Japanese Firms' Innovation Strategies in the 21st Century

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Introduction

The landscape within which Japanese companies innovate stands altered by events of the past two decades. Buffeted and metamorphosed by the forces of a severe asset value shock followed by a decade of economic malaise, then a decade of growth, and now the recent financial crisis, Japanese firms are transforming their innovation strategies because the institutional basis of those strategies seems to be altered by new economic realities. Even though the basis of the strategies, and perhaps the strategies themselves, are changing, Japan is maintaining its level of innovation according to recent data. Small companies seem to be increasingly part of recent innovation. So we ask, how is the level maintained given that the strategies that created Japan's acknowledged industrial innovativeness seem to be transformed by events?

The quasi-institutional basis of the innovation strategies that Japanese firms created and used to great advantage in the 1980's were changed in the post-asset bubble period of reform in Japan. We will argue that, while the strategies of innovation have changed because of institutional and economic alterations, Japanese firms are, on aggregate, maintaining a substantial level of innovation by using the human and economic legacies of the older equilibrium that remains complementary to new realities. Moreover, Japanese firms seem to be adapting by taking advantage of the global supply chain to focus industrial effort, and fostering new enterprises in Japan with an increased emphasis on product innovation particularly in communication, Internet, renewable energy, and machinery industries. Thus, there is both a momentum effect and a shift to product innovation.

Specifically, we will argue that the institutional structure of the past created a reliance on human capital (because of stable employment and the economic imperative to train employees for whom termination was not the norm), and that the human capital creation "system" remained due to path dependency. Japanese firms tend to find the

human capital development tactics of the past complementary to the new realities. Thus, the companies maintain innovation leadership while a new equilibrium is forming.

The innovation strategies of Japanese firms during the pre-bubble decade were predicated on three institutional supports; long-term business relationships, a main bank supervised corporate governance system, and labor market stability via lifetime employment. Subsequently, after a series of legislative reforms and a period of bank instability, these institutional bases became obsolete and firms sought new strategies for profit maximization.

New economic strategies made it more imperative for firms to focus on the most profitable lines of business in the most value added phases of the value chain. One consequence of this new focus was the continuing move of manufacturing to outside of Japan, implying further alteration of strategies for Japan's companies. We suggest that Japanese firms have responded by product innovations in new industries that rely on the strength of human capital development strategies that worked well in the older equilibrium. Further, a combination of government policies aimed at empowering the market and fostering new company formation, and the desire to emulate the rapidly rising equity values in the US NASDAQ market, have resulted in new firms that, of their nature, create business process and product innovations. This is not to say that a new equilibrium of optimal innovation strategies is already established. Rather, we argue that the combination of efforts to alleviate economic difficulty, combined with path dependent habit of fostering human capital, indicate that Japanese firms can continue innovative leadership.

This chapter will examine:

a) the equilibrium that characterized Japanese industrial organization, and thus innovation strategies until the financial problems of the 1990's,

b) the transformation of the economic habitat within which innovation took place as Japanese industry reforms were implemented and the institutional basis of the past became obsolete, and,

c) how strategies established in the earlier equilibrium find complementary usefulness in the context of new industrial architectures that may explain at least partly why Japanese firms maintain empirical innovation leadership.

The Firm level Strategy Perspective

The term, "national innovation system," or "Japan's innovation system," will not be employed in this chapter or used in its normal context. Japan is not an economic agent of interest with respect to the subject of innovation. In the context of innovation, firms are actors. This chapter will focus on the economic environment of Japan within which firms maximize their objectives by choosing, among a multiplicity of potential business strategies, to innovate. Moreover, it does not necessarily follow that innovation is a necessary or sufficient condition for profit maximization for any particular firm. This chapter sees innovation as endogenous to the firm and is undertaken by firms to gain a competitive advantage in its marketplace. Thus, innovation is a strategy for success in a marketplace and we look at innovation as a strategy within the overall objective of profit maximization.

Innovation may be broadly classified into two strategic families: product innovation and process innovation. Product innovation, as a strategy, is engendering changes to existing market outputs or the creation of new market outputs such that the new outputs are distinguished from competitive outputs via brand or qualitative differences to create a competitive advantage. On the other hand, we define process innovation as new technologies (in the broad sense), internal to the firm to create efficiency advantages for a firm's output. There is a well-established literature that

suggests that economic gains are possible through process innovation, (Romer 1990), (Grossman and Helpman 1994). Innovation, as a strategy, by creating economic output (products and services), and increased productivity, is now understood to be important for firms to maintain competitive advantage on both the domestic and international markets.

The Stratagems of the Past

The rapid recovery of Japan's economic systems and markets in the post-war period are well and thoroughly documented. Since the oil supply crisis of the early seventies until 1990, an equilibrium of Japanese business strategies developed that was both stable and innovative. It was what Imai calls, "a system of rigid flexibility," (Imai 2007). While product innovation was important in this period, (Sony and fuel efficient cars, for example), process innovation as a source of rising productivity was also important, (Kenney and Florida 1988).

This equilibrium developed as an institutional response to an informal discussion in the business community in Japan as to how to handle redundant employees as circumstances changed (Yoshimori 2005), and what were the best strategies for firms facing increasing input costs and more open global markets. In the case of redundant employees, the institutional labor market norms in Japan eschewed layoffs, yet inefficiencies would naturally arise should redundant employees be retained. Facing the additional pressures of rising energy costs in the 1970's as well as price competition for other industrial inputs, Japanese firms were constrained to adopt what became a famed system for improving industrial productivity. *Kanban* inventory management systems, work teams, and Total Quality Management are just a few examples, (Schonberger 1982). Input factors, labor, capital and raw inputs, were thoroughly, and in a continuous manner, reengineered to obtain maximum productivity and lowest costs consistent with market demands for increasing market quality, (Nagaoka and Flamm 2006).

A quasi-national system emerged from these economic pressures. We use the word "quasi" as it was not a designed system - bureaucratically or legislatively. It emerged as an ecology of firm strategies, perhaps best collectively called, after Aoki, the J-Firm, or by others the "Japanese Model." As a succinct summary of this model, Motohashi (2003) writes;

"The term "Japanese model" is a comprehensive reference to a unique management style that has been practiced by Japanese corporations as Japan's economy developed in the post-war period. With regard to business practices, it refers to the maintenance of long-term business relationships; with regard to human resources management, it refers to lifetime employment and reliance on seniority; in the financial sphere, it refers to a heavy reliance on indirect finance; and in corporate governance, it refers to the preponderant influence exercised by main banks."

Using Motohashi's framework, there are three key pillars of the Japanese model from an organizational architecture standpoint:

A. Long-term business relationships
B. Main Bank Governance System for corporate stability
C. Labor market stability via lifetime employment

During the 1980's, currents of scholarship offered two complementary streams of reasoning to explain Japan's innovation architecture; the influence of favorable government policies, and, a unique equilibrium of Japanese corporate management techniques. The unique structure of Japan's innovation was presumed to be the confluence of efforts where governmental guidance and financial support on selected areas of innovation were complemented by innovative manufacturing and management processes, as well as advantageous information sharing processes, and the idea of the "knowledge creating company" described by Takeuchi, Nonaka, and others, (Nonaka and Takeuchi 1995). On a more analytical level, Masahiko Aoki developed a theoretical

model of Japanese management noticing the institutional complimentarity between organizational architectures such as between long-term employment relations, and the main bank contingent governance system, (Aoki, 2001). In particular, the main bank intervenes only in the event of financial trouble letting management to pursue longer-term strategies than possible under the US system of the market for corporate control. From a game-theoretic point of view, institutional complementarities, such as this, mesh as stable and repeated strategies. Importantly for the new equilibrium now emerging, a change to any single institution implies a realignment of the entire system.

Changes in the Basis of Innovation Strategies

The equilibrium of the Japan model was shattered in 1990 as the collapse of the Japan asset bubble was expressed in a two-thirds decline in the Nikkei 250 stock. Employment climbed to a post-war record level of 6.1%, the business bankruptcy rate climbed to a record rate of 10%, and property values, in the Tokyo metropolitan area, fell by more than 70%. Three of Japan's five major banks became illiquid and on the verge of bankruptcy.

Chart E1

It is unlikely that the status quo was maintained in Japanese companies after 1990. The persistent decline in Japanese asset values during the 1990s engendered much policy, legal and corporate strategic responses. As the Japanese economy reached its nadir after the collapse of its asset bubble in 1990, the economic developments affected innovation strategies of many Japanese firms and assessments of Japan's innovation structures increasingly became the subject of re-examination. Once vaunted as the engine of the "economic miracle" of Japan's post-war growth, a broad business and policy criticism arose during the prolonged post-bubble recession, and blossomed during the recent

recovery, that the innovative architecture of Japan was no longer relevant to a new economic logic in a globalized setting with important rising Asian competitor countries.

