Taiwan's Petrochemical Industry since Economic Liberalization

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Abstract

Have liberalization and globalization made Taiwan's industrial policy apparatus dysfunctional in recent years? Using Taiwan's petrochemical industry as an example, it is found that trade liberalization helped the industry's growth, but the impact of deregulation of the domestic market was mixed. With globalization, the industry's outward investment grew to be almost equal to inward investment in the last decade. The policy mode turned much less interventionist and developmental from the 1980s. It was shown, however, that there was room for discretionary decisions regarding methods of deregulation and ways to allocate scarce resources. The relative autonomy of the state was not eliminated by globalization and democratization. The fact that geopolitical concerns dominated the state's concerns is consistent with this argument.

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1. Introduction

Have liberalization and globalization made Taiwan's industrial policy apparatus dysfunctional in recent years? This paper uses the case study of Taiwan's petrochemical industry to illustrate how the industry has reacted to external and internal changes and how the government's industrial policy has changed in response to the new environment. The industry's development is also assessed from a regional perspective.

Although it is widely agreed that the developmental states have contributed greatly to the economic growth in East Asian NICs[1], some contend that the onset of

[1] See Amsden (1989), Rodrik (1996) and Wade (1990), among others.

democratization would greatly weaken the capacity of these states[2]. The emergence of Taiwan's petrochemical industry in the 1960s has been very much a product of direct state intervention[3]. This paper will also examine whether the state's capacity has weakened in Taiwan, as shown by the state's intervention in the petrochemical industry in recent years.

Many NICs have tried to set up their own petrochemical industry as part of national modernization projects. The East Asian NICs are no exception. Taiwan, like its East Asian neighbors, started its first naphtha-cracking plant quite early in its post-war industrial development, in the late 1960s. By 1984, Taiwan's state-owned China Petroleum Company (CPC) had built 4 crackers and had ethylene capacity close to one million tons per year. At that time, it ranked about 11th in the world.

By the later half of the 1980s, liberalization, globalization, deregulation, privatization and democratization all began to speed up at the same time in Taiwan and elsewhere in East Asia. In particular, Taiwan's petrochemical industry found itself dealing with changes from various fronts. They faced more competition from imports and inflow of FDI and pressure to export more. The firms also had to begin seriously considering making direct investment abroad as part of their overall development strategy. The working of the local markets also was under transformation as deregulation and democratization progressed.

This paper will explore the changes in Taiwan's petrochemical industry since the late 1980s, with implications for other East Asian NICs and emerging economies in general. Section two outlines the changes in the external and the internal conditions facing the industry in this period. The third section describes the transformation of the overall industrial structure, and examines the response of Taiwan's petrochemical

[2] For related discussions, see Johnson (1999) and Weiss and Hobson (1995).
[3] See Amsden (1985) and Y.H. Chu (1995) for the role of state in Taiwan's postwar development in

industry to the changes and the industry's position in the world and the regional market. The last section discusses the role of industrial policy and makes some concluding remarks.

2. Liberalization and deregulation since the late 1980s

Before 1986, the policy regime in Taiwan was that of an archetypal developmental state. The state intervened heavily in industrial policy. It tried its best to facilitate the exporting activities of the downstream, labor-intensive industries, by making exceptions in an otherwise protectionist trading system. At the same time, the state promoted the upstream sectors, using secondary import-substitution polices[4]. The petrochemical industry was one such industry promoted to supply locally made intermediate inputs to the textile and apparel, plastic product and other miscellaneous product sectors, which were important exporting industries in the early stage of export-led growth. The government also worked hard to preserve a stable macroeconomic environment and pegged the currency to the US dollar.

After the Plaza Accord in 1985, the American government first forced Japan to appreciate the Yen substantially, and then pressed the Asian NICs to appreciate their currencies as well. By that time, in Taiwan, thanks partly to the undervalued currency, a large pile of foreign reserve had accumulated and begun to fuel bubbles in the stock and real estate markets domestically. Thus, the government in Taiwan allowed the NT dollar to appreciate about 40% against the US dollar in 1987, and lifted various restrictions on foreign exchange and capital movement. At the same time, economic liberalization began in earnest, with tariffs being lowered and non-tariff barriers

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general, and Gold (1981) and Chu (1994, 1997) for the petrochemical industry in particular.

[4] For discussions on Taiwan's industrial policy, see Li (1988), Wade (1990) and Chu (2001).

reduced extensively[5].

The environment the petrochemical industry faced in particular also underwent significant changes. The whole apparatus for implementing the secondary import-substitution policy for promoting upstream petrochemical production was abolished. Non-tariff barriers were removed[6] and tariffs were reduced to around 2.5-5% for petrochemical products (see Table 1). Restrictions on two-way capital movement were mostly lifted[7].

