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REFLECTIONS

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Reflections

Keynote Speech delivered at the
Conference on the Economics and Political Economy
of Development at the Turn of the Century

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ABSTRACT

This paper examines the causes of Taiwan's exceptional economic performance, focusing on the influence of organizational and policy choices and how Taiwan's example differs from those of more typical less-developed countries. After briefly citing cultural factors as proposed by his late colleague John Fei, Ranis proceeds to explore the issues of organic nationalism, natural resource endowment, access to foreign capital and other political factors that have produced such economic success.

The author demonstrates how Taiwan's unique combination of strong organic nationalism, meager natural resources and limited access to foreign capital helped curb the Extended Dutch Disease phenomenon endemic in LDCs. In addition, the government's non-oscillatory, relatively laissez-faire fiscal and monetary policies, encouragement of technological innovation, plus generous educational, R&D and infrastructural expenditures have contributed to low rates of inflation and high rates of GDP growth. The paper finally suggests a positive correlation between democracy and economic development.

Keywords: Economic Development, LDC, Political Economy, Taiwan, Extended Dutch Disease, Democracy

JEL Codes: O10, O11, O50, P16

Reflections

Keynote Speech delivered at the
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of Development at the Turn of the Century

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I

John Fei truly walked on two legs, as a human being and as a scholar. As a human being, it is a fact that he received all of his graduate education in the U.S. and spent most of his adult life there. But we also know that he never stopped being 100 per cent Chinese, in his thinking, his life style, his ability to express himself, whom he felt comfortable and at ease with. Those of John's siblings who attended the American School in Beijing during the 1940s assimilated quickly and fully into American life and mores; John, along with other siblings, attended Chinese schools — and that choice was undoubtedly what helped mark him off for life. John never ceased being a Peking Mandarin — a philosopher king — who, just below a thin layer of official humility, was convinced of the basic superiority of the Kingdom of Heaven and most of its citizens — whether at home or in some diaspora. If an educated Chinese did not succeed, in the fullest sense of that word, John would usually attribute it to some failure of the environment, some act of discrimination. While John cared deeply about democracy and Taiwan and worried equally deeply about Communist China — especially after Tiananmen Square — he was, above all, a Chinese nationalist who foresaw a great future for the golden triangle once the war of the 'isms had subsided, as he knew it would some day — and fairly soon at that.

As a scholar John also inhabited two worlds. Largely, I suspect, because he never was fully comfortable in literary English, his early work was heavily concentrated in the realm of quantitative methods, specifically mathematical economics as a tool of economic theory. His first job after leaving M.I.T. with a doctorate and a dissertation in international trade theory in

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hand, was with Leontief's input-output center at Harvard; and even after he began undergraduate teaching at Antioch College in Ohio, his research interests remained highly abstract and tools-oriented, utilizing graph theory, linear programming, topology and calculus.

John was also always deeply interested in history, especially Chinese economic history, and in philosophy, especially the writings of Confucius and Laotse, as well as, early on, in the contrast between the mixed economy of Taiwan and the controlled economy of Mainland China. But it was only after he became an advisor to the Pakistan Institute of Development Economics in 1960 — where, incidentally, he and I met for the first time — that he developed a strong and lasting interest in development.

We all know development economics to be an applied field, somewhat murky, of uncertain terrain, and amenable to a wide range of investigatory approaches. John took to it like a fish to water. It provided just the right challenge for his unique combination of academic talents and personal interests; and since then his scientific contributions have carried that distinct mark, of applying rigorous techniques to areas at the borders — and sometimes beyond — of standard neo-classical economics. Starting with two-sector models, asymmetric in labor market behavior as well as in commodity content, he went on to investigate causal links between the nature of the growth path and the distribution of income — via the use of a Gini decomposition technique — and to political economy-related issues. His objective was ever more clearly fixed on trying to explain the diversity of development experiences over time — more recently asking not only *what* various types of countries had done differently but also addressing the additional question of *why* some systems did so much better than others. This last concern forced him back to a consideration of initial conditions, including the study of history as an underexploited arena for the rigorous analysis of development. When he died last year, one of several unfinished books he was working on focussed on the economic history of China, another on a comparison of the development experience of China and Taiwan in the post-World War II era.

John loved teaching and he was famous for his clear exposition and his multi-colored diagrams — ever more complicated at first glance, but really quite simple and a great explanatory assist if one had the requisite patience to follow them, step by step. But basically his was an all-consuming interest in scholarship and research. Like a bull-dog worrying a

bone, he would tackle a problem until it was solved — a perfectionist — late to bed, late to rise — never satisfied.

Much of his applied interest was concentrated on explaining the East Asian experience. Especially since retiring from Yale in 1993 and settling in Taiwan his work was indeed focussed on explaining that country's success with the help of that unusual combination of tools, history, theory, and mathematics, at his disposal. I can think of no better way of honoring his memory than to have one more look at the country he loved so well — as an economist and as a Chinese — seen from the vantage point of contemporary scholarship and policy debate.

II

There is no need to rehearse once again in detail the exceptional performance of Taiwan over the past four decades, either in terms of the spectacular growth of per capita income or in terms of the distribution of that income, improving during the period of most rapid growth in the 1960s, thus providing the world's most persuasive counter-example to what was once viewed as Kuznets' inverse-U-shaped iron law. As Table 1 illustrates, Taiwan can be said to occupy a place of pride in international comparative terms, even among the select group of East Asian Miracle countries.

Taiwan also did exceedingly well in improving the basic conditions of well-being of its population during the past four decades. While excluded from the UNDP's Human Development Report for political reasons, our own estimates show that Taiwan's Human Development Index has improved steadily, from 0.618 in 1976 to 0.898 in 1993 (see Table 2 and Figure 1). Internationally, this has placed the country in the "high human development" category of the UNDP, just slightly below the average HDI for the industrial countries and in 26th place internationally, four spots ahead of its 30th rank in per capita real income terms (see Table 3).

It is well known that Taiwan, along with most developing countries, whether early-bird or late-comer, initially adopted an inward-looking or import-substituting pattern of development but that, unlike most others, it shifted after a decade or so into an export orientation mode, with an emphasis at first on labor-intensive agricultural and non-agricultural

exports, subsequently moving into capital, skill and technology-intensive output and export mixes. This metamorphosis over various developmental sub-phases was accompanied by a well-documented gradual liberalization trend in various critical markets.