We propose that the three pillars of Japan institutional innovation strategies, critical to the sustenance of the Japan Model, have been challenged because their underlying economic forces have been altered:

a) Main bank finance and contingent governance is transformed by the reorganization of the banks
b) Lifetime employment is transformed by the abandonment of this strategy by firms and the use of temporary workers. This changes the organizational architecture and shop floor cohesion affecting the information transfer crucial to the model of the J-Firm.
c) Fundamental change in business location forcing new business relationships and transforming business strategies

Main Bank Finance and Contingent Governance Changes

A broad criticism arose of this contingent governance and associated monitoring system during the 1980's. Partially in response to this criticism, and the general desire for reform after the bubble, a series of legal changes to the corporate laws were enacted, three of which this paper takes note. First, the new laws provided for increased propensity for minor shareholder activity. Second, legal barriers against merger and acquisition activities were further eased. Third, corporate governance systems were made more transparent making financing from non-main bank sources more tenable, (Nottage, European University Institute. et al. 2001).

The main banks also had their own problems. They were short of capital in the post bubble period and they were obliged, under the old system, to maintain a flow of

funds to so called 'zombie' firms. The banks, by maintaining lending in an illiquid environment, found themselves bankrupt and eventually reorganized. Illiquid banks undergoing reorganization are not in a position to exercise the contingent governance crucial to the operation of the Japan Model.

A consequence of all this was a disturbance to the equilibrium of governance relationships and an unwinding of their structures, cross-shareholding declined, the keiretsu lessened in importance. The main bank system discouraged effective monitoring when playing the role of first lender by reviewing and monitoring a company's investment projects and coordinating with other banks to supply funds. Since the bank had direct access to their customers' accounting information - and access to almost all other inside company information - and since the bank provided the critical contingent governance, there was little incentive to inform other stakeholders, (Gordon 1999). Further, since new alternate sources of finance became available in Japan during the 1980's and 1990's, (apart from main bank finance), the contingent governance system did not provide adequate transparency for the new sources of capital, (Maswood and Miyajima 2002).

The Japanese government during the 1990s implemented a series of counter-measures to shore up the banking system. These included a loan purchasing program set up in 1993, followed by the establishment of banks to buy out failed credit cooperatives and the *Jusen* that culminated in the reorganization of the supervision authority for banks. Further, the Ministry of Finance established an Y60 trillion fund for bank recapitalization. In 1998, the Long-Term Credit Bank of Japan (LTCB) and Nippon Credit Bank (NCB) were nationalized and reorganized, and three regional banks were put under receivership in the first half of 1999. In March 1999, 15 large banks applied for a capital injection and received Y7.4592 trillion of public funds, (Hoshi and Kashyap 1999).

Additional reforms were promulgated to encourage new forms of financial intermediation. Tax benefits created for "angel" investors, foreign venture capitalists, foreign private equity, and foreign lawyers became common. Purchase of shares with shares, triangular mergers, and repurchase of shares were all allowed. Moreover, several new stock exchanges were created expressly for relatively new companies, (Shishido 2007).

Corporate governance laws were also revised. For one, Japanese firms may now use U.S.-style board of director committees, with an upper limit placed on directors' liabilities. Japanese auditors are now required to be outsiders, and consolidated accounting is likewise compulsory, as well as "mark-to-market" rules for financial reporting. These are just a few of the changes, all of which combine to increase transparency in Japan's markets, (Eberhart 2009).

Labor Force Changes

Shop-floor process innovation of the Japan model depends on, among other things, the labor management, and training system within and without a firm. That system was structurally changed in the post-bubble period as more and more firms reduced dependence on lifetime employment systems and adopted the technique of hiring temporary workers. These workers could be terminated at will, were paid generally less, and had less benefits, (Schaede 2008). More importantly, the mechanisms of shop floor decision-making and tactic knowledge are untenable in a high labor force turnover situation. As recent events have shown, high turnover is manifest in 21st century Japan. The rate of labor mobility ((hired employees + separated employees)/regular employees) in Japan has increased since its lows of 26% to 30% annually in the 1980s to between 31% and 35% since 2001, and the type of jobs being held are transforming as indicated by union member ship which has fallen steadily since 1980 from 30.8% to 18.1% in 2007,(J.I.L.P.T 2008).

Insert Chart E3

Insert Chart E4

Externalization Manufacturing Strategy

In her book, "Choose and Focus," (Schaede 2008), gives an account of the dynamic forces that shaped new strategies for Japanese firms and the new quasi-equilibrium strategy of choose-and-focus that arose late in the 1990's.

First, in the Schaede analysis, Japanese firms engaged in a massive restructuring. Since 2003, after legal reforms were largely enacted, fully 75% of Japan's 475 largest companies restructured via divestiture, merger, or corporate re-organization. Alternatively, to look at it with another perspective, only 25% of Japan's largest firms engaged in no restructuring at all. How remarkable this is, as Schaede points out, is that compared to a period of major US firm restructuring, in the 1980's, the percentage of US companies that engaged in similar activities was only 20%. Japan's corporate restructuring must be seen as a major strategic infection point.

There has been a widespread rise in the proportion of Japanese manufacturing that occurs offshore. Immediately after the collapse of the asset bubble, as firms sought lower costs of production, the proportion of overseas production more than doubled from 1993 through 1996, (Cowling and Tomlinson 2003). Concurrently, economic forces were unleashed that were to transform business imperatives from a more market structure level. Reforms in China, and subsequent reforms in South East Asia made access to comparatively inexpensive labor and factor markets possible, (Vogel 2006). Not only possible, the tactic was indispensable.

Japan's FDI into China and south-east Asia reached record levels and the identified trend is for Japan to export components and machinery to owned plants in other countries, (Aminian, Fung et al. 2007). While final assembly occurs overseas, profits accrue in Japan, but the supplier - buyer relationships are disrupted. Recently, the trend has been made most manifest in Japan's trade data as exported capital goods, to supply new offshore factories, has grown faster than any other export category and come to be the majority of Japan's exports with profound consequences for the macro-economy.

Fig E4

There is evidence that manufacturing process innovations, developed and implemented in Japan, do not transfer effectively to Chinese or other countries' facilities. Taylor in a survey of manufacturing and management practices in China located subsidiaries of Japanese firms, found that manufacturing and managerial methods do not necessarily transfer and that Japanese firms cede much of the local management by necessity (Taylor 1999). There is also an observed effect on Japan domestic manufacturing skills as a study of more than 1000 Japanese firms with off-shore manufacturing operation found a reduction in shop-floor knowledge intensity in those firms as foreign operations increased, (Head and Ries 2002).

It is worth noting, however, that product innovation, which encapsulates process innovations in complete, modular pieces of equipment are likely to be considerably more mobile to outsourcing environments such as China. Products embed technology within them, so that the users of the technology need not have the same level of skills as those who created it. On the other hand, process innovations, to be sustained across borders, require similar levels of skills in the outsourcing environment as in the country which developed the innovation. Later, we discuss how Japan's labor force is well-positioned to innovate in products from the viewpoint of skills. The point we wish to stress here is

that, by focusing on product innovations, Japanese firms could capture more value out of a product than by focusing on process innovation, since much of the gain from process innovation is difficult to realize in offshore locations.

Accordingly, the three pillars of the Japan model are not able to support the quasi-institutional structure of innovation, as it existed in the 1980's. The main bank system and cross shareholding have crumbled leaving corporate stability nearly indistinguishable from other highly developed countries experience and lifetime employment applies to only a very small part of the labor force.

Empirical Evidence of Sustained Innovation in Japan

Nearly two decades of financial difficulty have not blunted Japanese companies *potential* for innovation. However, the Japanese public and even thought leader's realization of that potential has been notably muted. To examine why this is the case, we now examine the innovation strategies that characterized Japan's initial period of great success and how the changes of the 1990s rendered those strategies inappropriate. This will set the stage for a discussion of the new innovation strategies Japanese firms are employing and their potential for unlocking Japan's innovative potential.

Recent empirical data demonstrates that Japanese firms have maintained a surprising lead in common metrics of innovation. While there are no well-recognized and generally accepted measures of innovation, a comparative examination of Japan's scientific and technological knowledge base is a useful approach as Japan's current difficulties are often viewed in light of the rise of the rest of Asia, particularly China. Asian countries outside of Japan have made remarkable progress in developing their scientific and technical capabilities. As Table G2 (a) shows, Asia outside of Japan now consists of over ten percent of all U.S. patent applications, with South Korea and Taiwan showing particular strength and China a very rapid rise. As Panel (b) of Table G2 shows, Asia's

rise goes beyond patenting to include more basic science, also. The number of scientific and engineering papers published by country has also seen steady gains, with China exhibiting an especially amazing rise.

