technology development. Schumpeterian structuralism addresses this shortcoming. According to this view, technology development and even government policies are not determined by the visible hands of private firms or governments but shaped by the historical, structural dynamics of technological innovation (Justman and Teubal 1991). The structuralist view stresses the importance of dynamic efficiency and infrastuctural development. More specifically, the efficient generation and assimilation of technology is emphasized, as this process cannot be assumed to result automatically from capital accumulation this approach is strongly influenced by Schumpeter's conceptual framework. Schumpeter linked innovation with structural change and economic growth in an evolutionary process (Schumpeter 1942). During this process, new industries emerge and new technologies are diffused through the "creative destruction" of declining sectors. This conceptualization of resource allocation is radically deferent from that which underlies neoclassical growth models because it distinguishes between allocating resources among existing activities and allocating them to new industries.

For structuralists, the main emphasis is on change, especially change in the economic structure. The archetypal case of structural change is the emergence of a new, technology-driven industrial sector. One example is automobile manufacture in the earlier part of this century. The emergence was accompanied by a decline in the share of industry held by existing, conventional sectors. The notion of technology-driven structural change, however, also extends to the introduction and diffusion of major new technologies in the economy, like biotechnology and information technology. These changes affect a wide set of existing industries, and give rise to new activities in support of these technologies. Quite common is the radical restructuring of existing industries through the introduction lf new technologies, changes in the array of products being produced (e.g., the shift from commodities to specially products in the chemical industry), or a shift in focus from the local to the export market (Justman and Teubal 1991).

Justman and Teubal discuss a typical sequence of structural change within the manufacturing sector. The first major structural change since England's Industrial Revolution involved the transition from primary and light-industrial sectors *large-scale processing* (LP) industries such as steel, cement, and petrochemicals. The second change was the emergency of the *capital-goods* (CG) sector and its transformation into a key sector. Finally, the *high-technology* (HT) industry has been steadily displacing the first two industries since its emergence (Saltykov 1984). Justman and Teubal argue that while other sequences are feasible, the LP-CG-HT sequence is the most typical pattern of progression in the industrial and technological trajectories of developed countries.

The structuralist perspective is designed primarily to account for the impact of technological innovation on structural changes in the national economy. Nevertheless, it bears some important implications for understanding technological changes per se. As with the market model, structuralists postulate that private entrepreneurship is a principal driving force of technological innovation. However, it differs from the market model on several counts. First, technological innovation is not a result of atomistic actions by firms and entrepreneurs, but an outcome of the complex interlinkages between new and old technologies across different industrial sectors. Second, technological innovation is not necessarily driven by profit motives and relative factor prices. Once a breakthrough technology is introduced, it creates forward and backward linkages to technologies of other industrial sectors. Technological innovation and diffusion then tend to take on their own dynamics of development, fostering the creative destruction of old technologies, while opening venues for new ones. Neither firms nor governments can delay, detour, or redirect such dynamics. In this sense, structuralists can be characterized as being historical-structural determinists. Finally, government's science-and technology policy is by and large a reponse to technological innovations, especially in their diffusion process. Governments cannot lead, but rather follow the path already formed by the historical dynamics of technology development.

Very few have applied the structuralist model to the Korean experience. Westphal, Kim and Dalman have adopted the model in elucidating the patterns of Korea/s acquisi-

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tion of technological capability (Westphal 1983). However, several problems emerge in applying the model to Korea's experience. The most serious problem is the source of technology in Korea. As Chong-Ouk Lee points out, technologies mobilized for Korea's industrial development, but a result of the absorption and adaptation of foreign technologies, or their minor improvement at best. It was only after the mid-1980s that Korea began innovation and diffusion effects. Simply put the historical-structural dynamics of technology development necessitating a creative destruction was not there.

Second, the Korean experience has not as yet exhibited the LP-CG-HT sequence expounded by Justman and Teubal. The process of technological development in Korea reveals that science and technology development has not been evolutionary and unilinear. Labor- intensive LP, capital-intensive CG, and technology- intensive HT overlap one another, casting an image of "swarming sparrow" which stretches over multiple sectors and technologies. The Korean case resembles more the Branscomb model of innovation, which "envisages mutual interactions between design, production, marketing and research" in multisectors, than the structuralist model, which presupposes "a sequential pipeline of activities starting with research and ending with marketing" over time across sectors (Branscomb 1992).

Finally, the structuralist model underestimates the role of the government. As shall be discussed later, the Korean government has been deeply engaged in shaping technology development and structural change. The government has taken several measures: comprehensively integrated and mission oriented science and technology policy: conscious efforts to balance the expansion of technology supply capacity and the generation of technology demand; systemic promotion of proprietary technologies, which are closely related to the profit motivation of enterprises, in accordance with the principles of free competition at the market; and concerted efforts to enhance generic technologies which have a high externality through cooperation among industry, government, and research institutes. The importance of government's science and technology policies becomes all the more visible when hard realities are examined. Korean industries are not densely knit, and the connect6ions among them are not entirely cooperative and supportive, with the exception of those between the government and selected big businesses. Information channeling is limited among industries and between industries and public organizations. Private firms have also been short of capital for technological innovation. Thus, private firms cannot but be dependent on the guidelines and directives of the state. The structuralist model fails to pay due attention to this significant role of the government.

However, currently considering Apple's Steve Jobs' innovative ideas, in near future Korea need to emphasize the inner dynamics of S&T for international competitiveness of economy.

A creative enterpreneur, Steve Jobs, whose passion for perfection and ferocious drive revolutionized six industries: personal computers, animated movies, music, phones, tablet computing, and digital publishing. Steve Jobs thought of himself as a humanities person but liked electronics. Jobs was interested not just in engineering, but also the business aspects. Jobs also said that "I began to realize that an intuitive understanding and consciousness was more significant than abstract thinking and intellectual logical analysis." Jobs embraced Eastern spirituality Zen Buddihism. For him it was not some passing fancy or youthful dabbling. Jobs philosophy in which asceticism and minimalism could heighten subsequent sensations (Isaacson 2011).

Steve Jobs also contributed to combine manufactured products and services. Apple has been successful to combine iPod and iTunes. This kind of combination creates new terminology "Servitization"(Hwang Do-yeon 2010). In the foreseeable future IT industry should seek for more qualitative development. In South Korea, more humanitarian, environment-friendly technologies are needed to IT industries (Chong 2010). Korea's S&T development seems to be closely related to innovative ideas of individuals in Korea.

3. CONCLUSION

The market perspective suffers from several shortcomings, however, when applied to the Korean case. First, it does not take into serious account the historical, structural, and political contexts. By attributing technology development to the profit- and survival-driven activities of private firms and by overestimating their role in technological choice and development, the market model commits the fallacy of over-simplication. Second, the market model presents a grossly distorted picture of Korean reality. In the history of economic growth and technological development in Korea, the state has been the key actor, while private firms have been direct-

ed, guided, and disciplined by the state.

Currently, statist ideas are losing their explanatory power, as private firms expands their capabilities such as wealth, knowledge and information, and management skills. The reality is that conglomerates are domininating state apparatus in terms of socio-political influence in South Korea.

To understand South Korea's Science and Technology Development most scholars have used both market perspective and statist perspectives. However, Schumpeterian structuralism need to be added to explain South Korea's S&T evolutionary phase as science and technology become more complex and sophisticated. The combination of market-state-structuralism perspectives are increasingly required to grasp about South Korea's S&T. The delicate combination of the efficient management of national resources, dynamic and risk-taking entrepreneurship, and individual's innovative ideas could lead to next phase of new technology and more affluent society.

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