What is currently of special interest — and something John Fei turned his attention to near the end of his life — is not so much the rather well-known "what" of this performance but the less well understood "why", and this is essentially what I shall direct my attention to. Especially in light of the fact that virtually all countries initiated their transition efforts under similar import-substituting policies, with strong government intrusion penetrating their mixed economies, why was Taiwan, along with some other countries, willing and able to move onto a different path relatively early? It is not enough, as the practitioners at the World Bank and elsewhere have emphasized, to attribute the success of the East Asians to their more pronounced external orientation and their greater overall willingness to subject themselves to the competitive discipline of international markets; it is, instead, necessary to try to understand why we encounter such persistent enhanced flexibility and openness to adjustments in policy regimes in response to inevitable exogenous shocks. Other developing countries have from time to time entered upon a somewhat similar pattern of increased external orientation and the utilization of markets but were unable to maintain a more or less linear trend in these directions. Instead they could be characterized as following less clear-cut, oscillatory or stop-and-go patterns of organizational choices, with somewhat more market oriented episodes, temporarily followed by a return to restrictive interventionist policies, as particularly in evidence in much of Latin America, at least until very recently.

An investigation as to the "why" of differential policy choices will, of course, not lead us to try to fully endogenize policy; there is much too much noise in the system; but it should help us understand why the often very similar policy advice proffered by the international financial and academic communities was so differently received on this small island, in contrast to many other developing country policy-making circles.

In observing this divergence in organizational and policy choices across developing countries, John Fei placed considerable weight on fundamental philosophical and cultural differences among societies, emphasizing such factors as the role of Confucian ethics and the importance of the Chinese family clan. This is perhaps one of the few areas where we parted

company, largely because of my relative ignorance, but also because of my concern that to the extent explanations are cultural this represents a fundamental challenge to social science, as well as impugning the quality of the human capital embodied in policy-makers, entrepreneurs and "just plain folks" in other parts of the developing world. Adherents of this view should also be able to explain why Confucianism remained so perfectly in harmony with centuries of relative stagnation in China prior to World War II.

Happily John Fei and I agreed on almost all the other components of the "why" of the unusual historical experience on Taiwan, i.e. that the bulk of the explanation for its observed comparatively stellar performance was to be found in a combination of differences in initial conditions, partly socio-political, partly natural resource oriented, which helped shape the adoption or rejection of policy changes over time.

Following the typical developing country's achievement of political independence political forces customarily severely penetrate an LDC economy, with governments attempting to deploy macroeconomic instruments to shift resources among interest groups and promote growth. In particular, given the inability to muster an effective tax policy, except at the borders, the temptation to orchestrate "under the table", i.e. indirect or implicit, income transfers among social groups and thus be able to manufacture profits for the state or a favored new entrepreneurial class, was invariably strong. Although such covert practices often carry the potential for disaster in the future, the overriding need to solve a plethora of current problems and carry on a plethora of investments of all kinds usually distracts myopic governments from worrying unduly about the possibility of enhanced social conflicts arising later on. Under such conditions the concrete meaning of liberalization really rests on the gradual withdrawal of these political forces from the economic arena. Some countries do it more quickly than others and the sequencing differs. But it is changes in the nature of government actions intended to generate growth which explains much of the divergence in performance among developing countries.

My own work with Mahmood (Ranis and Mahmood, 1992), inspired in part by an earlier exchange with Fei (Ranis and Fei, 1988), represents one such effort to begin to explain the differential policy choices made — in this case in terms of differing initial strengths of organic nationalism, differing endowments of natural resources, and differential ease of access

to foreign capital. The assertion is that these initial conditions not only affect the initial levels of income but also policy responsiveness and flexibility over time, i.e. the extent to which, as Kuznets (1966) put it, policies can be seen as accommodating or obstructing the basic evolutionary changes which all societies must eventually undergo if they are to navigate a successful transition into modern economic growth.

This approach assumes that there exists a meaningful family affinity among subsets of developing countries, giving certain policies their uniqueness and suggesting that the organizational and policy choices made are related to such differences in the initial conditions. Others, including Chenery and associates, Bhagwati and Krueger, Sachs and Warner,[1] have, of course, made efforts to evolve a methodology for studying transitional economies by grouping them into different types based on some set of initial conditions or outcomes. Most of the time, however, the underlying organizational or political economy reasons for these choices have received much less attention. Kuznets, for example, while preferring to think of policies as either obstructing or accommodating some sort of natural evolution of a system over time, essentially excluded policy formation from his descriptive canvas. Chenery incorporated policy considerations in an informal way, identifying country types according to their development patterns achieved *ex post*, and thus only indirectly based his typology on the nature of the policies pursued. Sachs and Warner (1995) avoid explicit discussion of policy evolution in their recent cross-country study — though their results do suggest that resource abundance may hinder growth by encouraging LDCs to pursue protectionist policies longer than would otherwise be the case. Rodrik (1996) addresses the specifics of what affects policy choice over time, recognizing that recent trends towards market oriented reforms have generated a host of puzzles — namely why so many LDC governments have maintained inefficient and unsustainable policies for so long and why only a few, including Taiwan, have chosen to abandon them after shorter periods. He underlined the importance of examining the political milieu within which such policies are adopted or abandoned as he surveyed the current state of knowledge and the political underpinnings of the economic reform process.

The three critical dimensions we decided to focus on: the relative strength or weakness of what we call organic nationalism, the relative strength or weakness of a system's natural resource endowment, and the relative strength or weakness of a system's ability to

attract long-term capital "for the asking" seem to us to impinge directly on policy flexibility over time. The first affects the relative mildness of the seemingly inevitable early import-substitution subphase and thus the difficulty of later moving into a competitive export-led subphase, i.e. the political costs of effecting a painful adjustment. The second, ample natural resources, affects the size of the rents emanating from the primary sector, i.e. the larger the rents the more animated the resulting struggle among the various interest groups and the more severe the risks of contracting "Extended Dutch Disease". Finally, the third dimension, the volume of long-term foreign capital inflows, is seen to be strongly correlated with the size of the natural resource endowment, and thus serves to reenforce the Extended Dutch Disease-related response mechanism.

These critical dimensions of the initial conditions affect a system's policy responsiveness and flexibility over time and thus the extent to which development policies are likely to accommodate or obstruct basic evolutionary change. The strength of pre-existing organic nationalism, i.e. the extent of ethnic and linguistic homogeneity, affects the relative mildness or severity of the seemingly inevitable early import substitution subphase, the extent to which government feels it must initially expend its energies in a large variety of areas, leading to overcommitment, overpromise and difficulty in pulling back at a later point. Exportable natural resource wealth determines not only the strength of the exchange rate, to the disadvantage of non-traditional exports, but it also affects the decision-making process, taking the pressure off and inducing a postponement of required policy change. This is why we have called it "Extended Dutch Disease."

Finally, foreign investors and foreign aiders are more bullish when natural resources are abundant, especially in externally good times, and are more likely to be more depressed in bad times. Indeed, both tend to move together cyclically, i.e. natural resource bonanzas are likely to attract additional private investor interest; moreover, depending on the stage of development, the whole system is viewed as a better opportunity for foreign assistance. In other words, foreign capital affects the size of the "under the table" volume of rents which can be fought over and reallocated. As an example, such inflows into Mexico, private and public, were substantially enhanced by the discovery of new oil reserves in the early 1980s and the generally more optimistic attitude towards the future of an oil rich country markedly affected

these flows. In this sense capital movements, mainly private but also public, are likely to reinforce perverse political responses and exaggerate swings. The quick entry and exit of short-term foreign capital, in evidence during the debt crisis, and again very recently, represents an exaggerated version of this phenomenon.