The most important changes occurred in the policy area. Using the state-owned CPC, the government in the past had been the sole investor of naphtha cracking plants in Taiwan. The first cracker started production in 1968, and the fourth one in 1984. Every cracker plan was a vertically integrated project, with various private firms undertaking mid-stream production activities. The Formosa Plastics Group (FPG) has been the largest private chemical firm in Taiwan since the 1960s. FPG first requested to build its own cracker in 1973, but was turned down. In 1980, while the fourth cracker was under construction, the government announced a moratorium on further cracker projects. It was considered then that the industrial policy should shift to promote industries which pollute less and use less energy and natural resources.

After 1980, however, the political situation began to shift gradually. The private petrochemical firms, being mostly large oligopolistic enterprises and well organized, continued to put pressure on the government. They wanted and obtained lower feedstock prices from the CPC[8], and they, especially FPG, also persisted in lobbying for permission to build their own cracker project.

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[5] The average tariff rate was 30.8% in 1984, and declined to 9.8% in 1997. See CIER (1997).
[6] There were some measures to encourage downstream sectors to consider local input supply first before they were allowed to import the input from abroad. See Wade (1990) and Chu (2001).
[7] The government still prohibits the firms from investing in naphtha cracking facilities in Mainland China, due to political considerations. Outward direct investment destined anywhere else is not prohibited, and is even encouraged.
[8] It is widely believed that the CPC was forced to alter its pricing formula and provided the feedstock at

Their effort paid off, and the government ordered the CPC to build the 5th cracker and granted FPG permission to build its own in 1986. Later on, it was also decided that the oil product market, in which the CPC had been holding a monopoly, would be liberalized, and the CPC itself should be privatized.

The local environmental movement, however, began to gain momentum after martial law was lifted in 1988. As a result, the construction of the CPC's fifth cracker and the FPG's sixth were delayed for many years. The 5th cracker did not begin operations until 1994, while the 6th one was not running until 1999. Gasoline provided by the FPG's refinery hit the market in late 2000. The CPC's privatization is scheduled to take place in three stages starting from 2001.

Among the petrochemical-related sectors listed in Table 2, the "chemical materials industry" corresponds to the petrochemical industry discussed here, while all others listed there are related sectors. As shown in the Table, the share of the chemical material sector in total manufacturing value-added has increased from 5.4% in 1971 to 9.6% in 1997, while those of downstream sectors declined, including the textile sector. The share of the chemical material sector in total manufacturing value-added is much higher than its share in total export, indicating that this sector is still more domestically oriented. The dramatic decline in the share of the textile and apparel sectors manifested clearly a shift of Taiwan's industrial structure toward more capital- and technology-intensive industries.

All these patterns of changes were to be somewhat expected, for as the extent of industrialization has deepened and the wage levels have increased, Taiwan's industry has upgraded its product mix and its technology level while it continues learning advanced technology. There are, however, differences among the sub-sectors in their response to the changes in the environment. For example, as shown in Table 4, among

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subsidized prices in the 1980s. See Chu (1994).

plastic materials, the PS and ABS sub-sectors grew faster than others, increased their export ratio more, and exported an increasing share to the China market. Actually, their expansion into China has been the main component of the plastic material industry's recent growth.

The petrochemical industry's role as the upstream sector for the textile, plastic and rubber product sectors has changed. As downstream production has shifted out (mainly to Mainland China), the petrochemical industry has become direct exporters and dependent heavily upon the China market.

3. The expansion path of Taiwan's petrochemical industry since the late 1980s

3.1 Production and Trade

This subsection will survey the production and trade activities of Taiwan's petrochemical industry. The difference between the period before and after 1986 is of concern here, since major changes in the industry environment occurred around that time.

Table 3-6 lists the average annual growth rate of output, self-sufficiency ratio, and export ratio of the industry in two different periods. The industry is classified into four segments: feedstock, which comprises output of the naphtha cracker and aromatics plants; plastic materials, which include the six most common plastics; man-made fiber (MMF) materials, which cover the four major inputs for polyester, nylon and acrylic; and man-made rubber materials[9].

[9] The feedstock sector includes ethylene, propylene, butadiene and aromatics (benzene, toluene, and xylene, or BTX). Plastic materials include polyvinyl chloride (PVC), low-density polyethylene (LDPE), high-density polyethylene (HDPE), polypropylene (PP), polystyrene (PS), and acrylonitrile-butadiene-styrene resin (ABS). MMF materials include ethylene glycol (EG), acrylonitrile (AN), caprolactam (CPL), and purified terephthalic acid (PTA). Man-made rubber materials cover butadiene rubber (BR) and styrene-butadiene rubber (SBR).