However, including Japan data in these charts, as in Table G3, creates an important perspective. Despite the growth in innovation elsewhere, Japan still produces more U.S. patents than the rest of Asia combined. The situation is the same, albeit less dramatic, if one examines the growth of scientific and engineering publishing. Japan remains the dominant Asian producer of scientific and engineering papers.

Critically, Japan is strong in the fields that are commonly recognized as the foundation to future innovation. Table G4 shows the number of U.S. patents held by Japan and other Asian countries in four critical fields: nanotechnology, biotechnology, information and communications technology (ICT) and renewable energy.

The New Japanese Firm Innovation Strategies

The new environment facing Japanese firms: the demise of the Japan model of business equilibrium, the changing labor organization, and the changing international dynamic from Asian development and the worldwide drive for efficiency, meant that Japanese firms, seeking maximum competitive advantage, had to devise and follow new strategies to reflect the new rules of the game. Some writers are even finding that the financial and labor market reforms have greater potential for innovative development than the industrial policy efforts of the earlier equilibrium, (Noland 2007). Nolan found evidence that the high level of regulation in markets influenced by industrial policy actually retarded innovation so reforms would release their potential. Other authors find that university – industry linkages, usually modeled on American systems, hold promise for future innovation in the new economic contexts, (Pechter 2001), (Edgington 2008)

While this new literature is developing, it seems clear that firms have not yet, via the discovery of best strategies within the new institutional framework, found a common successor model. Within the varied strategies illustrated here, we find three major categories of innovation strategies that are found in the academic, policy and business literature. They may be summarized as:

a) Path dependency in human capital development as a complement
b) Innovation Opportunities in New industries
c) Innovation in new firms

Path Dependency in Human Capital Development

An important foundation of Japan's innovative potential is its basis of human capital that developed in the post war period. During the equilibrium before 1990, many authors noted the strategies that firms used to implement shop floor innovation involved workforce education, training and continuing education, (Nagaoka and Flamm 2006). We take note of two indicators that show that, even as the institutional basis of the past innovation strategies were altered, the human capital development efforts have remained.

First, the prevalence of scientific and technical researchers in the Japanese economy, (Table G1), exceeds that of other comparable nations. Whether one examines the number of researchers per thousand employees in the economy as a whole (panel (a)) or more narrowly within business enterprises (panel (b)), the proportion of Japanese employees engaged in innovation-creating research consistently leads the world. Despite the economic challenges faced by Japanese firms, they have continued to dedicate significant human resources to innovation. One explanation for this continued investment is a belief that, given Japan's relative high labor costs, investment in

innovation is required to maintain competitiveness (see, e.g.,(Dujarric and Hagiu 2009).

Particularly given low immigration rates, Japanese firm's innovation capability depend critically on its educational system producing highly educated workers. According to the 2006 OECD Programme on International Student Assessment (OECD PISA), Japan's 15-year old students rank third among OECD countries in average science competence. Not only does the average Japanese student exhibit higher than average competence in science, Japan has a comparatively large proportion of top performers (2.6% in the highest level and 15.1% in the second highest level, compared to an OECD average of 1.3% and 9%, respectively).

Second, Japan has been similarly successful in producing students with a high degree of mathematical competence. According to the 2006 OECD PISA, the average rating for mathematics skills of Japan's 15-year old students ranked sixth in the OECD. Again, Japan has an above-average proportion of top performers (18.3%) versus the OECD average (13%).

Building on success at the secondary school level, Japan is now 2nd in the OECD (behind Canada) in the proportion of people with university-level or vocational tertiary qualifications. Interestingly, Japan ranks slightly below the OECD average in the number of science graduates (1596 per 100,000 employed 25-34 years olds versus the OECD average of 1675). This is almost entirely explainable by the low number of female graduates in the sciences, nearly the lowest in the OECD and only 24.8% the number of male science graduates. While troubling, this discrepancy can also be viewed as a potential opportunity. Given the uniformly high quality of Japan's math and science education at the secondary level, Japan could dramatically increase its number of science graduates by increasing the participation of women in science at the tertiary levels.

Innovation Opportunities in New Industries

Due to Japanese firms' earlier status as technological innovators in telephony and other electronics, firms are now particularly well positioned to build upon their technological strength in the ICT (internet, Communications, Telephony) industry. Web-enabled services and products depend on the presence of a fast, inexpensive, and nearly ubiquitous network or Internet access. A long history of investment by Japanese firms has yielded one of the most sophisticated telecommunications infrastructures in the world. Although the penetration of broadband Internet access in Japan (23%) is just above the average of OECD countries, the quality of that access is exceptional. Japanese broadband customers enjoy the highest average speeds in the world (92,846 kbits/sec), which is almost an order of magnitude faster than the U.S. average of only 9,641 kbits/sec. Broadband service in Japan is also inexpensive. The average monthly broadband subscription price in Japan is $30.46, the least expensive in the OECD excepting Greece and Sweden ($30.06 and $29.22 respectively). Japan's true advantage becomes evident when pricing is adjusted for available speed. Japanese consumers pay on average $4.79 per Mbits/second, less than half of what U.S. consumers who pay, on average, $10.02 per Mbits/second.

One reason for the efficacy of Japan's telecommunications infrastructure is the prevalence of fiber optic, rather than copper, cable. Fiber constitutes ten percent of broadband access on average across the OECD. In Japan, forty-eight percent of broadband access is via fiber, leading second place South Korea (40%). Fiber is important because it offers much higher capacity than copper. Furthermore, it is much easier to upgrade and expand, meaning that networks in place today will form the basis of newer technologies for the next 25 years.

Therefore, the presence of an extensive fiber-optic network provides the infrastructure required for innovative web-based applications that are data-intensive, such as multi-media applications. Indeed, the presence of fiber may actually increase demand for such service. A recent study in Europe found that household with broadband access via fiber optic networks generated three times more traffic than those using the fastest

copper networks. This has occurred even though "dedicated mass-market fiber applications are not even available yet."

Japanese firms are also well positioned to take advantage of opportunities in the field of environmental technologies, including renewable energy. In this, Japan's oft-cited lack of natural resources, particularly fossil fuels, may have proven a competitive advantage. As noted above, Japan has significant technological strength in this field. More importantly, it has already achieved significant success in applying these technologies.

This success is indicated in Table G5, which compares common indicators of environmental innovation to other nations in East Asia. As shown in panel (a), Japan is a leader in the use of clean energy, producing almost 17% of its total energy production from clean sources. Japan is also extremely efficient in its use of energy. Panel (b) presents a measure very relevant to economic competition, the dollars of GDP produced per unit of energy use. At $7.32 per kilogram of oil equivalent (2005 PPP dollars), Japan is more than twice as efficient in translating energy into GDP as China. It is 21% more efficient than its closest regional competitor, Singapore.[1]

The combination of energy efficiency and clean energy production has yielded apparent benefits for Japan. As panel (c) shows, Japan a very low amount of CO_2 for each dollar of GDP. Combined with the application of other environmental technologies, it has allowed Japan to maintain very high air quality. Panel (d) reports the PM10 measure of air pollution. PM10 are the suspended particulates small enough to enter the lungs and cause significant health damage (under 10 micrometers), (Organization 2004) With approximately 31 micrograms per cubic meter, Japan is well below the EU's legislated limit of 40. It is also a regional leader, with less than half the air pollution of China, India, Indonesia, and Thailand.

[1] As an indication of the efficiency of Japanese manufacturing, Japan's advantage remains substantial after scaling for the percentage of (less polluting) services in the economy (Japan 68% of GDP, China 40%, Singapore 68% in 2006, according to World Bank figures).

Thus, Japan is a regional technology leader in a sector that will see increasing demand worldwide. In particular, Japan's geographic proximity and extensive investments position it to play a major role in China's market for green technologies, which some see growing in value to between $500 billion to $1 trillion, (Areddy 2009).

Innovation in New Companies

Japan governmental organs developed new policies and financial systems to encourage "IT" companies and a legion of small, technologically focused companies formed and became successful. Softbank, Value Commerce, Rakuten, Livedoor, Mixi, Cybird are just a few of these companies, some of which made their founders famous, and became enviable places to work. There is now evidence that small, new companies accomplish a not insignificant and increasing share of innovation in Japan.