Additional natural resources and/or additional foreign capital should, of course, in theory, be potentially helpful, i.e. provide additional capacity to buy out opposed vested interest groups and thus serve to facilitate a developing country's ability to achieve any agreed upon set of objectives. "More" should be better than "less". However, if "more", in fact, adds to the risks of contracting Extended Dutch Disease, "less" can indeed be "more".

Taiwan clearly belongs to the heavily labor surplus type of developing country, natural resources poor and human resources rich (see Table 4), with perhaps the strongest sense of organic nationalism in terms of cultural and ethnic homogeneity imaginable, further reinforced by the threat from the mainland, especially in the 1950s and early 1960s. Moreover, contrary to common belief, the cumulative contribution of foreign capital between 1952 and 1990 amounted to less than 10 percent of total investment. Not only was the total *quantity* of foreign capital, including foreign aid, relatively limited but its *quality* was extremely high. Inflows into Taiwan in the 1950s were critical in curbing runaway inflation and providing budgetary assistance. And the substantial aid ballooning made available by the U.S. between 1959 and 1963 was directly associated with the adoption of the famous 19 points of reform which, in fact, took Taiwan safely from import to export substitution.

The components of this critically important reform program emerged from a comprehensive dialogue between U.S. and Taiwanese government officials via the Joint Commission on Rural Reconstruction. Reforms were carefully negotiated and Taiwan-"owned". As important was the fact that the U.S. simultaneously announced that economic assistance would cease by 1965; thus a helpful crutch would have to be used to effect change — not to take the pressure off — since it would soon be withdrawn. One observer concluded that this use of foreign assistance "doubled the annual growth rate of GNP".[2]

Taiwan's experience clearly indicates that the foreign aid lending cum conditionality process can work well in this fashion, but only when local polities have decided, largely on their own — if with the help of technical assistance provided through the JCRR structure —

to define their reform needs and implement a sequence of policy changes. Helpful was the reassurance that foreign capital would help ease the inevitable pains of adjustment incurred in moving from one subphase to the next. Used in this fashion, public capital inflows, instead of contributing to the Extended Dutch Disease phenomenon, in fact tend to curb its risks.

In this fashion foreign aid was also directly supportive of private capital flows to Taiwan which increased substantially after the 1960s, as aid was phased out. Private capital, which customarily can be counted on to look for profits, regardless of the overall policy setting, can be expected to make a similarly positive contribution to the transition process if, in fact, policy change has been effected with the help of public flows. Carefully negotiated public sector program lending is likely to be critical for ensuring that the accompanying or subsequent inflow of private capital, instead of leaving a deficient policy environment untouched, in fact plays a supportive role, quantitatively as well as qualitatively.

Our basic proposition therefore is that the issue of accomplishing politically difficult changes in development policy is not so much a function of an inadequately shared understanding of technical issues, but a function of more subtle political economy-tinged processes which are not yet fully understood. It is the burden of the argument here that once the relationship between initial conditions and policy responses is made more transparent, i.e. once we understand what transpired in a place like Taiwan, the chances for a better understanding of the development process generally are substantially enhanced.

The basic notion is that the transition from import substitution to export orientation, associated with the gradual withdrawal of political influence by government, presents a politically difficult task. It requires radical changes in the rules of the game, as economic agents, in particular the new industrial class, have to be persuaded to start operating in a radically different, much more competitive, environment, entailing a shift from earning certain large unit profits on a small volume to earning uncertain small unit profits on a large volume. This politically more difficult and more risky strategy was adopted, if not without some hesitation, in Taiwan in the early 1960s. It is the political economy dimensions of that process that I would like to focus on.

In assessing the response of Taiwan to such commonly experienced external shocks as terms of trade fluctuations, we may note the relatively limited response in terms of growth

promotion activities of the Government in contrast to other, say Latin American, cases. Taiwan's export ratio, for example, rose from 10 per cent to 35 per cent during the expansionary 1960s and reached even higher levels during the externally less favorable 1970s. The typical LDC response to positive external shocks was to succumb to the temptation to use the additional resources generated by foreign trade to opt for additional growth promotion via domestic fiscal and monetary expansion. Such temptation was resisted in Taiwan. Import surpluses never exceeded 5 per cent of GDP, and even when a relative deterioration in the external environment set in in the 1970s, large and increasing export surpluses began to appear.

The absence of severe growth activism also extended to exchange rate management and trade policies. During the 1950s, the import substitution years, Taiwan had pegged its exchange rate at an overvalued level. But by the late 1950s the government had already begun to liberalize its foreign exchange and trade regime. As early as 1955 a system of rebates of indirect taxes for the export component of industrial production was put in place, followed by exchange rate unification and a series of devaluations in the 1958 to 1960 period, the elimination of direct controls on trade and, a bit later, the establishment of export processing zones and bonded factories as a half-way house to full export orientation. While the rest of the Taiwan economy remained protected for some time to come, i.e. tariffs were not radically lowered until much later, the incentives for import substitution and exports were approximately equalized.

Just as significant is the fact that, in the fiscal and monetary arena, Taiwan's policies did not oscillate in response to external shocks. Even though small government deficits occurred in the early 1960s, these were quickly replaced by surpluses, virtually throughout the entire period of observation. The domestic money supply increased at annual rates of 15 to 20 percent during the pre-1970s, rates which did not change markedly during the post-1973 turndown. This means that, unlike the "typical" response elsewhere, there was no effort to replace a deterioration in the flow of money of foreign origin with money of internal origin. Such relatively stable rates of monetary expansion, combined with a continuously declining velocity — as one would expect in the case of a system with ever maturing financial institutions — yielded modest annual rates of inflation at less than 5 per cent annually.

Indeed, it is important to note that whenever there was a temporary minor spurt in inflation, i.e. in 1973 and again in 1979 — undoubtedly affected by oil price-related supply-side shocks — Taiwan's authorities immediately responded by drastically reducing the growth of the money supply and running extra-large government surpluses. Such behavior stands in sharp contrast to the traditional developing country policy syndrome.

Combining continuously low inflation with high rates of growth in real GDP was one of the clearest results of the monetary and fiscal policy chosen in Taiwan throughout the period under observation. Restraint in money printing also permitted Taiwan to extract a steady rate of forced savings, on average 3 to 4 percent, while real rates of interest could be kept substantially positive most years. Meanwhile the savings rate increased to remarkably high levels, with the percentage of savings flowing through official channels continuously on the increase.

