Economic Liberalization and Development
—The Case of Lifting Martial Law in Taiwan

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I. Introduction

The lifting of martial law in 1987 was hailed as a great transition of Taiwanese politics and society. While some limitations still exist in continuing Nationalist Party (KMT) dominance of the central government and the government news media, as well as the slow pace of privatization of public enterprises, the political transformation was swift and peaceful. However,

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its impact on the Taiwanese economy, which has been liberalizing gradually and consistently since the mid-1960s, are not clear and still not properly examined. This paper examines the indexes of civil liberties, political rights, and economic freedom to investigate the impact of democratization and liberalization on the Taiwanese economy.

To our knowledge, no study has addressed these economic questions empirically or theoretically, either for Taiwan or for developing countries in general, using time series analysis. Empirically, it is difficult to study economic transition over time, since long-run economic statistics of reasonable quality are not available in most developing countries. Fortunately, Taiwan has been blessed with rich economic and industrial statistics, which enable us to apply the advanced econometric methods on complicated economic analysis.

In Sections II, we trace the origin of the authoritarian regime in Taiwan from the prewar period, and relate how it was continued after the World War II. We then show in Section III how Taiwan’s liberalization was first prompted by the foreign influences in the early 1960s, and then continued to the following three decades through export promotion policy. We reason that as the economy developed and the language problem eased, the younger generalization of Taiwanese, who were educated under the Chinese system, started socially and politically assertive. Diplomatic setbacks and external events finally led to the lifting of martial law in 1987. Section IV presents external and internal factors which accelerated democratization and liberalization after 1987.

Section V defines three kinds of freedom, which are measured quantitatively by some world watch organizations, and confirm the progress of freedom in Taiwan since the mid-1977. Section VI examines some of the previous studies on the impact of liberalization on economic performance and structural changes.

To investigate the impact of the lifting of martial law on economic activities using time series analysis in Sections VII and VIII, we have chosen six important and popular economic series: Real GDP, real GDP per worker, real money supply, real government expenditures, inward direct foreign investment, and outward investment. Since time series regression analysis requires stationarity of the series, we first test these series for the stationarity with structural changes in Section VII. We assume that the lifting of martial law in 1987 is a big bang of liberalization and test statistically whether it has significant influences on the Taiwanese economy. Thus, in section VIII, we examine the statistical significance of one time change in
1987 and structural changes in the constant term and slope of these time series before and after 1987.

As shown in the first several sections, the Taiwanese economy has been opening up continuously since mid-1960s, the post-martial law era may be considered as a gradual transition of the Taiwanese economy instead of a discrete big bang break. Hence, we also examine in Section IX the possibility of smooth transition of these six series, using nonlinear smooth transition model of logistic functions. Some concluding remarks are in the last section.

II. The Origin of the Authoritarian Regime in Taiwan

Modern Taiwanese economic development started after Taiwan was ceded from China to Japan in 1895. For fifty-one years until the end of the World War II in 1945, Japan developed Taiwan from a feudalistic pre-modern economy into a modern capitalist society. Guided by Taiwan’s comparative advantage in the Japanese prewar empire, Japanese capitalists invested heavily in developing Taiwanese agriculture (Hsiao, 1997). For six agricultural products (Bananas, canned pineapples, sugar, sweet potatoes, rice, peanuts) Taiwan ranked within the ten largest producers in the world by the end of the 1930s (ibid., 507). After the outbreak of the Manchurian Incident in 1931, Taiwan’s industrialization started in earnest. A major hydraulic power plant was completed in 1934, triggered the development of industry of aluminum, shipping, pulp, fertilizer, oil and fat, and others (Hsiao and Hsiao, 1996, 119-121). Before the World War II, the Taiwanese economy completed the phase of primary-export-led growth, and the industry was already in the stage of import substitution, during which economic policy of self-sufficiency was adopted. Basic social and economic infrastructure, like modern transportation, communication, schools for all levels, irrigation and flood control, and electric power generating facilities were already in place at the end of the war (Ho, 1978; Lin, 1973). According to Maddison’s data (1995), by the early 1940s, real GDP per capita of Taiwan, along with Korea, was higher than all the Asian countries, except Japan\(^1\) (Hsiao and Hsiao, 1999a, Figure 1).