The data from METI's most recent survey of new company formation showing a trend in ICT and software startups is associated with legal changes enacted to encourage startups. Within the past ten years, many laws have been enacted to promote entrepreneurship, and thus innovation. Just some of these are:

- Allow the money need to establish a stock issuing company to be lowered from Y10, 000,000 to Y1.
- Revise the bankruptcy laws to allow the directors of bankrupt companies to retain much of their personal assets
- Encourage mergers through a series of laws including the loosening of regulations surrounding triangular mergers
- Allow limited liability companies to exist to encourage venture capital firms to form
- Giving tax breaks to "angel" investors

New company formation rates in the ICT industry are comparable to U.S. rates, long considered the standard in this regard. There is now evidence that small, new companies accomplish a not insignificant and increasing share of innovation in Japan. For example, in the biomedical industry, recent data shows that biomedical patents from new companies now account for 23% of total patents, up from 4% in 2003, (Kneller 2007).

Conclusions

In this chapter, we have shown that Japanese firms in the 21st century maintain a high rate of innovation and are entering new fields of business. This is occurring even though the institutional support of innovation for Japanese firms extant in the 1980's have undergone important changes.

The main bank contingent governance system, the stable labor markets and long term business relationship have been destabilized by economic realities after the collapse of Japan's asset bubble in 1990. In the past, these three factors contributed to both the incentives to raise the level of human capital and the long-term stability of the economic context within which firms operated. Main bank contingent governance ensures long-term shareholding and leads to a stability of expectations from capital. Long-term business relationship and long-term employment similarly tended to ensure stability of corporate behavior. In the old environment of stable, long-term ownership, management, and employment, a firm generated high returns from improving labor and management productivity within the constraint of keeping employment constant. Strategies that raise productivity while reducing staff were unacceptable. The former is more consistent with process innovation, while the latter is equally consistent and - more importantly - complementary to product innovation.

Japanese firms, in the former equilibrium, depended heavily on the strategy of human capital development. We find that through path dependency, Japanese firms maintain their reliance on this key strategy, and, perhaps serendipitously, that this

strategy is complimentary to product innovation. Certainly, Toyota and other large Japanese firms maintain all aspects of the earlier environment, and, accordingly, produce incremental process innovation to maintain a competitive edge, (see (Osono, Takeuchi et al. 2008). Now, it seems clear that the habits of human resource development may compliment the more recent demands of product innovation.

Through continued development of human capital, Japanese firms can mitigate the effects of changing demographics by making each employee more productive. This also serves the needs of a company improving its competitive position through new product innovation. Further, the new, entrepreneurial companies that are beginning to flourish in Japan find that the well educated and trained workforce.

Japanese firms have a well-deserved reputation for innovativeness in a developed and dynamic economy. As Milhaupt and West commented in 2004, Japan could not maintain its remarkable position as the second largest economy for decades without being both innovative and entrepreneurial,(Milhaupt and West 2004). The data seems to confirm that institutions of the past may account for some Japanese firm's strengths.

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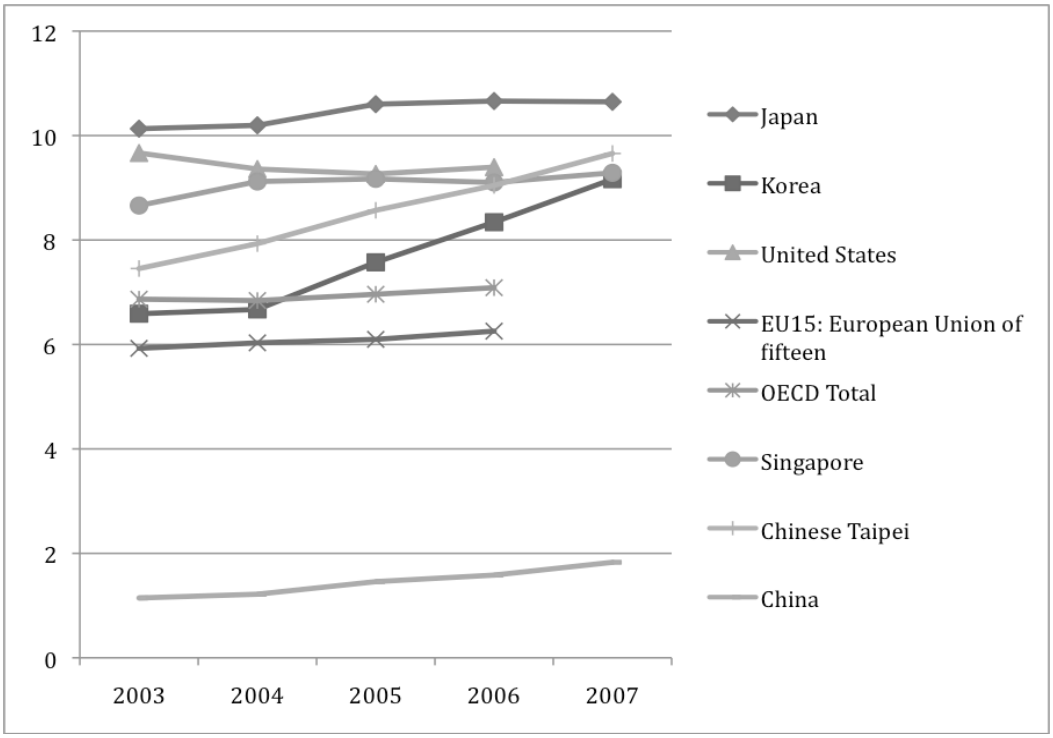
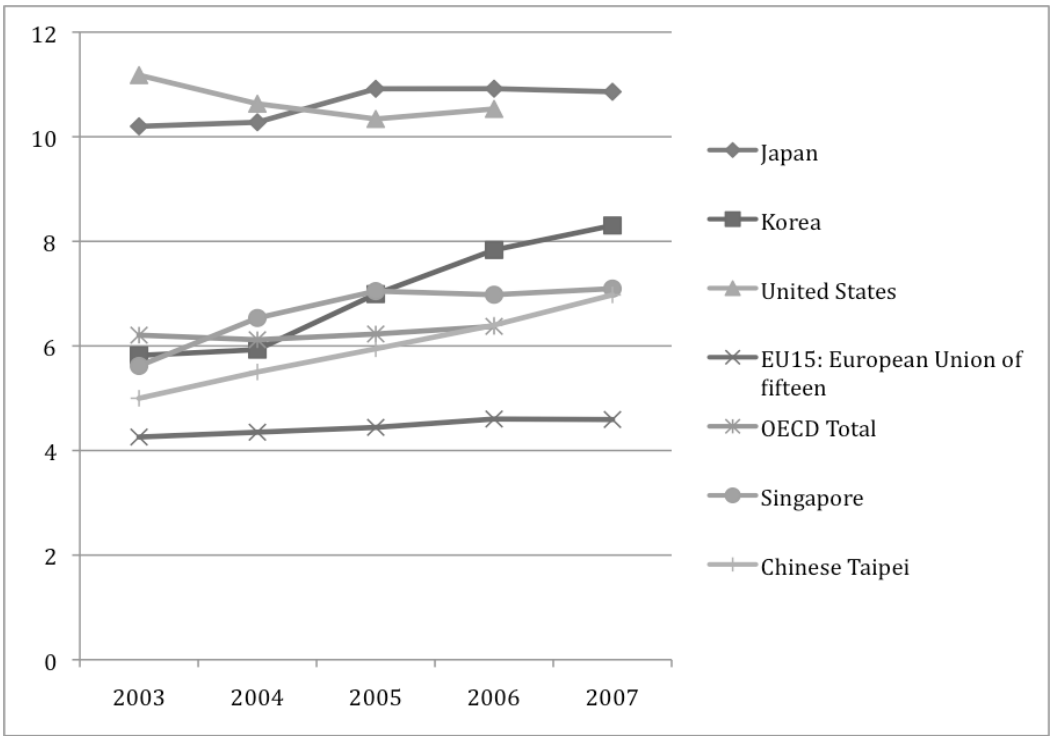
Table G1: Researchers in the workforce