All in all, in spite of imperfections in financial markets, we witness lower rates of inflation and higher savings rates, including higher rates of forced savings — and a more sustained rate of reduction in the average rate of protection — than in most developing country cases. Accompanied by approximate budgetary balance, a restrictive monetary policy and exchange rate flexibility, these changes provided the backdrop for a dramatic shift in output and export mixes; during the 1960s and early 1970s total exports grew by almost 30 per cent annually compared to about 20 per cent in the 1950s. There was a pronounced shift from agricultural or land based to industrial or labor based exports, concentrated in textiles, synthetic fibers, apparel, wood and other products. Thus, the initial vent for surplus in the form of unskilled labor permitted low unit labor costs in food processing, later in apparel, textiles and electronics, to determine output and export mixes.

The pattern of policy evolution in virtually all markets described here exhibits itself by a consistent, relatively non-oscillatory, long-term pattern, signalling the substantial withdrawal of government from the politically dictated interventionism of the early import substitution era. Even during periods of relatively rapid growth, responses were less politically economy tinged than a function of real variables, permitting the economy to shift from land to labor to technology intensive production and export activities. Consequently, consistent increases in the rate of growth, accompanied by a more equitable distribution of

income, were achieved. When times were good, government resisted the attempt to make them even better; and when times were bad, government resisted the pressure to adopt populist expansionary policies. Both the money supply and foreign exchange reserves were increasingly being assessed in terms of their usefulness for transactions purposes and not as instruments for the promotion of growth. In contrast to many, on the average more interventionist, LDC governments Taiwan's response was to follow a generally more "natural" path. Consequently, growth rates were only marginally inferior in downturns than they were during upturns, i.e. the Government was willing to accommodate temporarily lower growth and thus achieved secularly higher growth. In other words, by not adopting artificial growth promoting policies in the short term, long term growth was enhanced.

Our basic proposition has been that Taiwan's substantial and sustained depoliticization resulted from the fact that the absence of natural resources and the lack of easy access to foreign capital combined with the pre-existence of organic nationalism to render Taiwan relatively immune from the Extended Dutch Disease. The steady-as-you-go pattern of Taiwan's development path and the willingness to let prices adjust, rather than respond to problems via across-the-board interventions in various markets, stands in sharp contrast to the upward leaps and retrenchments that have all too frequently characterized policy evolution elsewhere.

Clearly, the natural resources poor Taiwan economy which also attracted a relatively low volume of foreign capital inflows has experienced a superior rate of development in terms of real GDP per capita, income distribution and human development achievements. Most remarkable, however, was the relative persistence, and thus the credibility, of the policy directions encountered here. The shift from the government's use of macro-economic policies for generating growth directly, to micro and macro-economic policies which accommodate it indirectly, which we have sought to demonstrate, does not, however, mean a diminished role for government, only a different role. Static Walrasian equilibrium does not guarantee development. One needs government to worry about externalities, the provision of public goods and much more. That "much more" means an effective but a not overbearing state, able to implement agreed on policy change, improve the functioning of markets, and guarantee property rights and an equitable regulatory and legal framework. Of course, the wrong kind of

government intervention can make things worse. But in the context of the always lively — sometimes misdirected — debate concerning markets versus government the experience of Taiwan demonstrates not, by any means, a case of a *laissez faire* system displacing interventionism; it constitutes, instead, a change in the nature of government intervention from across the board *ad hoc* direct controls to selective intervention, plus institution construction and the provision of public goods accommodating development.

Critical shifts in government investments in human capital need to be especially noted in this context, with primary education, focussed on in the 1950s and early 1960s, giving way to secondary, including a heavy emphasis on vocational education, in the 1960s. Compulsory education was raised from six to nine years, once the first harbingers of unskilled labor shortage were experienced at the end of the 1960s. Expenditures on education rose from 2 per cent of GNP and 11 per cent of the budget in 1955 to 4.6 per cent of GNP and 20 per cent of the budget by 1970. The emphasis on vocational training at the secondary level is especially noteworthy; between 1966 and 1974, as the non-agricultural labor force increased by 80 per cent, vocational training increased six-fold, with 40 per cent of high school students in the vocational track in 1963 and almost 70 per cent by 1980 — approximately half administered by private enterprise and half by government agencies. Finally, in the 1980s and 1990s, emphasis shifted to higher education, especially towards the engineering, science and technology related fields. Table 5 column 1 indicates the consistent rise of total public expenditures on education as a percent of GNP, contributed to by both a rising total government expenditure/GNP ratio (column 2) and, more significantly, a steady increase in government expenditures devoted to education (column 1). We may also note the changing composition of education expenditure, especially as between primary, secondary and tertiary levels (columns 6, 7 and 8). If we take a leaf out of the UNDP's Human Development Reports and assign different weights, reflecting changing priorities, to the various components of education over time (see the arbitrary weights indicated in the key at bottom of Table 5), we can also compute an education priority ratio (column 9) as well as the ratio of priority education expenditure to GNP (column 10), holding fairly steady between 1 per cent and 2 per cent.

Other important government actions included an unusually generous provision of rural

irrigation, transportation and power, building on the policies pursued by the Japanese colonial government, which combined to render Taiwan's unique rural industrialization pattern possible. Indeed, Taiwan's railway density was second only to Japan's in all of Asia. The internal transport network was generally well articulated with respect to the main ports and export processing zones. This permitted the system's export potential to be fully exploited once the overall policy environment had shifted. Power capacity was maintained well ahead of demand and distributed relatively equally throughout the island, accompanied by a uniform set of electricity rates between rural and urban locations.

The Government also assisted Taiwan's predominantly medium and small-scale firms by establishing a number of research institutes, science parks, etc., providing training, technical assistance, credit and overheads in varying proportions. The Industrial Training and Research Institute, to cite but one example, established in 1973, was initially fully funded by the Government but increasingly supported by private contracts; it is generally considered responsible for developing many key technologies, ultimately transferred to the local private sector, thus facilitating Taiwan's medium and small scale industry development. The Government also set up a large number of rural industrial estates, providing the essential physical overheads for private industry. The institutional infrastructure which had served agriculture well early on was now available to provide assistance to agriculturally-linked rural industry and exports. The JCRR, for example, later financed research and development efforts in support of fish canning at Kaohsiung. Farmers' associations now included rural transport and the promotion of rural industries among the services rendered.

A number of additional government actions can be cited in the later, i.e. post-labor surplus era of the 1970s to 1990s, enhancing the flexibility or adjustment capacity of the domestic production structure and facilitating the continuously shifting product cycle. For example, the ten major public sector projects of the early 1970s were partly addressed to solving emerging transportation bottlenecks, partly to circumventing the inadequate financial intermediation sector, in an effort to link small savers to large investment requirements. Even more important were the additional shifts in educational policy. By the 1980s Taiwan began to increasingly emphasize tertiary education and, within tertiary education, to move resources towards science and technology instruction.