Feedstock. Changes in the output level of the upstream feedstock sector mainly evidenced the changes in government policy and in the CPC's investment behavior, before the FPG's 6th cracker began operation in 1999. After 1986, the government closed the first and second crackers in response to local environmental protests, which also caused delay in the construction of the 5th cracker. Therefore, the output level of feedstock barely increased in the period after 1986. The effect of the most significant policy shift, deregulation, although starting to emerge in 1999, will not be completely felt until the FPG's huge 6th project begins / has begun full operation after 2002.

Plastic Materials[10]. Performance varies greatly among the six plastic material sub-sectors. The PE and PP sectors have to rely upon local supply of ethylene-derived inputs, which are hard to transport. Thus, due to the stagnation of local ethylene production, PE barely grew while PP growth was possible only because it got input-supply allotment in the 5th cracker project. The PE and PP sub-sectors also experienced a decline in the self-sufficiency ratio and an increase in the export ratio, indicating an increase in the degree of globalization.

The other sub-sectors were able to rely on imported inputs, and thus grew more quickly. PVC has been the major common plastic material in Taiwan ever since FPG began its operations in 1957. After 1986, PVC sub-sector has maintained stable but slower growth. The PS and ABS sub-sectors have been growing especially fast since 1986, after which 78% of PS's and 89% of ABS's current capacity was added. As shown in these tables, their growth has been mainly fueled by exports, especially those to Mainland China, with the export ratio reaching 68% for PS and 72% for ABS by 1998.

MMF[11] Materials. The four MMF material sub-sectors have also differed in their

[10] See Chu and Huang (1998) for a discussion of the development of this sub-industry.
[11] Chu and Tsai (1999) discusses the growth path of the MMF industry in Taiwan.

respective performance during this period. CPL, An, and EG all have to rely on local supply of ethylene-derived inputs, and their growth was hence constrained by the stagnation of feedstock production after 1986. In contrast to their lack of growth, the PTA sub-sector, the input for polyester, has grown more than five-fold since 1986, after which 85% of its current capacity was added[12]. At the present time, PTA's export ratio still remains low, but its next-stage product, polyester, has been growing rapidly in Taiwan by exporting to the fast-growing Chinese market, leading Taiwan's polyester capacity to rank number one in the world.

However, the speed of polyester export growth and that of PTA output expansion has been slowing down recently. The same applies to the dizzying growth of PS and ABS. After the FPG's 6th cracker's production reached full steam in 2001[13], the capacity of these common plastic and MMF materials will increase significantly and the pressure to export will intensify further.

In all, trade liberalization has helped the industry's growth by further facilitating imports (of inputs) and hence exports, just in time to participate in the China market boom. Domestic deregulation, on the other hand, has had a great influence. Changes in feedstock capacity mainly reveal the government's decision to close the two old crackers and to build the 5th one, and to allow FPG to build the 6th one, while for those sub-sectors that were not dependent upon local supply of inputs, their fast growth has mainly come from supplying to an expanding market in Mainland China.

3.2 Outward investment

[12] By 1998, PTA's capacity consisted of 84% of the MMF material sub-sector.
[13] The FPG's 6th cracker project is coming on stream step by step. Its first naphtha cracker started operation in 1999, but its downstream plastic and MMF material plants have not. Data in Table 3 includes FPG's feedstock production, but not other sub-sectors.

The local petrochemical firms in general have faced increasing difficulties in setting up new plant facilities locally after 1986. The emergence of the local environmental movement has led the government to set and enforce stricter environmental protection standards[14]. Taiwan is one of the most densely populated countries in the world, and its industrialization has intensified the competition for the usage rights of highly scarce natural resources, including land and water supply. Besides, in the midst of global concerns of climate control, reducing total emission level has become a policy target.

The petrochemical industry's reputation of being energy- and resource-intensive, and highly polluting certainly does not help the matter. There have been many petrochemical investment plans that were not granted government permission, or simply stalled. Moreover, FPG, being the largest private business group in Taiwan, utilized all its cards to get the permission to build the gigantic 6th cracker. That implies that it has crowded out many competitors, in that the amount of land, water and other resources available is extremely limited.

Under these circumstances, outward investment becomes an important avenue for successful petrochemical firms to grow. On the one hand, some firms want to invest in oil-producing countries to control the supply of raw materials. On the other hand, some invest in advanced countries so as to be close to the source of technology and the market. Growth opportunities in the China market have also attracted attention. The pattern of outward investment of Taiwanese petrochemical firms can thus be classed into these categories.

There has been no systemic data available on these firms' outward investment. This study has collected data from various sources, and the result is listed in Table 8. Instead of being a complete list, it is a minimal list; that is, the actual amount could only

[14] Environmental impact evaluation now has to be carried out on this major investment project.

be greater than this. This table only lists investment relating to the major sub-sectors discussed in this paper.