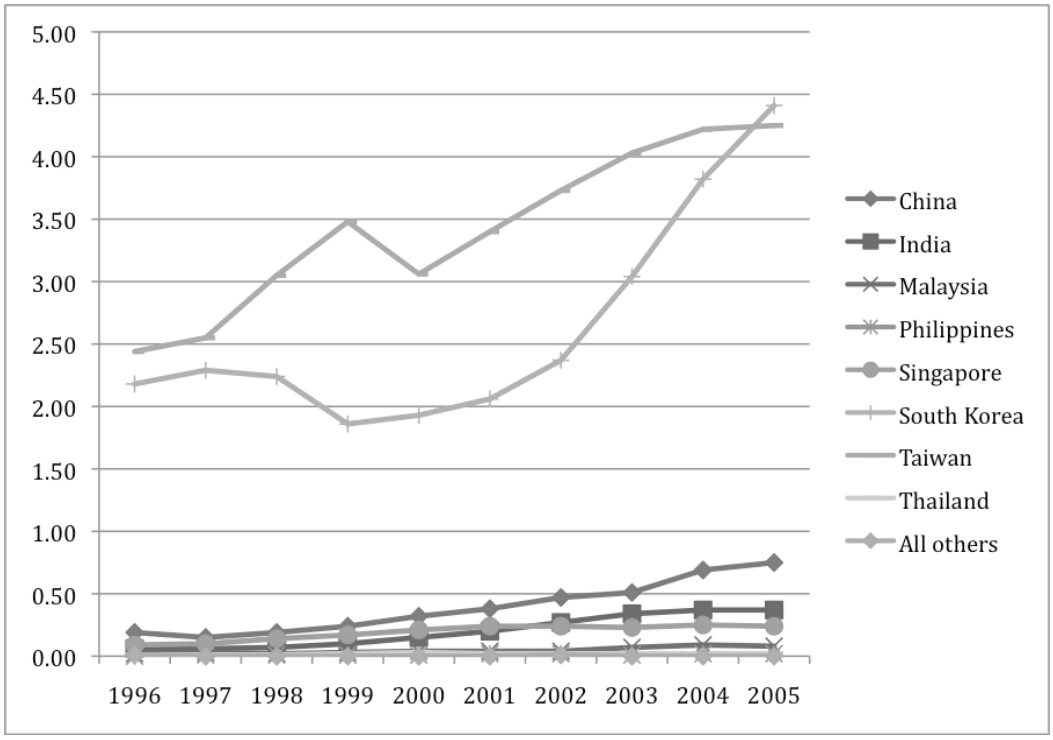
(a) Researchers per 1000 employees



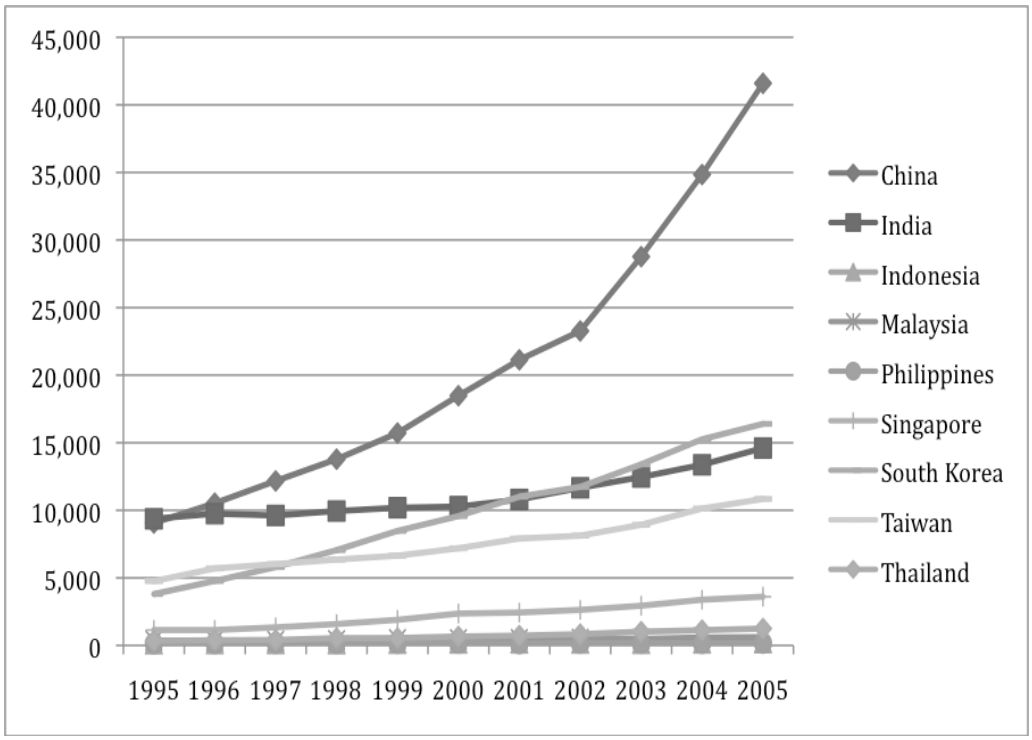
(b) Researchers per 1000 employees in business enterprises

Source: www.oecd.org/statistics

Table G2: Creation of scientific and technological knowledge in Asia, excluding Japan