Another important contribution to maintaining international competitiveness was, of course, the increasing impact of domestic R&D expenditures. As can be seen from Table 6 and Figure 2, R&D as a percentage of GNP continued to increase consistently, with government providing more than 50 per cent of the total. It should, moreover, be noted that these numbers do not include military or defense-related R&D spillovers, nor the important informal private R&D efforts of smaller firms not captured in the official statistics. If we were able to add the R&D of this private, blue-collar variety Taiwan's total R&D level as a percentage of sales or of GDP would undoubtedly begin to approach DC standards; it should be noted that R&D normally runs below the .5 per cent of GDP level in LDCs and at 5 per cent for developed countries. Taiwan's approaches 2 per cent.

A cross-section regression for 1991 clearly indicates a significant positive relationship between R&D expenditures and exports.[3] Once Taiwan's labor surplus had been exhausted, the volume of technology intensive exports increased four-fold between 1984 and 1994, from NT$284 billion to NT$1146 billion; the share of technology intensive exports in total exports doubled, from 23.6 per cent to 47 per cent, during the same decade.

Those who claim that high savings rates are sufficient to explain the Taiwan "miracle" still owe us an explanation of why indeed these rates were so high and why they were accompanied by respectable levels of productivity change. According to Paul Liu and associates (Industry of Free China, November 1994), total factor productivity growth in manufacturing was respectable in the 1970s and 1980s, even if not as high as in the earlier period when the economy was still dominated by agriculture and food processing. While we can easily find even higher investment rates, for example, in Scandinavia and, in earlier periods, in the Soviet Union, these were associated with much higher capital-output ratios and a much worse export performance. Whether the Taiwan explanation runs in terms of high investment rates or technological change — depending on the valuation of a heterogeneous capital stock and the particular production function assumed —, those who claim that there is nothing "special" in the Taiwan experience[4] need to explain why savings rates were so high and yet investment remained so productive.

It is clear that, over time, the impact of exports on domestic productivity levels became increasingly important, associated with equipment imports, technological licensing and the

enhanced flow of DFI. To this should be added a substantial volume of advice proffered by customers abroad concerning desirable design, quality and product modifications. This flow was initially enhanced by a concerted effort to attract previously brain-drained Taiwanese engineers and scientists from such places as Silicon Valley in the U.S. to participate in the domestic production and export drive. For example, fully 70 per cent of the companies in the Hsinchu Science-based Industrial Park have in recent years been led by returned overseas Chinese.

Trade and growth in Taiwan were thus mutually supportive throughout the country's highly successful transition growth experience.[5] The tendency in the literature to ascribe a "leading sector" role to trade is as misleading as earlier tendencies to focus exclusively on balanced domestic growth patterns. Given the accommodating macro-economic policy changes already referred to, technology change and the mobilization of agriculture had set the stage early on, enabling processed agricultural exports to expand rapidly and change their composition radically. Later on, as the economy's center of gravity shifted to an unskilled but literate labor-based industrial output mix, the mutual reinforcement between domestic technology change and rapidly expanding light industry exports took over. Taiwan was able to respond promptly to the early harbingers of labor shortage by shifting emphasis from primary, to secondary, to tertiary education, as well as by deepening its science and technology infrastructure, including via the encouragement of private and public sector R&D. Increasingly, technology imports are now carried by machines, multinational company patents and licenses of a proprietary character, including substantial resort to "reverse engineering" by the country's many medium and small-scale firms. Still more recently, Taiwan has managed to prolong the life of her labor-intensive exports by way of investing in neighboring countries. At home, technology, the product mix and exports have moved upstream. Persistent domestic "learning by doing" processes continue to induce exports as much as the other way around.

John Fei was also keenly interested in the issue of the democratization of Taiwan not only as a bottom line "good" but also as an instrumental variable in relation to development, critical to the Taiwan/Mainland China comparison which always drew his attention. While it is generally agreed that growth promotes democracy, at least after some time, the more problematic issue is whether democracy also promotes growth, especially at an early stage.

We, of course, all know of countries, e.g. Haiti and Burma, which are both undemocratic and unsuccessful, as we know some which are democratic and successful, e.g. Costa Rica and Poland. But the fact is that the difficult cases, at least initially undemocratic successes, include Chile and South Korea, as well as Taiwan.

If one accepts the Przeworski minimalist view of democracy, i.e. a multi-party system, elections, and losers accepting the verdict, Taiwan clearly did not qualify in the early days but fully qualifies today. Strangely, if you take the broader definition of Robert Dahl, i.e. effective participation by most citizens, we may have to take another look at the Taiwan experience. If we think of democracy as having both horizontal and vertical dimensions, i.e. in terms of the existence of legislative, judiciary as well as executive powers, on the one hand, and decentralization of the decision making down to local bodies vertically, on the other, it is really the rule of law and the existence of credible property rights which may be said to lie at the heart of what might be called "economic democracy", rather than the requirements of Westminster-type voting institutions. In the absence of regulatory reform, liberalization is likely to be accompanied by increased income disparities, presumably inimical to democracy. Clearly, democracies require more deliberative time, greater transparency, and are more exposed to vested interest pressures, all of which may well hurt the chances for reform in the short run. On the other hand, social capital is enhanced by the horizontal ties associated with political pluralism and democracy. Certainly collective action is helped by ethnic homogeneity, in line with our earlier discussion of organic nationalism. The extent to which both development and democracy are based on credibility and explicit, enforceable contracts is, of course, important. Development clearly depends on government credibility and reputation which permit reforms to go forward and the avoidance of stop-go patterns. Similarly, democracy is based on the strength of the expectation of fair play as the notion of an unequal distribution of initial chips does not necessarily mean an unfair return on one's human and capital assets.

We usually accept the notion that a strong executive branch within a strong central government is needed in the early import substitution phase, with less reliance on markets and democracy — and that, later on, as decisions become more complicated, a more decentralized market mechanism as well as increased entry on the political side become necessary. As

educational levels rise and civil society is enhanced demand for participation increases. We thus have a natural spillover from economics onto the political scene, leading to the commonly acknowledged notion that development promotes democracy at some point in the transition process. If the median voter is going to be satisfied there is less chance of a populist revolt upsetting macro-economic policy stability. Development usually means the increased strength of the middle class, customarily also conducive to the blossoming of democracy.

Democracy and development can thus be seen to be increasingly intertwined, both in terms of the vertical and horizontal dimensions of institution construction. We often assume that development participation is favored by decentralization of both the vertical and horizontal types but we still need a strong center to ensure standards and equity across subdivisions of the country. If democracy is focussed heavily on participation in decision making then, even in the early days, Taiwan, relying heavily on farmers' associations, compares favorably with so-called democratic Colombia where two elite parties continually vie for power at the polls. Perhaps the extent of the possible isolation of the bureaucracy from pressure and bribery, related to the extent of transparency and accountability, should carry a larger weight in making these delicate judgments.