According to this compilation, in the last ten years, within these major sub-sectors, if we add up the physical capacity of these investment projects, then total outward investment amounts to 6.17 million tons per year. During the same period, these firms invested in these same categories around 6.56 million tons capacity domestically. From the available data, by 1999, the amount of outward and inward investment was roughly comparable in size. For a capital-intensive industry in an NIC, the ratio of outward investment is quite high.

Out of the total amount of outward investment, 3.7 million tons was invested in the DCs, and 0.9 million in Mainland China. A major portion of the investment in the former, however, is accounted for by the FPG's two large naphtha cracker projects in Texas. Although the investment in China only consists of around 15%, most projects in the planning stage right now are heading in that direction. The main thing holding them back is the government restriction due to political considerations.

3.3 Latecomers' Market Niche

In general, ethylene capacity is used as a way to measure and compare the size of countries' petrochemical industries[15]. Table 9 lists the distribution of the world's ethylene capacity in recent years. In 1998, North America made up 33.8%, Western Europe 22.6% and Japan 8.4%, jointly accounting for 64.8% of the world's total. However, Asia's share (excluding Japan's) has been increasing, albeit slowly.

Table 10 presents the changes in ethylene capacity in the Asian region in the last

[15] For a general discussion of the global petrochemical industry, see Spitz (1988). Data on the industry in Asia is taken from UCL (various).

ten years. The average annual growth rate for the region (excluding Japan's) reached 15% during the period. South Korea increased its petrochemical capacity about tenfold in a little more than ten years[16], as the large *chaebol* fiercely competed (amongst themselves) to expand. The Chinese petrochemical industry has been growing steadily during this period, and increased about three times. The growth rates were rather high for Thailand, Malaysia and India, but they all started from a very low base and the former two countries have relied greatly on foreign direct investment.

The pace of growth shows a slowdown of expansion in South Korea after the financial crisis. The anticipated large expansion in Southeast Asia may not be fully realized for the same reasons. The growth in Taiwan mainly manifests the completion of the FPG's 6th cracker project. The Chinese petrochemical industry, of course, is expected to continue to grow. Nonetheless, the Asian (excluding Japan) petrochemical industry as a whole is expected to grow faster than that of advanced countries, and hence increase its share in the world from 16.2% in 1998 to 19.4% in 2002.

The DCs no longer dominate the global petrochemical market completely as they used to do. The latecomers have been investing heavily in the production of low-end commodity chemicals in the last few decades. Thus, the DC firms are not increasing their production in this segment of the market; instead they focus more on high-end specialty chemicals. However, any serious R&D is still mostly done inside the DC firms. The latecomer chemical firms concentrate on learning purchased technology and improving processing efficiency, and are not spending much on formal R&D[17].

The competitive advantage of chemical firms in Taiwan thus lies in processing efficiency and scale economies in operation. To achieve that, they do specialize to a

[16] Its annual ethylene capacity was 505 thousand tons between 1984 to 1989 and reached 4920 thousand tons in 1999.
[17] The ratio of R&D expenditures as a percentage of sales is only 0.65% for the chemical material sector in Taiwan in 1998, which is lower than the manufacturing industry average of 1.37%. See National Science Council (1999: 48).

great extent. For example, Taiwan's ethylene capacity accounts for only 1% of global capacity and ranks number 15 in the world. However, Taiwan's polyester and nylon output levels now rank number one and two in the world respectively. Among Taiwan's common plastics, ABS capacity is about a quarter of the global total; and Chi-Mei, the leading ABS firm, is also the world's top-ranked ABS producer in terms of quantity. FPG has PVC production facilities abroad and domestically; together they account for about 10% of global output, and render FPG the world's largest PVC maker.

Among the first-tier Asian NICs, South Korea certainly has been the heaviest investor in this industry. The Korean chemical firms, although still going through painful adjustment after reckless expansion and the subsequent financial crisis, now are more or less stabilized and remain strong competitors. Singapore has been a successful case of industrial upgrading. It not only has maintained stable growth in the past, but also managed to attract new foreign investment which includes more sophisticated operations to be completed in the next two years[18].

Development in the second-tier NICs, such as Thailand, Malaysia and Indonesia, has been more varied and of a more uncertain future. Their manufacturing growth in the last two decades has been very much dependent upon foreign firms, and they do not have a strong developmental state to carefully guide the course of development. Most of the planned expansion in this industry has been put on hold after the crisis, and probably will not resume until real recovery materializes.

The Chinese market has been growing rapidly in the past two decades. At the moment, the demand from the fast-growing downstream industries has far outstripped local supply. Thus, imports of commodity chemicals have been increasing rapidly, and fueled the growth in Taiwan and other NICs. As China has been gradually adding capacity of its own, the import needs may be lessened in the future. As a result,

chemical firms in Taiwan, whose further domestic expansion is restricted by the government, are eager to make more direct investment in Mainland China.