\(^1\) In a report to the United States Congress, Conlon Associates (1959, p. 139) wrote that “Taiwan did not enter the post war era without advantages. Progress under Japan had been extensive. Prior to World War II, the Taiwanese had a standard of living second only to that of Japan itself in Asian. The people had acquired many industrial and agrarian skills. The years immediately after 1945, however, were years of chaos….”
As the Sino-Japanese War erupted in 1937, Taiwan entered into the period of wartime-controlled economy and society. Japan’s declaration of war against the Allied Forces in 1940 caused the total mobilization of national resources and complete control of the Taiwanese economic and social activities (Lin, 1996). When the war ended in 1945, the Nationalist Chinese took over Taiwan and confiscated major Japanese industries and reorganized them as government and KMT Party enterprises. Taiwanese economy was mostly in ruin due to allied air raids, and inflation was rampant. The Nationalist Government was defeated in the Civil War in China and reestablished itself on Taiwan in 1949. Martial law was declared in that year, and Wartime Temporary Provisions was declared and the Constitution was suspended. Under these conditions, the government perpetuated the strictly controlled economy of the Japanese wartime period (Twu, 1975, 499) under the pretence of “recovering the Chinese mainland.” It continued and exploited Japanese colonial laws and institutional arrangements, while additional control measures were introduced. The government had huge deficit spending for defense and refugees and the future was bleak. The outbreak of Korean War in 1950 and the beginning of the Containment Age, however, prompted the resumption of U.S. aid to Taiwan. It stabilized the economy and protected Taiwan from falling to Chinese communists.


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2 See Chen (1996) and Huang (1996). Cheng and Haggard (1992, 3) aptly observed, “Taiwan’s decolonization took the form of a wholesale transfer of power and resources from a defeated Japan to a soon-to-be-defeated KMT. … the new political order in Taiwan in the immediate postwar period resembled in many ways a colonial one. An outside power, the KMT, established political control over the domestic politics of a subject people largely excluded from political representation.”

3 “From June 1951 to June 1965, $1,465 million of economic aid was earmarked for Taiwan, averaging about $100 million a year, … or about 6 percent of the Taiwanese GNP during this period … ” (Hsiao and Hsiao, 1996, 229-30, 233-34). During that period, “Taiwan remains heavily dependent upon American aid. … (It) helped to produce substantial improvements in the Taiwan economy as in its military defenses. … On a per capita basis, few countries in the world have received so much American aid.” (Conlon Associates, 1959, 139).
In the 1950s, the KMT government control of Taiwanese economy and politics was omnipresent and omnipotent. In production, it even monopolized daily items like liquor, beer, tobacco, sugar, salt, and about 90 percent of petroleum and its products. It had a majority of shares in the production of food, chemicals and chemical products, metal and metal products, and others, which included from bagasse board to shipbuilding. In the distribution and financial sectors, the government monopolized railroads, all the communication facilities, commercial and development banks, and external trade (ibid., 236, 256). The government monopoly of the economy also reflected in the government revenues and expenditures. In the 1950s and long afterward, government revenues relied mostly on indirect taxes and monopoly. Almost 80% of the central government expenditures, or 65% of central and local government expenditures, were on the defense and general administration (ibid., 233).

During 1950s, however, some new infrastructures for future development were laid. Massive U.S. economic and military aid was infused into the country, especially in the electric power industry and agricultural development (Hsiao and Hsiao, 1996, 233-234), the Seventh Fleet kept peace and stability in Taiwan area, land reform was implemented in 1949 and almost completed in 1953 (Hsiao and Hsiao, 1996, 224-226), inflation was practically subsided (ibid., 245), the first four-year economic plan was launched in 1953 (Li and Yeh, 1982). Thus, by 1959, the U.S. Agency of International Development (AID) “projected ‘an accelerated economic development program’ for Taiwan, based upon a belief that the conditions of rapid progress already were in existence and that a stronger effort should be made by the Chinese government to create in Taiwan a ‘showcase’ of the achievement possible by a free economy” (Jacoby, 1966, 134). The director of the U.S. AID Mission then proposed an 8-Point Program of reform. It included “noninflationary fiscal and monetary policies, tax reform, unification of foreign exchange rates, liberalized exchange controls, establishment of utility commission and of investment banking machinery, and also the sale of government enterprises to private owners” (ibid., 134).