Just as markets are never complete, i.e. information is never perfect, markets underinvest in R&D and education, and there always exist coordination failures of various kinds, democracy is never perfect, whether we use minimal or maximal definitions. Clearly, dictatorships may make things worse as, for example, in the sedentary bandit model of Mancur Olson (1993). We can be reasonably sure that as an economy and polity mature both decentralization and democracy will be enhanced when society is faced with a more and more complicated set of decisions requiring more and more decentralized mechanisms. Thus, very early on, democracy may help growth because it strengthens the existence of organic nationalism. At the very end growth helps democracy, as we have already noted. In between, the claim is made that excessive democracy can lead to populism, excessive consumption, and redistribution, thus inhibiting growth. However, this assertion needs to be questioned, with Taiwan's experience clearly relevant. On the island, income distribution equity and decentralization have proved generally consistent with economic democracy, with political democracy to follow. As long as the median voter is satisfied, in terms of his/her participation

in decision-making, there seems to be no necessary spillover into populism or citizen unrest. In contrast, on the Mainland the unquestionable spurt in economic growth in recent years seems to have been accompanied by worsening distribution. Vertical decentralization has not been associated with devolution as much as with a kind of anarchy, with local bodies, townships, provinces and/or the military carrying out unrecorded and underassessed economic "experiments". Horizontal decentralization in terms of property rights, regulatory frameworks, the rule of law, etc., also clearly still has a long way to go. The possibility for a mutual reinforcement between development and democracy to evolve still requires many additional steps. But in the end, given enough time, as John Fei not only fervently hoped but expected, it will be Taiwan's example which will peacefully "conquer" the Mainland.

Notes

1. For example, Chenery, 1960; Chenery and Syrquin, 1975; Chenery and Taylor, 1968; Bhagwati and Krueger, 1973; and Sachs and Warner, 1995.

2. See Neil Jacoby, 1984.

3. With 96 observations, the equation yields:

$$\frac{Export}{Sales} = \underset{(.0655)}{.0182} + \underset{(4.004)}{43.00}\frac{R\&D}{Sales}. \qquad R^2 = .5461.$$

4. See especially Krugman, 1994 and Young, 1992.

5. See also Ranis, 1996 for a fuller treatment.

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Table 1: Postwar Performance Indicators of a Sample of LDCs

(a) Average real per capita GDP growth rates (percent per year)

	1960-69	1970-79	1980-89	1990-93
Taiwan	5.9	8.1	5.6	7.3
South Korea	4.9	7.5	4.3	6.1
Thailand	5.0	5.0	3.1	5.0 (1992)
Philippines	2.1	3.3	-1.5	-0.2
Pakistan	3.9	2.0	3.6	5.7
Sri Lanka	2.2	2.1	3.4	4.8
Colombia	1.9	3.9	0.7	2.8
Mexico	4.1	1.9	-0.7	3.2
Costa Rica	3.1	3.5	-1.1	3.2
Brazil	2.4	5.7	0.5	0.2
Kenya	3.2	0.9	-1.5	0.9
Tanzania	4.7	1.8	-2.6	3.8 (1992)

(b) Income Distribution (Gini Coefficients)

	1950	1960	1970	1980	1990
Taiwan	.56	.44 (1959)	.29	.29 (1978)	.38
South Korea	-	-	.37	.38 (1976)	.38 (1986)
Thailand	-	.41 (1962)	.44 (1968)	-	.43 (1987)
Philippines	.49 (1956)	.50 (1961)	.49 (1971)	.50 (1977)	.47 (1991)
Pakistan	-	.36 (1964)	.33 (1970)	.36 (1979)	.42
Sri Lanka	.46 (1953)	.45 (1963)	.35 (1973)	.45 (1982)	.45 (1988)
Colombia	-	.53	.56	.52 (1982)	.55 (1988)
Mexico	-	.54	.58	.50 (1977)	.52 (1984)
Costa Rica	-	.50 (1961)	.43 (1971)	.42 (1982)	.46
Kenya	-	-	-	.59 (1977)	.52 (1986)

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Table 2: HDI Data for Taiwan

Year	Life Expectancy at Birth* Average	Combined First, Second, and Third Level Gross Enrollment Ratio****	Literacy Rates** Average	Per Capita GDP*** PPP$	Adjusted Per Capita GDP*****	Life Expectancy Index	Education Index	GDP Index	Human Development Index
1961				366	366			0.050	
1962				392	392			0.055	
1963				419	419			0.060	
1964				464	464			0.068	
1965				501	501			0.075	
1966				545	545			0.083	
1967				612	612			0.096	
1968				663	663			0.105	
1969				722	722			0.116	
1970				829	829			0.136	
1971				951	951			0.159	
1972				1097	1097			0.186	
1973				1289	1289			0.222	
1974				1507	1507			0.263	
1975				1608	1608			0.282	
1976	70.97		77.80	1904	1904	0.766		0.337	
1977	71.09		78.99	2170	2170	0.768		0.387	
1978	71.56		80.11	2543	2543	0.776		0.457	
1979	71.75		81.17	2988	2988	0.779		0.540	
1980	72.37	0.6823	82.17	3416	3416	0.789	0.775	0.620	0.728
1981	72.05	0.6911	83.23	3849	3849	0.784	0.785	0.701	0.757
1982	72.22	0.7005	84.13	4171	4171	0.787	0.794	0.761	0.781
1983	72.35	0.7122	84.96	4575	4575	0.789	0.804	0.837	0.810
1984	72.87	0.7198	85.79	5111	5111	0.798	0.812	0.937	0.849
1985	73.19	0.7312	86.59	5449	5156	0.803	0.821	0.945	0.857
1986	73.31	0.7539	87.32	6205	5186	0.805	0.833	0.951	0.863
1987	73.60	0.7604	88.03	7349	5214	0.810	0.840	0.956	0.869
1988	73.49	0.7737	88.73	8154	5230	0.808	0.849	0.959	0.872
1989	73.69	0.7793	89.32	9092	5246	0.811	0.855	0.962	0.876
1990	73.94	0.7986	89.93	9850	5258	0.816	0.866	0.964	0.882
1991	74.40	0.8169	90.57	11228	5276	0.823	0.876	0.968	0.889
1992	74.42	0.8318	91.01	13088	5305	0.824	0.884	0.973	0.894
1993	74.47	0.8405	91.38	13565	5308	0.825	0.889	0.974	0.896
1994	74.67	0.8343		14505	5312	0.828		0.974	

* Source: *Taiwan Statistical Data Book 1995* . CEPD, ROC.