In sum, the DCs are conceding the low-end chemicals to the latecomers. Taiwan, a prime latecomer, has developed its petrochemical industry by using secondary import-substitution policy and other complementary industrial policies. The industry grew by supplying to downstream export sectors and increasingly to the Mainland Chinese market. Its competitive strength lies in its own operating efficiency and its access to the local and regional markets. Emphasis on quantity expansion still predominates.

4. Has Industrial Policy Become Dysfunctional?

Have liberalization and globalization led to the demise of the developmental state and made industrial policy dysfunctional since the late 1980s in Taiwan? We can now evaluate this hypothesis using the evidence presented above from Taiwan's petrochemical industry in the last two decades.

Taiwan's government had used industrial policy to mainly promote growth industries. The policy tools used include state-owned enterprises and trade protection for basic industries in the earlier stage, and R&D subsidies, science parks, and tax benefits for high-tech industries in the later stage of development[19]. By the 1980s, Taiwan had built up basic industries, though still not at the world frontier. In such a latecomer country then, was industrial policy still relevant for a mature industry like the petrochemicals? We would argue from the evidence here that government policy still matters a great deal. That is, the way it deregulates, changes incentives and allocates

[18] Exxon is building a new facility there to be completed by 2003. See UCL (various).
[19] See Amsden and Chu (forthcoming).

scarce resources will greatly affect the industry's further development.

The Taiwanese government's petrochemical industry policy has been in two different modes before and after 1980. The policy regime before 1980 was more developmental and interventionist. Within this mode, there was a change of strategy in the late 1970s, however. The government used state-owned enterprises to directly promote the petrochemical industry starting in the 1960s, but decided to restrict further development of the industry in the late 1970s. The government then still had an overall development plan, which listed sunrise industries to be promoted and sunset industries not to be promoted. And the status of petrochemicals changed from a sunrise to a sunset one in the late 1970s.

In 1980, Premier Sun Yun-hsuan canceled the CPC's 5th cracker project and turned down FPG's request to build its own cracker for the second time, making it clear that the development of this industry should be restricted[20]. The rationale came from the new strategic development plan prepared by the government-planning agency.[21] Following Japan's example, after having established basic industries, the new economic plan stressed the need to promote industries which are less polluting, with low energy- and resource-usage and high technology intensity. The petrochemicals obviously do not meet these criteria.

This is an archetypical developmental state model of policy making, with the state directly intervening in the industrial development strategy. Although the Taiwan state had been following this model from the early stages of the postwar era, this turn of events around 1980 turned out to be the last of its kind in the case of the basic industries. After Premier Sun stepped down in 1982, this old policy regime of strong intervention gradually unraveled in mature industries. The state continued to promote growth

[20] See Chu (1994, 1997) and Yang (1989).
[21] Council for Economic Planning and Development (CEPD), 1980.

industries, especially high-tech, but the policy tools used differed, relying more upon R&D subsidies, science parks, and spin-offs from government laboratories[22].

The second model, beginning after Premier Sun's departure, evolved steadily toward liberalization, deregulation, and privatization. The political old guards with strong political will and intervention tendency gradually left the stage. Democratization, growth of private interests, intense American pressure to liberalize, and the newly emerged free market orthodoxy all had their influences.

What was the guiding principle under the second model? Can the free market doctrine offer a complete solution to all policy concerns? The answer seems to be 'no'. Other, especially developmental, concerns often had to enter into policy considerations, besides the so-called neutral market-rule settings.

As for deregulation, besides the need to set up a "fair" competitive environment for all entrants, old and new, the way to deregulate inevitably involved issues such as how to allow in foreign competition with little crowding-out effects, how to maintain market competitiveness in the long term, and how to privatize so as to mitigate the social and economic impact of privatization. Different approaches to deregulation would have varying growth effects and social implications.

Moreover, discretionary allocation of scarce resources by the state unavoidably was entailed. For example, FPG obtained the right to build its own harbor for the 6th cracker project and became the envy of all others. Probably due mostly to geopolitical considerations, FPG was able to play the China card and obtain various subsidies and benefits for building the cracker plant in Taiwan, rather than in Mainland China. Besides the exclusive harbor privilege, the FPG also got rights to scarce coastal land, public land, pollution emission, guaranteed water supply at subsidized rates, and state-guaranteed loans. The fact that outward investment had been encouraged and

[22] See Amsden and Chu (forthcoming).

assisted by the state, as long as it was not directed toward Mainland China, shows that geopolitical considerations, not political influences by the private interests, dominated the state's concerns[23].

As resources are limited, and as the state originally holds the political power to decide the allocation of these resources, there are no so-called neutral ways to allocate them. Any attempt to set up rules to allocate them involves value judgments and policy choices and has its implications regarding growth, competition and distribution.