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4 The monopoly of government and KMT Party enterprises in Taiwan has continued well into the 1990s, despite the intermittent talks of privatization. See Chen, et al. (1991); Chou (1992), Chu (1992). Also see reports by Underwood (1997) and feature articles on “Slicing up the Taiwan Pie,” “In-depth Look at the Newly Liberalized Telecommunications, Power, Petroleum and Banking Industries,” in Topics, The American Chamber of Commerce in Taipei, 28(2), March 1998.
After “discussing” with the KMT government, and using U.S. aid as leverage, the proposal was elaborated into the 19-Point Program of Economic and Financial Reform early in 1960 (ibid., 134-135). “It added actions to encourage saving and private investment, fully utilize government production facilities, remove subsidies, raise public utility rates, liberate trade regulations and hold the military expenditures to the real 1960 level” (ibid., 135). The Program was subsequently adopted by the KMT government in its Third Four-Year Economic Plan, 1961-1964, and a Statute for Encouragement of Investment was enacted in that year to execute the Program.\(^5\) Thus, the twenty-five year long wartime strictly controlled economy in Taiwan since 1937 finally began to change in the 1960s. The Statute was originally intended for 10 years. It was extended two more decades, and finally was substituted by the Statute of Industrial Upgrading in 1990.

**III. Continuous Liberalization and Democratization**

The economic and financial reform programs paved the way for export expansion,\(^6\) which has continued until today. However, economic liberalization proceeded only gradually.\(^7\) Export processing zones was started in 1966. In the 1970s, import controls were relaxed in 1970, the bond market was established and rice-fertilizer barter program was discontinued in 1974, and floating exchange rate system was introduced in 1978. In the 1980s, trade mark and patent laws were amended in 1982, tariffs and import controls were further reduced and capital market was liberalized in 1983. Reform had accelerated in the mid-1980s, bank interest rates were deregulated and the labor standard law was published in 1985, value-added tax, which is fairer than tariffs, was implemented in 1986.

In general, the wartime authoritarian controlled economy and the government policy priority of “recovering the mainland,” rather than promoting local economic and social

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\(^5\) Hsu (1997, 55-57). The Statute was revised more than ten times during the three decades, and expanded from 35 to 80 items. The major contents consisted of tax reduction, procurement of industrial land, and coordinated development of public enterprises (ibid., 57). The statute’s effectiveness of encouraging investment was mixed (ibid., 88).

\(^6\) Elsewhere we have pointed out that the advance to export expansion policy was not so much due to small domestic market nor shortage of natural resources, as not all smaller countries adopt export expansion policy (WDR, 1987, Hsiao and Hsiao, 1996, 256).

\(^7\) The following chronology from 1952 to 1995 is based on Li (1988, Appendix). For the summary table of financial reform before 1997, see Hsu and Yang (1997, 168).
development kept Taiwan’s industrial sector from recovering fully to the prewar peak of the Japanese period until the end of the 1950s. When it recovered, however, the possibility of “an accelerated economic development” for Taiwan was envisaged, and economic reform was brought about by external influences. Rapid economic growth then ensued. The reform began with consolidating the multiple exchange rates into a single rate, and subsequent reform programs have been catered to the purpose of promoting exports. The success of export promotion policy is due to the fact that, among other factors, Taiwanese economic development was parallel to the growth of Japanese multinational corporations, and the subsequent formation of the Pacific trade triangle among Japan, Taiwan, and the United States.

Along with the progress of economic liberalization came the political reform. In the 1950s, the Chinese who replaced the Japanese in the government did not speak Taiwanese, and the Taiwanese became the silent majority. The terror of the 228 Incident of 1947 further silenced and alienated most of the Taiwanese. However, the language problem eased gradually after the next generation of Taiwanese, who were educated under the Chinese system, started being socially and politically active in the mid-1970s (Hsiao and Hsiao, 1996, 223, 252-253). They were middle class intellectuals who were exposed to the Western democracy and society (Cheng and Haggard, 1992, 10-11). They started questioning the legitimacy of the authoritarian regime and formed political opposition groups. External events also played a decisive factor in spurring political reform. Taiwan was expelled from the United Nations in 1971, Japan and the

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8 Jacoby, 1966, 137, 144, 169, 221, 223. In evaluating the “extent of leadership commitment to economic development” among 74 developing countries in the period of 1957-1962, Adelman and Morris (1967) placed Taiwan only at 55 percentile, slightly better than average. Their evaluation of Taiwan’s economic indicators (18 variables) is generally higher than that of political system indicators (7 variables) during that period. (Hsiao and Hsiao, 1998b).