** Source: *Statistical Yearbook of the ROC 1994* . DGBAS, Executive Yuan, ROC.

*** Source: Penn World Tables. Mark 5.6. January 1995.

Per Capita GDP Figures beginning in 1991 are estimated to be (Real Per Capita GDP in US$)*1.25(PPP$/US$)

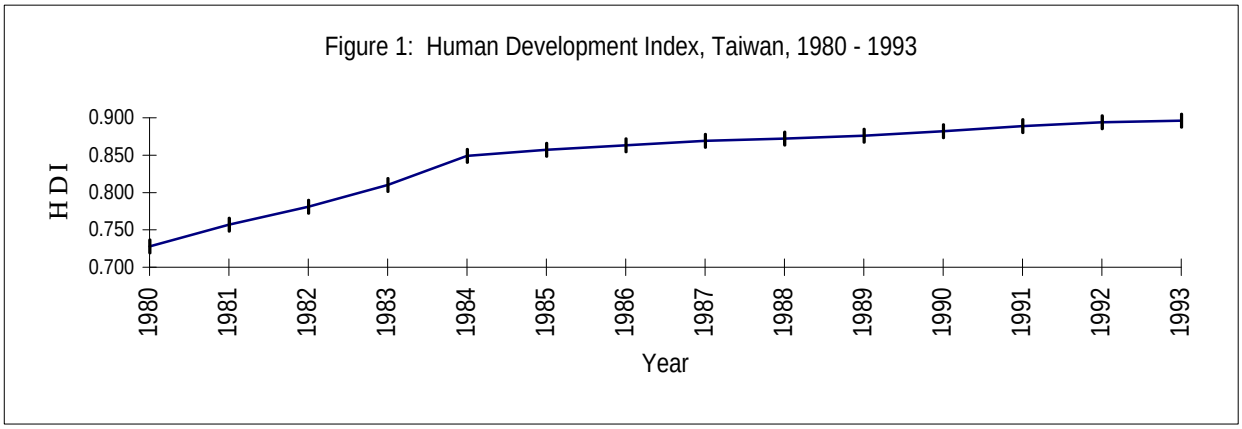
**** *Monthly Bulletin of Statistics of the Republic of China* . DGBAS, ROC. Sept. 1995.

***** The Adjusted GDP Per Capita is calculated according to the method used in the *Human Development Report 1995* .
This method, based on the work of Meghnad Desai, takes the world average income of PPP$5,120 in 1992 as the threshold level (y*) and any income above this level is discounted using the following formula for the utility of income:

W(y) = y, for 0 < y < y*

= y* + 2[y-y*)^1/2], for y* < y < 2y*

= y* + 2(y*^1/2) + 3[(y-2y*)^1/3], for 2y* < y < 3y*



Beginning in 1984, Taiwan's GDP per capita surpassed the threshold GDP of PPP$5,120.
Consequently, from 1984 onwards, Taiwan's GDP is discounted according to the work of Meghnad Desai,
and as found in the Human Development Report 1995, page 134.

Table 3: 1992 Human Development Index, International Rankings

Source: Human Development Report 1995 .

HDI Rank	Country	HDI	Real Per Capita GDP (PPP$)	Per Capita GDP Rank Minus HDI Rank
1	Canada	0.950	20,520	7
2	USA	0.937	23,760	-1
3	Japan	0.937	20,520	5
4	Netherlands	0.936	17,780	16
5	Finland	0.934	16,270	19
6	Iceland	0.933	17,660	15
7	Norway	0.932	18,580	8
8	France	0.930	19,510	3
9	Spain	0.930	13,400	20
10	Sweden	0.929	18,320	7
11	Australia	0.927	18,220	7
12	Belgium	0.926	18,630	2
13	Switzerland	0.925	22,580	-11
14	Austria	0.925	18,710	-1
15	Germany	0.921	21,120	-9
16	Denmark	0.920	19,080	-4
17	New Zealand	0.919	14,990	-9
18	United Kingdom	0.916	17,160	5
19	Ireland	0.915	12,830	11
20	Italy	0.912	18,090	-1
21	Israel	0.907	14,700	6
22	Greece	0.907	8,310	21
23	Cyprus	0.906	15,050	2
24	Hong Kong	0.905	20,340	-14
25	Barbados	0.900	9,667	12
	TAIWAN	0.894	13,088	4
26	Bahamas	0.894	17,360	-4
27	Luxembourg	0.893	21,520	-22
28	Costa Rica	0.883	5,480	32
29	Belize	0.883	5,619	28
30	Argentina	0.882	8,860	9
31	South Korea	0.882	9,250	7
32	Uruguay	0.881	6,070	21
33	Chile	0.880	8,410	8
34	Malta	0.880	8,281	10
35	Singapore	0.878	18,330	-19
High Human Development		0.888	13,605	
Industrial Countries		0.916	15,291	
World		0.759	5,410	

Table 3 (continued)

HDI Rankings in East Asia

3	Japan	0.937	20,520	5
24	Hong Kong	0.905	20,340	-14
26	TAIWAN	0.894	13,088	4
31	South Korea	0.882	9,250	7
35	Singapore	0.878	18,330	-19
58	Thailand	0.827	5,950	-3
59	Malaysia	0.822	7,790	-14
83	North Korea	0.733	3,026	14
100	Philippines	0.677	2,550	8
104	Indonesia	0.637	2,950	-5
111	China	0.594	1,950	12
120	Vietnam	0.539	1,010	0

Table 4: Initial Conditions (approximately 1950)

(a) Natural Resource Endowments

(in terms of per capita production in 1950; all units of measurement are in metric tons per thousand population unless otherwise indicated)

Natural Resource	Mexico	Taiwan	Philippines
Coal	34.70	187.80	7.84
Lignite	-	-	-
Natural gas[a]	66.74	54.14	-
Crude petroleum	394.30	-	-
Manganese ore	0.60	-	0.59
Iron ore	10.90	-	15.90
Copper ore	2.30	-	0.51
Lead ore	9.10	-	0.04
Zinc ore	8.50	-	-
Tin concentrates	0.02	-	-
Chrome ore	-	-	4.67
Tungsten ore	0.001	-	-
Antimony ore	0.20	-	-
Mercury	0.005	-	-
Gold[b]	0.48	0.13	0.51
Silver	0.06	-	0.004
Round Wood[c]	-	-	0.15
Natural rubber	0.03	-	-
Cash Crops			
Coffee	2.51	-	-
Tea	-	1.58	-

[a] in cubic meters per thousand population
[b] in kgs. per thousand population
[c] in thousand cubic meters per thousand population
- nil or not significant

Source: United Nations, Statistical Yearbook, 1953.