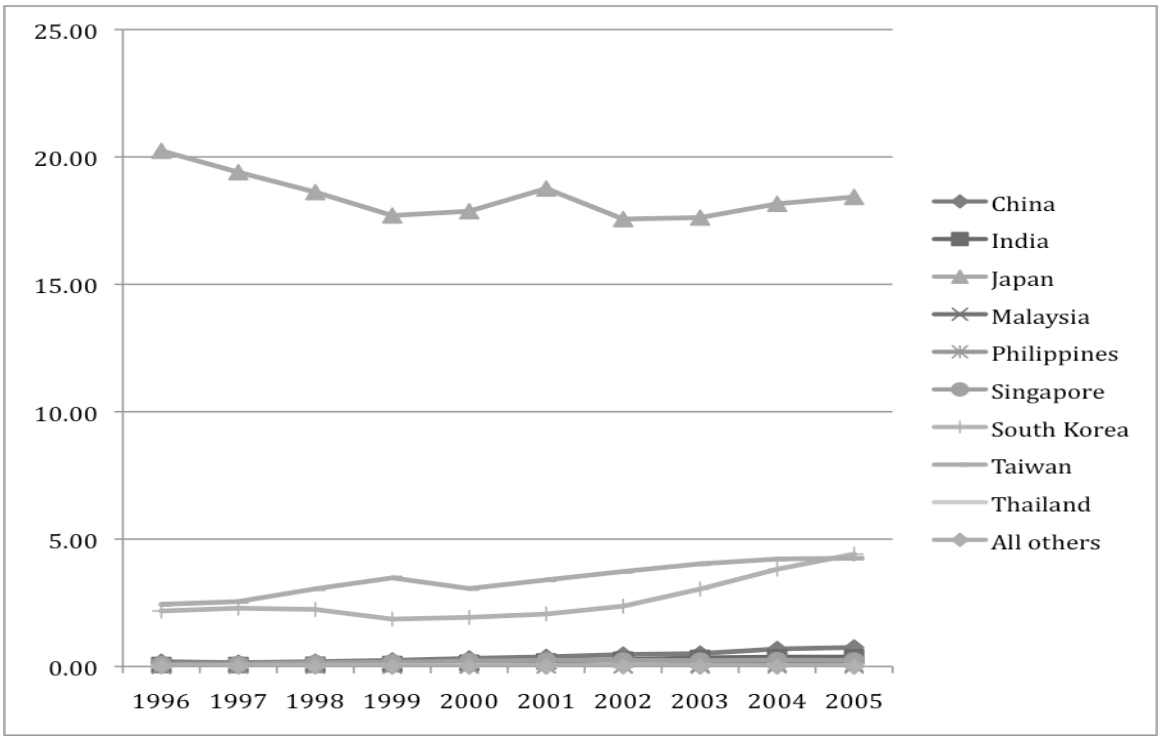
(a) Percentage of US Patents



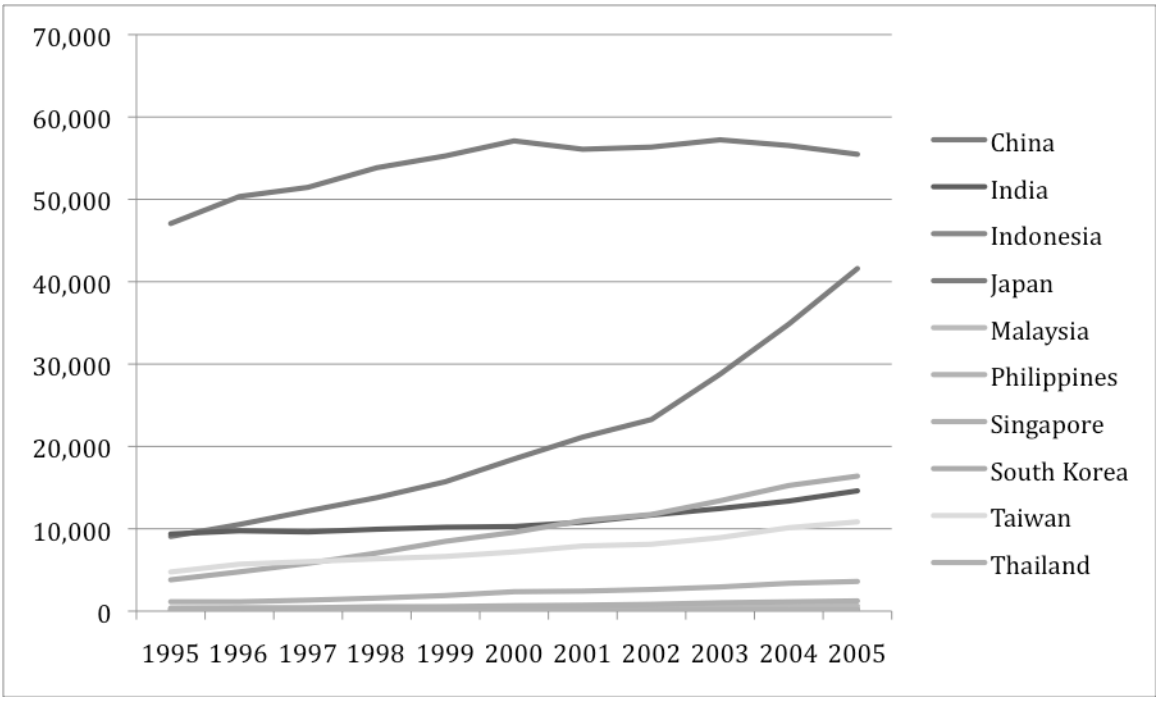
(b) Number of scientific and engineering articles

Source: National Science Foundation Science and Engineering Indicators

Table G3: Creation of scientific and technological knowledge in Asia, including Japan



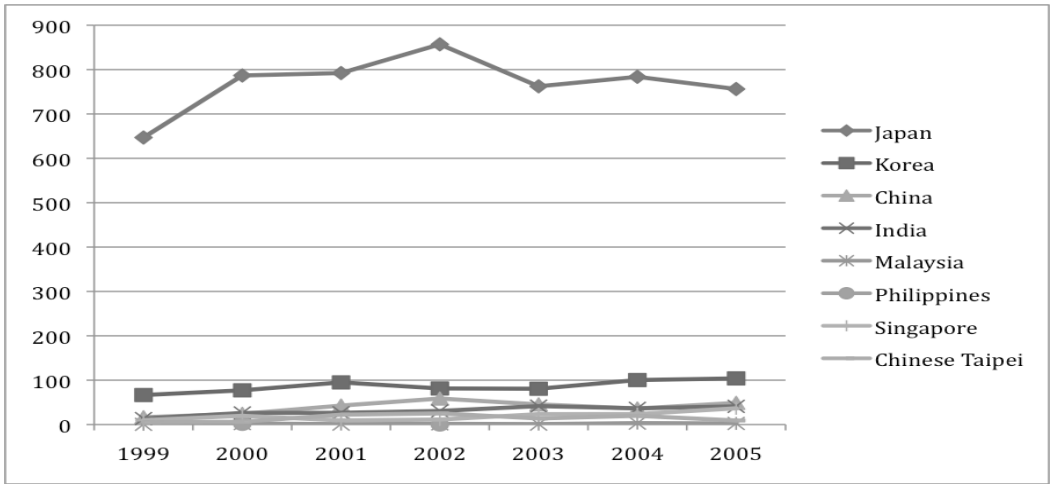
(a) Percentage of US patents



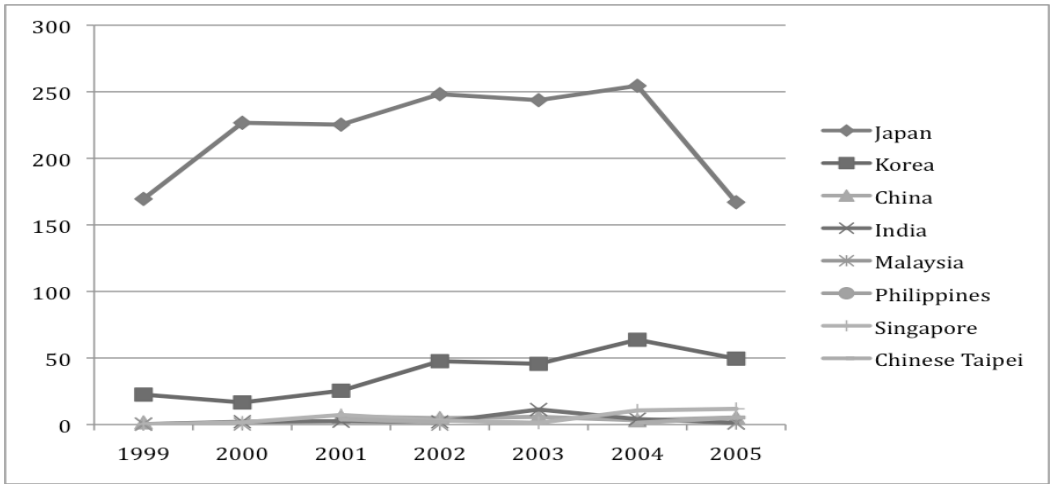
(b) Number of scientific and engineering articles

Source: National Science Foundation Science and Engineering Indicators

Table G4: U.S. patents held in key fields of innovation



(a) Biotechnology



(b) Nanotechnology

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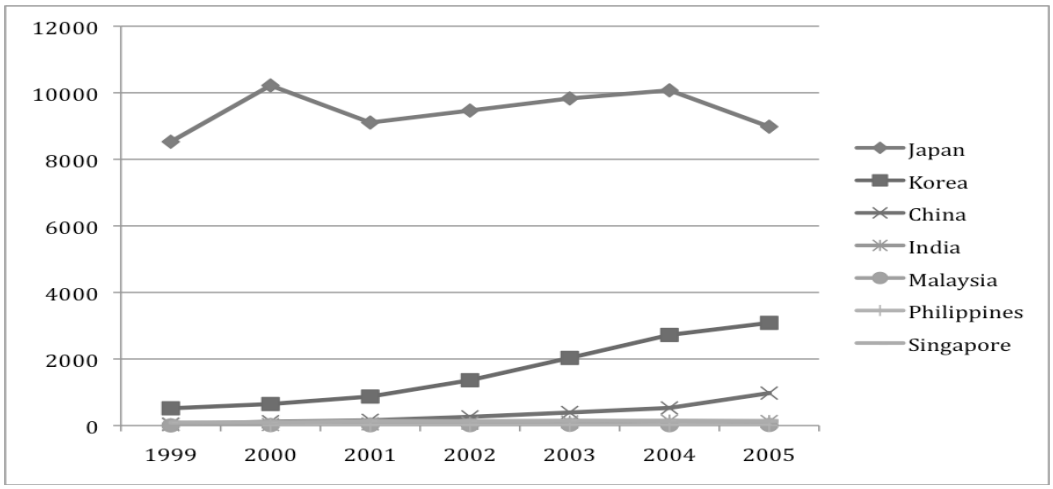
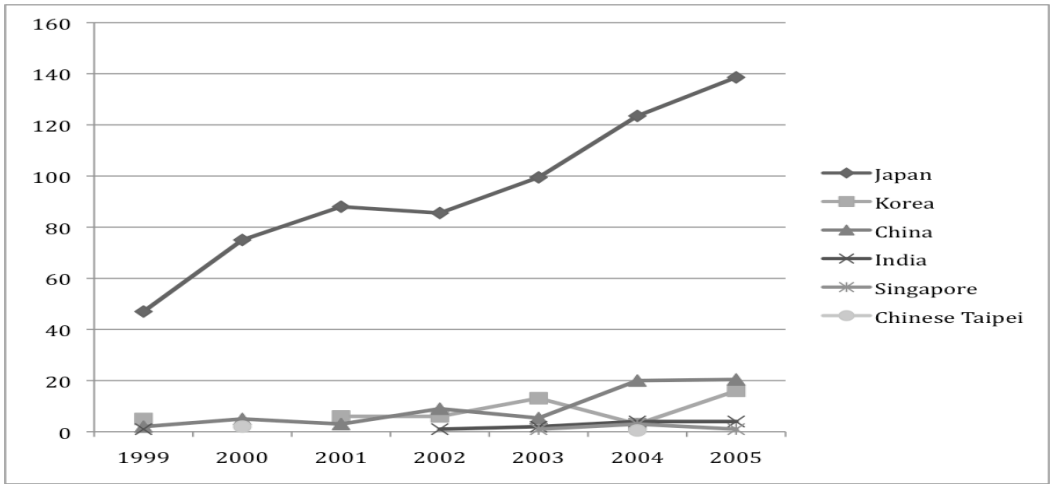
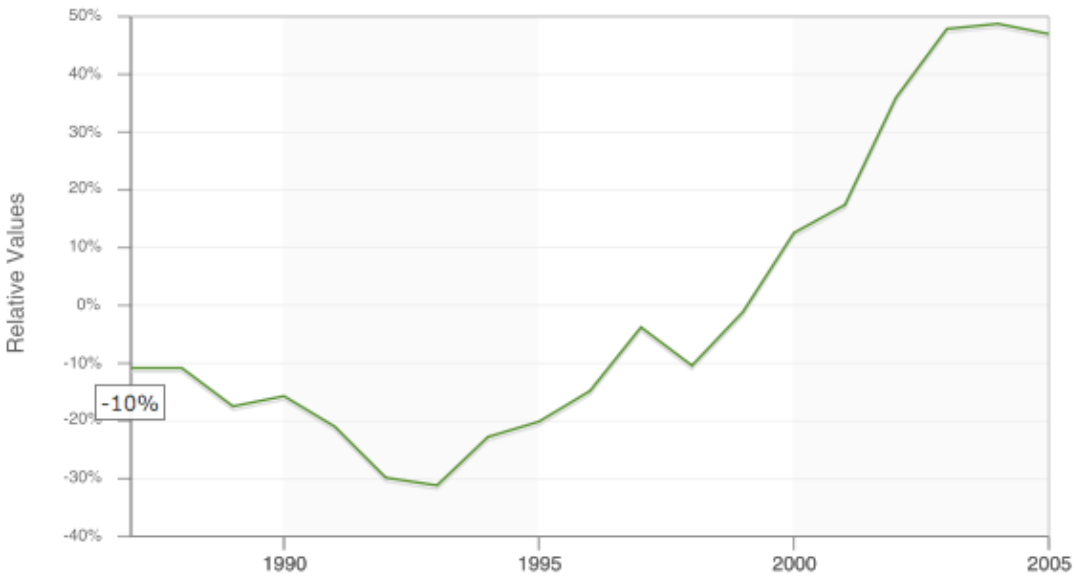