By switching from the first to the second model, the state certainly had become less directly interventionist. Addressing the question as to whether globalization and democratization would inevitably make industrial policy dysfunctional, however, the answer is 'no'. Even in the second model, the Taiwan state still retained various policy tools to influence the growth path and competition level of the industry. Although the actual policies adopted indicated that geopolitical concerns, rather than other growth-related concerns, dominated the state's policy thinking, this does not contradict the argument made here that the state still retained power to practice industrial policy if it chose to do so. Can we treat the influence of Mainland China as one sign of globalization? It may be so, but the state in Taiwan had been encouraging outward investment elsewhere, indicating outward FDI by itself was not a particular concern, while relations with China were.

5. Conclusion

What has been the impact of liberalization on Taiwan's petrochemical industry since the late 1980s? It is found that external liberalization did facilitate trade. In some plastics sub-sectors, of which inputs can be easily imported, export volume grew

[23] See Y.H. Chu (1995).

quickly and export ratio more than doubled. This, however, coincided with the boom in the Mainland Chinese market starting in the late 1980s. Accumulated capabilities enabled Taiwan's petrochemical industry to benefit from the boom.

The impact of internal liberalization, which took the form of deregulation and privatization, had been more significant. The government had given up the policy regime of direct intervention in mature industries, like petrochemicals. A private firm, FPG, got a permit to build its own cracking project in 1986, and other follower firms also had other projects in the plan. At the same time, ironically, local protests have made it increasingly difficult to build new chemical facilities. The government also has to take into account other policy objectives, such as the need to cap total CO_2 emission levels, to lessen the burden on the environment, and to promote industrial upgrading. The state maintained the developmental tendency in terms of promoting growth industries, but switched to the deregulation mode when dealing with mature industries. Due to geopolitical considerations and domestic political factors, however, the deregulation process has been problematic.

Have globalization and democratization led to the demise of the developmental state and made industrial policy dysfunctional since the late 1980s in Taiwan? Using the petrochemical industry as an example, we find that the policy mode switched from a strongly interventionist developmental one, to one which was much less so in the 1980s. The direct causes of the change are hard to ascertain, for various forces were operating at the same time, including economic maturation, democratization, US pressure to liberalize, and the rising influence of the free-market doctrine.

Even in the new policy mode of deregulation, it was shown that there was room for discretionary decisions regarding methods of deregulation and ways to allocate scarce resources. The relative autonomy of the state was not eliminated by globalization and democratization. When examining how the government exercised its discretion,

ironically, we find that geopolitical concerns dominated the state's concerns. Nevertheless, we do not find support for the hypothesis that globalization and democratization eliminate the relative autonomy of latecomer developmental states.

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Table 1 Taiwan's Tariff Rates for Key Petrochemicals

	Tariff Rates %											
	1973	1985		1987		1988		1989		1993		1998	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Petrochemicals													
Ethylene	20	15	10	0	0	0	0	0	0	0	0	0	0
Propylene	20	15	15	0	0	0	0	0	0	0	0	0	0
Butadiene	20	15	15	0	0	0	0	2.5	0	0	0	0	0
Benzene	26	20	15	20	15	20	15	7.5	5	7.5	5	7.5	5
OX	26	20	15	20	15	20	15	7.5	5	7.5	5	7.5	2.5
PX	26	20	15	20	15	20	15	7.5	5	7.5	5	7.5	2.5
PVC	33	30	25	10	7	10	5	5	2.5	5	2.5	5	2.5
LDPE	33	30	25	10	7	10	5	5	2.5	5	2.5	5	2.5
(HDPE	33	30	25	10	7	10	5	5	2.5	5	2.5	5	2.5
PP	33	30	25	10	7	10	3.5	5	2.5	5	2.5	5	2.5
PS	33	30	25	10	7	10	5	5	2.5	5	2.5	5	2.5
ABS	33	30	25	10	7	10	5	5	2.5	5	2.5	5	2.5
AN	26	25	25	2.5	1.25	2.5	1.25	2.5	1	2.5	1	2.5	1
EG	20	25	25	2.5	1.25	2.5	1.25	2.5	1	2.5	1	2.5	1
CPL	26	25	25	2.5	1.25	2.5	1.25	2.5	1	2.5	1	2.5	1
PTA	26	25	20	2.5	1.25	2.5	1.25	2.5	1	2.5	1	2.5	1

Note: The second column tariff rates apply to countires with most favored nation status, while the first column rates apply to the rest.

Source: 1) R.O.C. Customs Office, Tariff Schedules, various years.
2) Petrochemical Industry Association of Taiwan, Petrochemical Industry of Taiwan, R.O.C., various years.