(b) Size and Extent of Labor Surplus

	Size[a]	Labor surplus[b]
Mexico	25,826	1.0 (1950)
Taiwan	7,981	4.0 (1950)
Philippines	19,910	2.2 (1948)

[a] Population (in thousands)
[b] Rural population/arable land ratios (in persons per hectare)

Table 4: Initial Conditions (approximately 1950) (continued)

(c) Human Capital Resources

	Adult literacy rate (in %)		School enrollment ratios (adjusted)[a] first and second level		
	1950	1960	1950	1955	1960
Mexico	56.8	64.5	37	43	53
Taiwan	51.1	73.0	47	57	74
Philippines	60.0[b]	74.9	89	70	70

[a] These are the ratios of total enrollment at the two levels to the estimated population in the age group corresponding to the actual duration of schooling in each country

[b] 1948

Sources: United Nations, Demographic Yearbook; FAO, Production Yearbook; UNESCO, Statistical Yearbook; United Nations, Statistical Yearbook.

Table 5: Public Spending on Education

Source: *Social Indicators in Taiwan Area of the Republic of China 1993*. DGBAS, Executive Yuan, Republic of China. Pages 112 - 113.

	Educ Exp / GNP	Gov Exp / GNP	Educ Exp / Gov Exp	As a % of Educational Expenditures at All Levels					Priority Ratio	Education Expenditure Ratio
Year	Educ / Y	E / Y	Educ / E	SocEd	PreEd	PrimEd	SecEd	HiEd	PEd / Ed	PEd / GNP
1964	2.94%	19.4%	15.15%	2.79%	0.78%	39.43%	32.26%	14.70%	33.77%	0.99%
1965	2.96%	21.0%	14.10%	3.09%	0.80%	35.98%	32.43%	18.28%	32.93%	0.97%
1966	3.38%	20.3%	16.65%	3.90%	0.80%	32.72%	35.09%	19.63%	32.68%	1.10%
1967	3.40%	22.8%	14.91%	3.13%	0.69%	32.54%	35.87%	19.63%	32.48%	1.10%
1968	3.56%	21.1%	16.87%	3.32%	0.64%	31.72%	35.45%	22.45%	32.55%	1.16%
1969	3.99%	22.7%	17.58%	2.88%	0.29%	26.66%	40.15%	22.53%	31.11%	1.24%
1970	4.14%	23.4%	17.69%	4.33%	0.53%	27.28%	37.69%	24.53%	33.50%	1.39%
1971	4.58%	22.3%	20.54%	4.29%	0.42%	25.13%	37.29%	27.32%	33.17%	1.52%
1972	4.10%	22.0%	18.64%	4.21%	1.10%	27.12%	40.26%	21.72%	34.31%	1.41%
1973	3.57%	22.8%	15.66%	3.73%	1.04%	28.23%	40.63%	21.81%	34.67%	1.24%
1974	2.95%	18.0%	16.39%	3.39%	1.21%	27.79%	39.26%	21.89%	33.81%	1.00%
1975	3.87%	22.8%	16.97%	3.23%	1.09%	28.87%	36.40%	19.97%	32.23%	1.25%
1976	2.95%	23.3%	12.66%	3.21%	0.91%	28.20%	37.76%	20.75%	32.81%	0.97%
1977	4.06%	25.3%	16.05%	3.15%	1.14%	27.78%	35.40%	20.35%	31.47%	1.28%
1978	4.09%	25.3%	16.17%	2.30%	0.94%	27.50%	33.62%	19.98%	30.09%	1.23%
1979	3.96%	23.3%	17.00%	3.15%	1.03%	29.48%	37.43%	19.23%	32.74%	1.30%
1980	4.27%	25.9%	16.49%	3.79%	1.42%	28.41%	35.53%	19.57%	27.55%	1.18%
1981	4.54%	26.5%	17.13%	4.37%	1.64%	25.64%	34.98%	21.46%	27.99%	1.27%
1982	5.15%	26.9%	19.14%	3.23%	1.73%	23.55%	34.10%	22.34%	27.43%	1.41%
1983	5.58%	25.1%	22.23%	3.39%	1.64%	24.51%	31.46%	23.68%	27.53%	1.54%
1984	4.95%	23.1%	21.43%	3.21%	2.32%	24.31%	33.23%	22.12%	27.32%	1.35%
1985	5.06%	23.0%	22.00%	3.75%	3.23%	22.91%	32.35%	21.79%	26.95%	1.36%
1986	5.14%	23.6%	21.78%	3.85%	3.21%	22.48%	31.36%	21.51%	26.46%	1.36%
1987	4.73%	21.2%	22.31%	3.28%	3.10%	21.98%	31.63%	24.70%	27.84%	1.32%
1988	4.92%	21.8%	22.57%	4.56%	3.12%	23.42%	30.32%	25.64%	28.59%	1.41%
1989	5.35%	32.6%	16.41%	4.45%	3.33%	24.59%	30.15%	23.67%	27.80%	1.49%
1990	5.90%	27.6%	21.38%	6.33%	3.20%	23.74%	31.35%	23.85%	28.62%	1.69%
1991	6.63%	30.6%	21.67%	5.74%	2.74%	23.58%	32.70%	23.94%	28.77%	1.91%
1992	6.96%	32.7%	21.28%	5.94%	2.90%	22.72%	29.10%	23.80%	27.54%	1.92%
1993	7.24%	32.6%	22.21%	6.66%	2.72%	24.37%	29.53%	22.82%	27.69%	2.00%
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
			= 1 / 2							= 2 * 3 * 9

Key:
1960's: PEd / Ed = 0.5[(0.5)(4) + 5 + 6] + 0.3(0.25)(4) + 7] + 0.2[(0.25)(4) + 8]
1970's: PEd / Ed = 0.3[(0.5)(4) + 5 + 6] + 0.5(0.25)(4) + 7] + 0.2[(0.25)(4) + 8]
1980's: PEd / Ed = 0.2[(0.5)(4) + 5 + 6] + 0.3(0.25)(4) + 7] + 0.5[(0.25)(4) + 8]
1990's: PEd / Ed = 0.2[(0.5)(4) + 5 + 6] + 0.3(0.25)(4) + 7] + 0.5[(0.25)(4) + 8]

Table 6: Total R&D Expenditures, Taiwan, 1982 - 1992

Source: *Taiwan Statistical Data Book 1995*. CEPD, Taiwan. Page 107.

Period	Total R&D in NT$ Billions	Total R&D As % of GNP	Government As % of Total R&D	Domestic Private As % of Total R&D	Foreign Private % of Total
1982	16.86	0.89	58.2	41.4	0.4
1983	19.20	0.91	61.2	38.6	0.1
1984	22.44	0.95	63.3	35.8	0.9
1985	25.40	1.01	63.6	35.4	1.1
1986	28.70	0.98	60.1	39.4	0.5
1987	36.78	1.12	50.8	48.6	0.6
1988	43.84	1.22	56.5	43.2	0.3
1989	54.79	1.38	47.7	51.8	0.5
1990	71.55	1.65	45.8	54.0	0.2
1991	81.77	1.70	52.0	46.4	1.5
1992	94.83	1.79	52.2	47.3	0.5

Notes:

After 1983, R&D expenditures in the humanities and social sciences are included.

All R&D figures exclude national defense spending.