9 Hsiao and Hsiao, 1998a, 98. Using DYIMIC (Dynamic Multiple Indicators and Multiple Causes) econometric model, Hsu (1997, 82) reported that the degree of industrialization in the postwar Taiwan exceeded the Japanese period only after 1966. Taiwanese standard of living did not recover to the prewar peak until the mid-1960s (Hsiao and Hsiao, 1998a; Wu, 1991).

10 Hsiao and Hsiao (1996, 258). The importance of external factors in Taiwan’s economic and political transition was also emphasized in Shiau (1994).


12 An anthropological study of a small village, Liu Ts’o, in the middle Taiwan, indicates that from 1945 to 1970, only two small factories appeared. However, dramatic changes occurred after 1970, approximately 20 small-scale
United Kingdom severed diplomatic ties with Taiwan in 1972, and the United States followed suit in 1979. After winning several local elections, the opposition and the ruling party confronted in the Kaohsiung incident in December 1979. The subsequent struggle of the opposition and concession of the ruling party led to the formation of the Democratic Progressive Party (DPP) in 1986, the first new political party in postwar Taiwan. The big bang event of lifting the 38-year martial law ensued in July 1987. An observer of the event wrote that “the changes have been sudden… as 20 years of reform occurring in 12 months.”

IV. Post-1987 Reform

After 1987, the pace of both political democratization and economic liberalization accelerated. In 1991, the “Temporary Provisions” was abolished and the “Period of National Mobilization for Suppression of the Communist Rebellion” was terminated, ending the 42-year long state of war with the Chinese communist government. In 1994, the governor of Taiwan and the mayors of Taipei and Kaohsiung were directly elected by popular votes, instead of being appointed by the “Central Government.” Finally, the president and the vice president of Taiwan were elected directly by the Taiwanese people for a four-year term in 1996. In 1997, the newly elected National Assembly voted to reduce the power of the “provincial government” of Taiwan, a step considered to be eliminating the fiction of Taiwan being a province of China.

Similar pace of reform occurred in economic front. Externally, the change of global trade policy environment accelerated the process of economic liberalization in Taiwan. To curb the persistent trade deficits of the United States and trade surpluses of Japan, Germany, and to a lesser degree, Taiwan and South Korea, the Plaza Agreement of G5 in 1985 allowed an orderly factories had emerged (Hu, 1983, 391-392; Hsiao and Hsiao, 1999b). We submit that the change is attributable to the rise of Chinese speaking Taiwanese youths (Hsiao and Hsiao, 1999b).

13 King (1988, 234). King wrote further that “Observers generally credit President Chiang Ching-kuo…. as the architect of the reform. But… the growing influence of pragmatic foreign-educated bureaucrats within the ruling Nationalist Party, or KMT, had at least nominal influence on the process.”

14 The following two paragraphs are based on Facts on File, Far Eastern Economic Review, and Asia and Pacific Review, various years.

15 The speed of liberalization and democratization after 1987 seems outpaced many Taiwan observers. In the early 1990s, after studying “liberalization, democratization, and the role of the KMT”, Meany (1992, 115-116) listed 11 counterindicators of liberalization or democratization in Taiwan. She expected that “Comparing the situation in Taiwan to the regimes studied in the literature on transitions, the potential for a halfway house of liberalization without full democratization appears high.”
devaluation of the U.S. dollar, and urged the accessibility of the market of the developing countries. In 1988, the U.S. Congress passed the Omnibus Trade and Competitiveness Act to require the U.S. government to make investigation on foreign trade barriers of the U.S. exports, and to negotiate with, even retaliate, the offenders by provoking Super 301 provision. In 1989, Taiwan was dropped from the offender’s list by her agreeing to appreciate its currency sharply against the dollar, and proposed to cut tariffs on “4,800 agricultural, consumer and industrial products to open Taiwan’s market wider to foreign traders.”