Table 2 Shares of Chemical-related sectors in Manufacturing Value-added, 1971-97

Unit: %

	Textile	Apparels	Chemical materials	Chemical products	Petroleum refinery	Man-made rubbers	Plastic products
1971	20.09	2.76	5.43	3.32	5.35	1.73	7.69
1975	21.51	2.00	6.84	2.36	4.91	1.31	7.40
1980	14.28	2.57	6.16	2.71	7.99	1.94	6.43
1985	11.31	3.81	6.70	2.06	5.32	1.56	8.24
1990	8.58	2.14	6.98	2.45	4.80	1.58	7.78
1995	6.94	0.96	9.49	2.83	5.46	1.21	5.28
1997	6.41	0.88	9.61	2.91	5.59	1.09	5.12

Source: MOEA Statistics Dept., Industiral Production Statistics Monthly, Taiwan Area, various issues.

Table 3 Production and Trade Statistics- Basic Feedstocks

Unit: million tons, %

	Production	Import	Export	Self sufficiency ratio (%)	Export ratio (%)
1969	62	-	-	100.0	-
1975	193	-	6.8	100.0	3.5
1980	1,094	93	25.6	92.0	2.3
1985	1,995	232	-	89.6	-
1990	1,766	833	0.2	68.0	-
1995	2,529	1,744	68.6	58.5	2.7
1998	2,499	2,369	3.2	51.3	0.1
Average annual growth rates					
1969~1986	26.0			96.0	1.6
1987~1998	2.2			63.1	0.6
1969-1998	16.1			82.9	1.2

Note: Basic feedstocks include ethylene, propylene, butadiene, benzene, toluene, xylenes.

Source: Calculated from data taken from Petrochemical Industry Association of Taiwan, *Petrochemical Industry of Taiwan, R.O.C.* , various years.

Table 4 Production and Trade Statistics- Plastic materials

unit: million tons, %

	Production	Import	Export	Self sufficiency ratio (%)	Export ratio (%)
1969	107	49	20	63.8	19.0
1975	264	67	43	76.6	16.1
1980	773	95	86	87.8	11.1
1985	1,368	74	135	94.3	9.9
1990	2,179	417	464	80.4	21.3
1995	3,249	701	1,303	72.9	40.1
1998	3,764	869	1,670	70.7	44.4
Average annual growth rates (%)					
1969~1986	19.3			83.2	11.1
1987~1998	6.9			76.1	29.3
1969-98	14.3			80.5	18.1

Note: Plastic materials here include LDPE, HDPE, PVC, PP, PS, ABS.

Source: same as Table 3.

Table 5 Production and Trade Statistics- Man-made Fiber Materials

unit: million tons, %

	Production	Import	Export	Self sufficiency ratio (%)	Export ratio (%)
1969	-	21	-	-	-
1975	-	218	-	-	-
1980	479	159	30	73.8	6.2
1985	938	358	8	72.2	0.8
1990	1,200	1,039	15	53.3	1.2
1995	2,597	1,419	276	62.1	10.6
1998	2,928	1,571	91	64.4	3.1
Average annual growth rates (%)					
1969~1986	37.8			33.5	3.2
1987~1998	9.9			57.7	4.3
1969-98	22.6			42.9	3.7

Note: Man-made fiber materials here include: CPL, EG, AN, PTA.

Source: Same as Table 3.

Table 6 Production and Trade Statistics- Man-made Rubber Materials

unit: million tons, %

	Production	Import	Export	Self sufficiency ratio (%)	Export ratio (%)
1969	-	8	-	-	-
1975	-	13	-	-	-
1980	73	17	30	71.8	40.7
1985	85	7	39	87.1	45.7
1990	92	25	40	67.6	43.5
1995	146	35	75	67.1	50.9
1998	163	35	102	63.3	62.6
Average annual growth rates (%)					
1969~1986	22.0			41.5	44.4
1987~1998	4.4			64.8	51.7
1969-98	11.9			50.8	48.4

Note: Man-made rubber materials here include: SBR, BR.

Source: Same as Table 3.

Table 7 Changes in Annual Production Capacity of Key Petrochemicals

Feedstocks

	Ethylen	Propylen	Butadien	BTX	Total
Changes in annual capacity, unit: tousand tons/year					
1968 86	953	437	130	1,164	2,684
1987 99	512	413	115	-67	974
1968-99	1,465	850	245	1,097	3,658
Distribution of capacity changes, %					
1968 86	65	51	53	106	73
1987 99	35	49	47	-6	27
1968-99	100	100	100	100	100

Plastic Materials

	LDPE	HDPE	PVC	PP	PS	ABS	Total
Changes in annual capacity, unit: tousand tons/year							
1957~1986	240	200	808	220	223	155	1,846
1987~1999	-	-20	385	275	803	1,245	2,688
1969-99	240	180	1,193	495	1,026	1,400	4,534
Distribution of capacity changes, %							
1957~1986	100	111	68	44	22	11	41
1987~1999	-	-11	32	56	78	89	59
1969-99	100	100	100	100	100	100	100

Man-made Fiber Materials

	CPL	AN	PTA	EG	Total
Changes in annual capacity, unit: tousand tons/year					
1975~1986	100	132	470	250	952
1987~1999	22	54	2670	30	2776
1975-99	122	186	3140	280	3728
Distribution of capacity changes, %					
1975~1986	82	71	15	89	26
1987~1999	18	29	85	11	74
1975-99	100	100	100	100	100

Note: Same as in Tables 3-6.