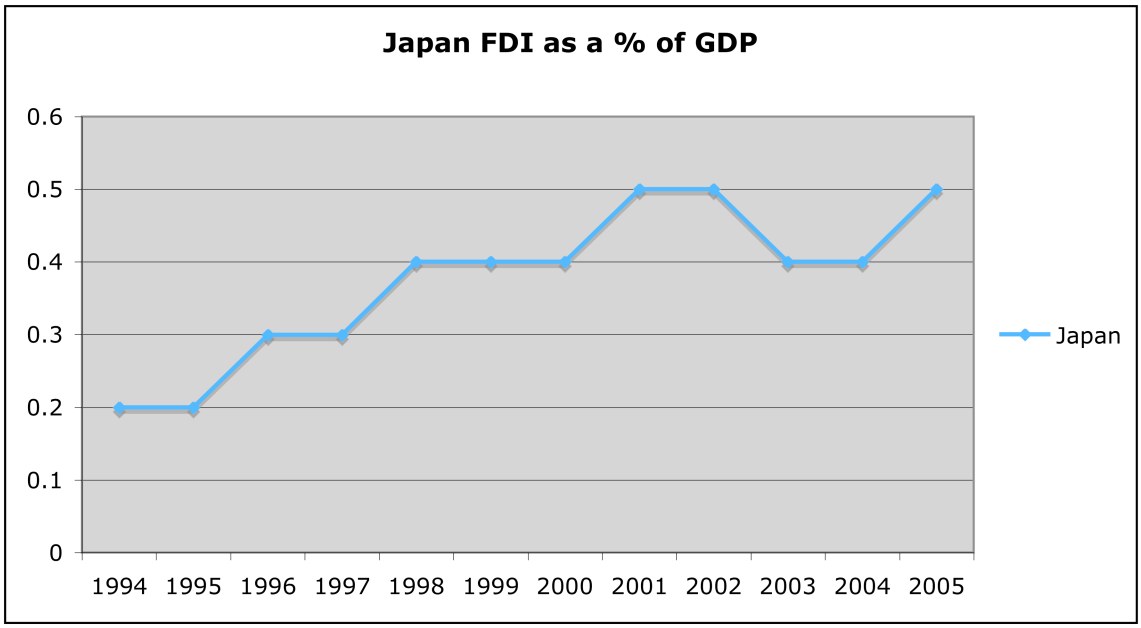
(c) Information and communications technology

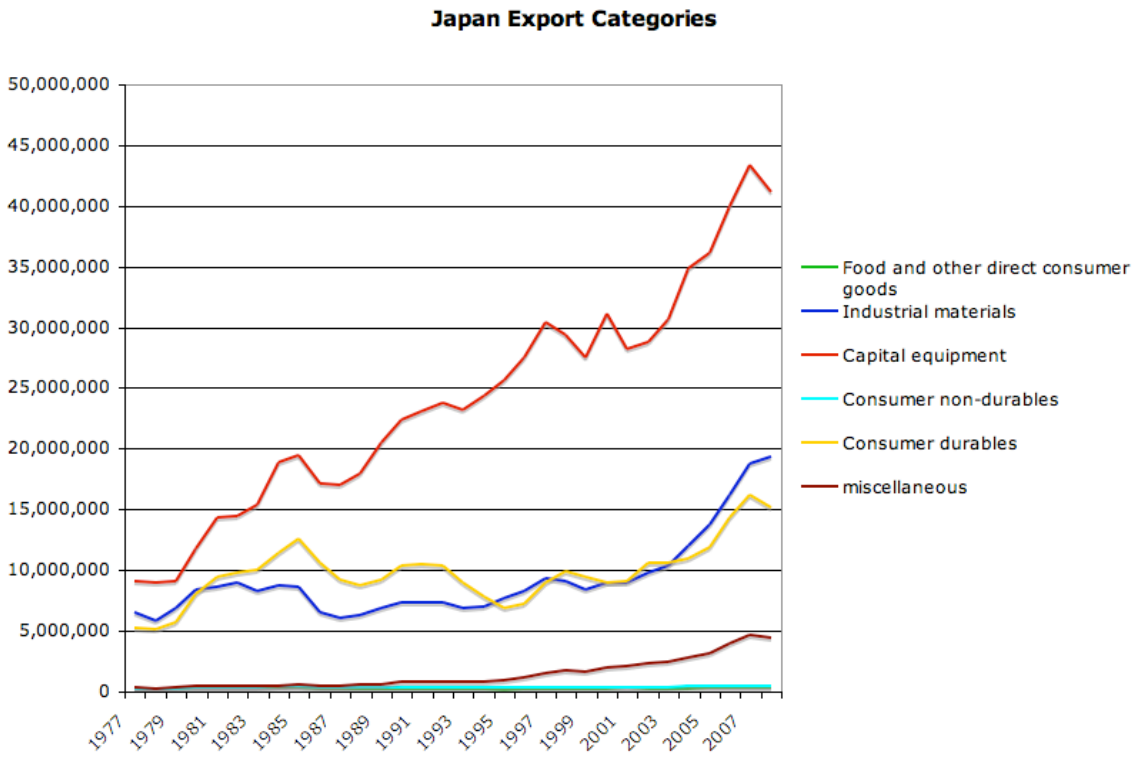


(d) Renewable energy

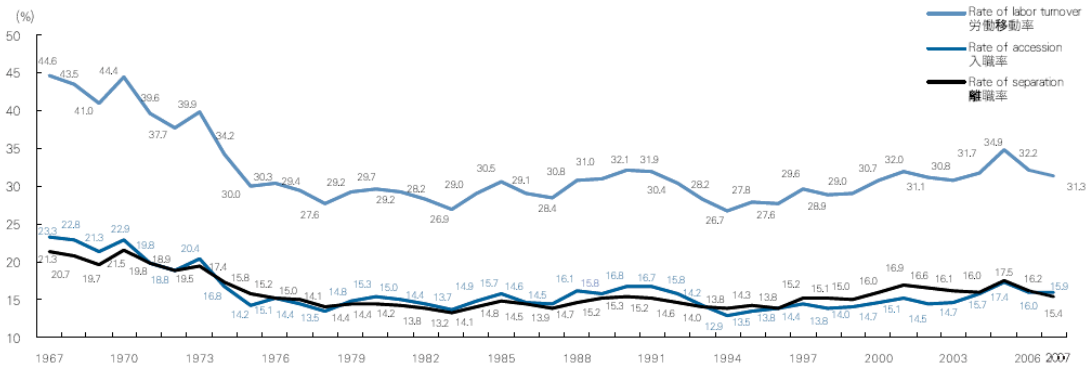
Source: *OECD Compendium of Patent Statistics, 2008*