Realizing the significant change in international trading environment and relieving of foreign exchange constraint, in July 1987, the Taiwan government eased foreign exchange controls, which had lasted 38 years. No limits on outward investment up to US$ 5 million and no limits on the amount of imports payment. Tariffs were cut on some 2,500 products. In 1988, import tariffs were reduced on the average of 50% for 3,500 items, including automobiles, color television sets, and videocassette recorders. A new banking law was promulgated in 1989. Commercial banks’ interest rates were completely deregulated. Private banks are allowed to open and invest in stock market. A new foreign trade law was passed in 1993 to liberalize trade for the purpose of Taiwan’s application to join the World Trade Organization (WTO) and developing Taiwan as an Asia-Pacific Regional Operation Center (APROC). In 1994, Taiwan allowed the foreign banks to open offices and branches.

In general, after the lifting of martial law, both democratization and liberalization proceeded hand-in-hand through internal and external pressures. However, democratization appears to happen in a big bang, while liberalization occurred gradually. Changes in Taiwan’s democratization and liberalization processes are reflected in various freedom ratings by world watch organizations. Figure 1 shows three indexes of freedom: Civil liberties (icl), political rights (ipr), and economic freedom (ief). The terms will be explained in the following section.

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17 The following is a very good example of gradual nature in economic liberalization in Taiwan. Before 1960, there was only one rate for bank deposit and bank loan. In 1975, the bank deposit rate was set by the Central Bank, while the Banking Association, with the approval of the government, determined the bank loan rate. In 1985, each commercial bank set its own loan rates within certain upper and lower limits. In 1986, the requirement of the upper limit was lifted, and in 1989, the requirement of the lower limit was also lifted. Thus, after 1989, all banks can set their own interest rates. Hsu and Yang (1997, 168, Table 5.4).
All three indexes increased over time. Note that, icl is generally lower than ief before 1987, but it became higher after 1987. In the following sections, we will define icl and ief, and examine the effects of icl and ief on economic growth.

V. Quantitative Measurements of Freedom

There are several definitions and measurements of democracy and freedom (Siermann, 1998). Here, we adopt the Gastil approach, which provides long-run consistent ratings. We took the indexes for civil liberties and political rights from “The Comparative Survey of Freedom” published in January-February issues of Freedom Review from 1983 to 1997, supplemented by Gastil (1982) for ratings from 1977 to 1982. Civil liberties are defined as “the freedoms to develop views, institutions and personal autonomy apart from the state” (FR, 1966, 6). It has thirteen checklist items, including the independence of the news media, freedom of opinion and religion, right of fair trial, and the number of political prisoners (Gastil, 1979, 15-24). The light line in Figure 1 shows the civil liberties index over the years.

We also considered political rights, which “enable people to participate freely in the political process,” that is, “the polity chooses the authoritative policy makers and attempts to make binding decisions affecting the national, regional or local community.” (ibid., 5-6). It has eight to nine checklist items, including the existence of significant opposition parties and openness of voting procedures. They are rated on a seven-category scale, shown as the heavy dotted line in Figure 1. Note that, for Taiwan, the index of political rights (ipr) is either lower than or equal to the index of civil liberties (icl), however, they generally move together.

In the freedom ratings, the average of category numbers for civil liberties and political rights in each country is then classified into three major categories, “free,” “partly free,” and “not free.” As may be expected from the previous three sections of this paper, Taiwan was rated “not free” from 1973, the year the ratings started, to 1976 (Gastil, 1982, 40), “partial free” from

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Note that since the freedom indexes are ordinal numbers, it does not make sense to compare the two indexes without normalizing the indexes to the unit interval.
1977 to 1996, and finally has become “free” after 1997. Taiwan is one of a few countries that have gone through, and advanced through, all these three categories since 1973.20

Economic freedom index (ief) is a weighted average of 17 components: Money and inflation (four items), government operations and regulations (six items), takings and discriminatory taxation (three items), and restrictions on international exchange (four items) compiled by Gwartney, et al. (1996, xv) for 104 countries. Three kinds of weighting methods for the 17 components are used: The Equal Impact Index, Survey Index 1 and 2, each ranges from zero (least free) to 10 (most free) for each component and each country. Figure 1 draws the Survey Index 1 for Taiwan. Dividing the original rating by 10 has normalized the index. Since the ratings are conducted for 1975, 1980, 1985, 1990 and 1995 only, the ratings of the intermediate years are interpolated by fitting a cubic function of time (t) using these five points:

\[
\text{ief} = 4.140 + 1.045 t - 0.318 t^2 + 0.417 t^3
\]  

(1)

The ief (the marked solid line) in Figure 1 shows a near perfect fit, showing a rising trend of economic freedom over the years, slowly at the early years, rapidly after 1987. Using equation (1), we have extrapolated the indexes for the last two years. As can be seen from the diagram, like the index for political freedom (ipr), the ief index increased steadily. In fact, Taiwan is one of a few countries that have the index of economic freedom advanced from middle-rated countries in 1977 to one of the 15 highest-rated countries in the world in 1995.