Source: Same as in Table 3.

Table 8 Outward Investment by Taiwan's Petrochemical firms

Company	Country	Year	Items	Capacity/tons per year
Tuntex	Thailand	1995	PTA	42
	Mainland China		PTA	28
	Thailand*	postponed	naphtha cracking	
Formosa Plastics	USA*	1981*	EDC/VCM*	
	USA*	1983*	EDC/VCM*	
	USA*	1991*	EDC/VCM*	
	USA	1993	naphtha cracking	136
	USA	2000	naphtha cracking	90
Grand Pacific	Thailand	1992	ABS	2
	Mainland China	1996	ABS, PS	6
	Thailand	1999	SM	20
	Indonesia*	1999*	SM*	
Taiwan Synthetic Rubber	Mainland China	1998	SBR	10
	Thailand	postponed	BR	12
	Malaysia	1999	BR	10
l	Mainland China	1999	PP	
	Saudi	1999	PP	
Gulf Taiwan	USA*	1984*	PE*	
	USA*	1991*	Ethylene	
	USA	1991	naphtha cracking	52
	Malaysia	1992	naphtha cracking	23
	Mainland China	1999	PVC, PA, PS	20
Chi Mei	USA	1992	ABS	30
	Thailand/Singapore	postponed	ABS*	
	Mainland China	1998	PS	30
	USA	1998*	SM*	
	Singapore*	1998*	SM*	
China American	Singapore	1997	PX	44
Oriental	Canada	1994	EG	30
	Indonesia*	postponed	EG*	
Far Eastern	Canada	1998	EG	32
Taita	USA*	1991*	SM*	
			Total	617

Source: same as in Table 3; United Daily News, various years, *IDB, various years.

Table 9 Global Ethylene Capacity

unit: million tons, %

	1997		1998	
	Annual Capacity	%	Annual Capacity	%
USA	24.4	28.1	25.7	28.3
Canada	3.3	3.8	3.6	4.0
Mexico	1.4	1.6	1.4	1.5
N.America total	29.1	33.5	30.7	33.8
Brazil	2.4	2.8	2.4	2.6
Other S. Am.	1.0	1.2	1.0	1.1
C&S America total	3.4	3.9	3.4	3.7
W. Europe	20.2	23.2	20.5	22.6
E. Europe	6.3	7.2	6.3	6.9
Europe total	26.5	30.5	26.8	29.5
Japan	7.6	8.7	7.6	8.4
S. Korea	4.5	5.2	4.9	5.4
Taiwan	1.0	1.2	1.0	1.1
China Mainland	3.9	4.5	4.3	4.7
S-East Asia	2.8	3.2	3.2	3.5
India	1.2	1.4	1.4	1.5
Aisa total	21.0	24.2	22.4	24.6
Mid East	5.1	5.9	5.8	6.4
Africa	1.3	1.5	1.3	1.4
Oceania	0.5	0.6	0.5	0.6
Total	86.9	100	90.9	100

Source: Union Chemical Laboratories, ITRI, 1999,
1999 Annual Report on the Petrochemical Industry of Taiwan, ROC, ITRI, Hsin-chu.

Table 10 Capacity Changes in Asia Region, 1990-99

Unit: thousand tons, %

Year / Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	1990-99 Avg. growth rate
Japan	5,927	6,040	6,595	6,868	7,639	7,639	7,639	7,639	7,639	7,639	2.9
S. Korea	1,155	2,305	2,905	3,505	3,570	3,570	3,950	4,290	4,690	4,920	20.2
Taiwan	953	845	845	845	1,015	1,015	1,050	1,050	1,465	1,465	5.8
Mainland China	1,650	1,820	2,095	2,095	2,348	2,738	3,718	4,168	4,168	4,363	11.9
Singapore	400	400	400	422	422	422	422	937	965	990	14.8
Thailand	315	315	315	315	315	728	728	1,268	1,268	1,701	26.6
Malaysia	-	-	-	-	230	550	550	550	630	960	41.2
Indonesia	-	-	-	-	550	550	550	550	550	550	0.0
India	243	525	525	525	525	525	525	1,275	1,375	1,424	30.0
Total (Japan excluded)	4,716	5,895	7,085	7,707	8,975	10,098	11,498	14,088	15,111	16,373	15.0

Source: Same as in Table 9, p. 4-9.