Relative Values
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-10%
1990
1995
2000
2005


Japan FDI as a % of GDP
0.6
0.5
0.4
0.3
0.2
0.1
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Japan


Japan Export Categories
50,000,000
45,000,000
40,000,000
35,000,000
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
Food and other direct consumer goods
Industrial materials
Capital equipment
Consumer non-durables
Consumer durables
miscellaneous

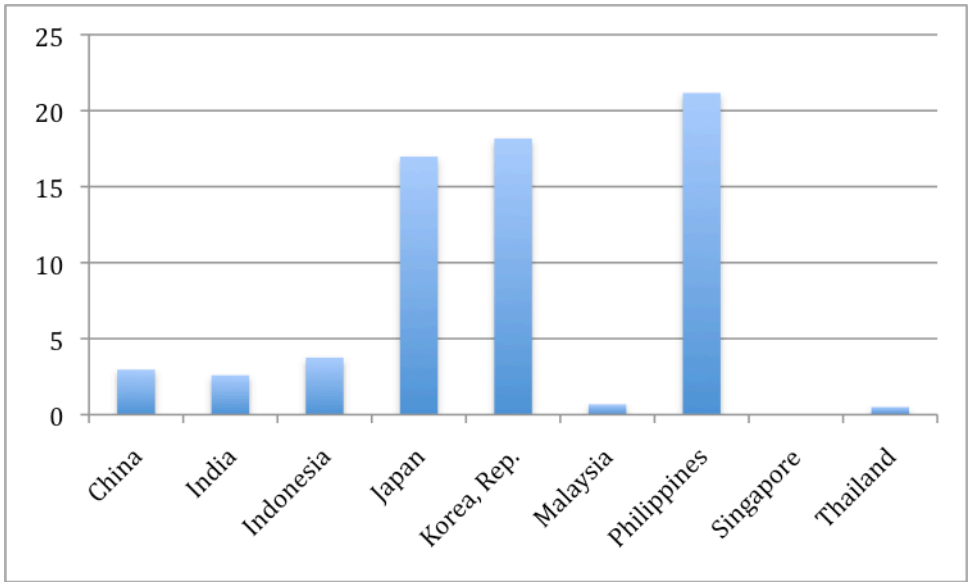
29. Trends in Labor Turnover
労働移動の推移



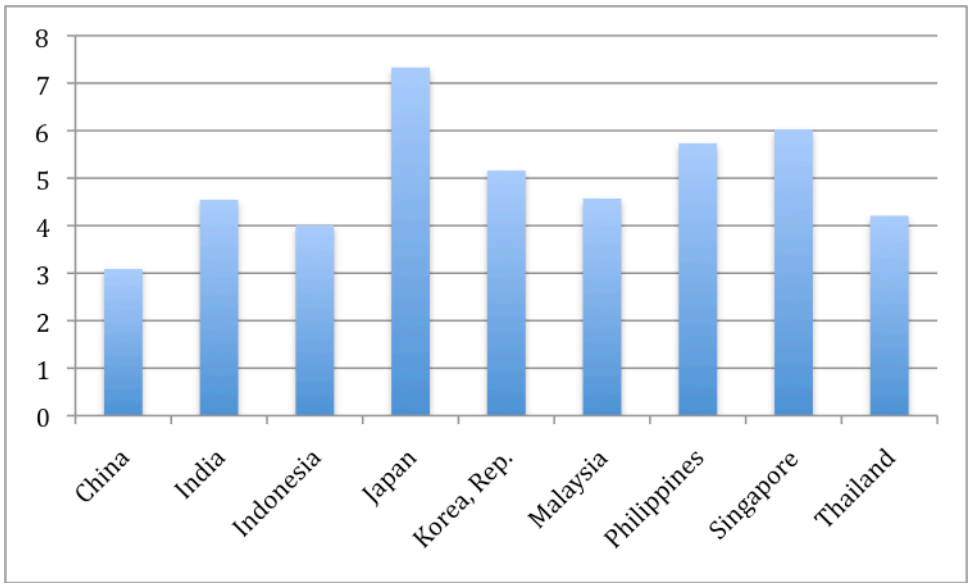
Source: Ministry of Health, Labour and Welfare, ***Survey on Employment Trend***.

Notes: 1) Rate of accessions = Number of hired employees / Number of regular employees (A) (as of July 1).
Rate of separation = Number of separated employees / Number of regular employees (B) (as of July 1).
Rate of labour mobility = (A) + (B).
2) From 1991, Construction is included.
3) As industries covered have been partially increased since 2004, figures do not connect to those before 2003.

Table G5: Indicators of environmental innovation



(a) Clean energy production (% of total energy use)



(b) GDP per unit of energy use (constant 2005 PPP $ per kg of oil equivalent)

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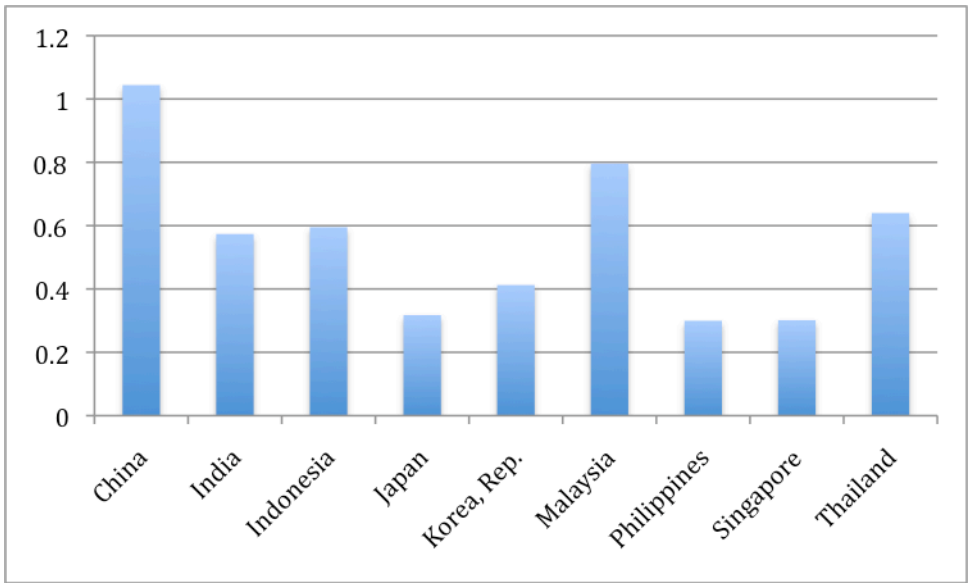
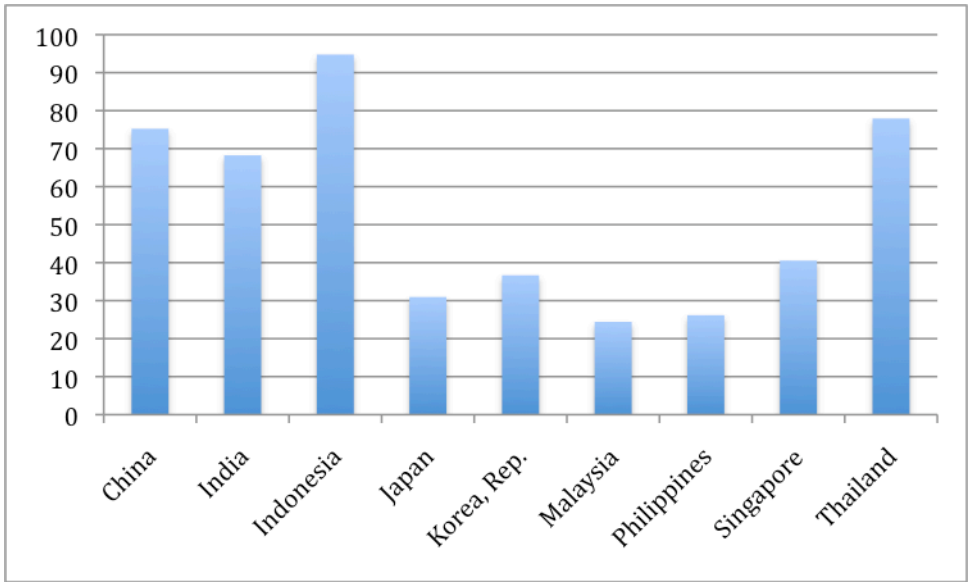


(c) CO2 emissions (kg per PPP $ of GDP)



(d) PM10, country level (micrograms per cubic meter)

Source: World Development Indicators, World Bank. Data from 2005.