We may point out that Taiwanese experience of transition from authoritarian to democratic regime is not unique. In fact, Taiwan follows the world trend. In 1986, the political freedom in the world was evenly divided into “free,” “partly free” and “not free” countries: 56, 56, and 55. The composition changed considerably in 1996. 76 countries were free, 62, partly

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19 The Survey rates civil liberties and political rights from 1 (the most free) to 7 (the least free) for each country. To facilitate our regression analysis below, we have changed the order from 1 (the least free) to 7 (the most free), and normalized the number to percentage by dividing by 7. Hence each category advances by 0.14 point.

20 Also see Hsiao and Hsiao (1983, 51, 54). Several countries have been in and out of the three categories throughout the years, indicating that a political system changes with time. However, China is one of a few countries which has been consistently “not free.”

21 Equal impact index (Ie) assigns each component a weight inverse to its standard deviation across countries. Survey index 1 (Is1) is the average of the weights given by 18 experts on each component. Survey index 2 (Is2) assigns each component a subjective country weight in accordance to the size of a correlation coefficient (Gwartney, 1996, 37-41). The difference among these three ratings is not significant for Taiwan (ibid., 210).

22 Gwartney, 1996, 64. In Gwartney (1996), there is a slight numerical discrepancy between the indexes of Taiwan listed in p. 64 and those in country table in p. 210. However, the conclusion here does not change.
free, and 53, not free (Karatnycky, 1996, 5). The condition of freedom in a country can change over the years. Taiwan is one of a few countries that its gain of freedom has been proceeded linearly upward.

VI. Some Previous Studies on the Impact of Liberalization

There are many studies related to economic performance and liberalization. The consensus is that they are generally positively related. Recently, Aswicahyono, et al. (1996) study the case of Indonesian liberalization since the mid-1980s. They found that there is no clear tendency of industrial concentration by domestic and foreign enterprises due to freer market entry and rising import competition. There are decline in state enterprises, increase in the private sector, slight changes in the firm size, steady growth in medium-sized firms at the expense of larger firms, and little impact on spatial distribution of manufacturing activity. Finally, they found that the total factor productivity (TFP) growth for selected industries was increasing, but it is not clear what the impact of liberalization on TFP.

In Taiwan, while there are some discussions on the impact of liberalization, few related specifically to the effects of martial law on the economy. Chou, et al. (1997) applied single country computable general equilibrium model to assess the effects of trade liberalization (in their case, joining GATT) on Taiwan. They showed that, from 1971 to 1986, and to 1992, the average tariff rate in Taiwan was reduced from 12.25% to 6.96%, and to 4.87%; the import duty rate was also reduced from 13.51% to 9.31%, and to 6.74%. Their most optimistic simulation shows that multilateral liberalization of Taiwan by joining GATT will increase real GDP by 1.09 % and total consumption by 2.88 %. However, the agricultural and motor vehicle sectors will be adversely affected.

The above two studies do not specifically deal with the impact of economic liberalization due to a sudden change in the political climate, like the lifting of martial law. Chang (1996a, 1996b) is more specific. He compares the impact of liberalization before and after the mid-1980s, especially 1987. He observes that, after 1987, the Taiwanese economy has changed “quite visibly” (Chang, 1996a, 26), without, quite curiously, ever attributing the changes to the lifting of martial law. The real GDP share of manufacturing industry, which faced the rising labor cost due to the labor protection law, peaked at 38% in 1986-87, and then declined to about 31% in 1993 and after. On the other hand, rising consumer income expanded the service sector.
Its real GDP share increased from 49% to about 58% during the same period. Liberalization enhances competition in domestic and foreign markets, resulting in industrial specialization. Thus, inside the manufacturing industry, the real GDP share of capital goods and durable consumer-goods industries exceeded the share of the non-durable consumer-goods industry for the first time in 1989 (39% vs. 37%). By 1994, the gap increased steadily to 44% vs. 29%, reflecting the technological advancement of the economy (ibid., 29-32).

Liberalization lifts the import restriction and local content requirements. Real imports of final goods contracted by 0.1% per year in 1981-1986, but expanded at 20.7% per year in 1986-1991. Real imports of intermediate goods also grew from 7.7% in 1981-1986 to 12.8% in 1986-1991. In the tradable sector, it was from 8.6% to 12.8%, and in the non-tradable sector, it was from 2.6% to 17.3%, while in the service sector, it was from 0.4% to whopping 17.4% (ibid., 34-37). At the same time, “the import contents of domestic final demand expanded from 15.0% in 1986 to 36.8% in 1991” (ibid., 40), among them, the tradable sector changed from 24% to 47%, non-tradable sector from 11% to 32%, and service sector from 7% to 29%.

Liberalization also accelerated industrial restructuring by changing the sources of industrial growth. On the input side, during 1981-1985, “of the 6.7% real GDP growth of all industries, labor productivity gain contributed 51.9%, employment increase contributed 37.4%, and employment structural change contributed 10.7%.” In contrast, during 1986-1994, average real GDP growth rate was 8.1%, and the above percentages changed to 64.8%, 19.4%, and 15.8%, respectively (ibid., 45-46). Thus, after liberalization, the effect of labor productivity gain on real GDP growth becomes a predominant factor. On the demand side, using the Syrquin model of input-output analysis, Chang (ibid., 48-49) also found that 1981-1986 was characterized by strong foreign demand and weak domestic demand. The situation reversed in 1986-1991. It featured weak foreign demand and strong domestic demand.

Using a similar input-output analysis, Hsu-Ku (1998) compared the industrial structures of 1962-1987 period and 1988-1997 period without, like Chang, attributing the changes to the lifting of martial law. He found that the income elasticities of demand, the labor productivity growth rates, and the labor reallocation effects for both agricultural and industrial sectors all decreased while those of the service sector increased.

While the above studies of the impact of liberalization provide a valuable insight and help us understand the expected results of changes in economic environments and policy reform,
the major problem is that, as in any input-output models or simulation models, the analyses are based on descriptive statistics, no statistical inferences are applied. The calculated results of the variables naturally differ from year to year or period to period. They may increase or decrease. Even if one finds that the change is large, it may not be statistically significant, implying that the change is merely due to some random factors not related to the lifting of martial law. On the other hand, although the change may seem to be small, it may be statistically significant, meaning that the change is due to some systematic factors, like the lifting of martial law, and the results of changes in underlining basic social and economic characteristics. Thus, we propose a time series analysis and test the structural changes of the variables statistically.

VII. Tests of Stationarity with Structural Changes

We have seen that all three indicators of freedom in Taiwan have improved over time. We also have seen that political rights and civil liberties increased suddenly in 1987 and afterward. We would like to know whether these political events in 1987 affect the structure of the economy.

In this section we examine the changes in the Taiwanese economy before and after 1987 by testing the following six economic time series. They are some of the important variables in the process of the Taiwanese economic development, namely, total output (gdp), output per worker or labor productivity (ypw), monetary policy indicator (m1), fiscal policy indicator (expd), external resources (dfi), and outward investment (outinv). The data are defined as follows:

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\begin{align*}
gdp & \quad = \text{real GDP at 1991 prices (NT$ million)} \\
ypw & \quad = \text{real GDP per worker (NT$)} \\
dfi & \quad = \text{approved inward private direct foreign investment, including “foreign” and “overseas Chinese” investment (US$ million)} \\
outinv & \quad = \text{approved outward investment (US$ million)} \\
m1 & \quad = \text{real money supply M1 (NT$ million), a proxy for monetary policy} \\
expd & \quad = \text{real total expenditures of all levels of government (NT$ million)}
\end{align*}
\]

The six time series are all in natural logarithm. The original annual data from 1977 to 1997 are obtained from TSDB (1998). The sample includes the data 10 years before and 10 years after 1987. We have chosen the year 1977 as the beginning year, which is at the mid-point of the second
import substitution period (1974-1980), to eliminate the shock of the first oil price crisis. The series ypw is calculated from the real GDP (that is, deflated by GDP deflator) divided by the number of persons of working age (15-64). The series m1 and expd are the nominal money supply (M1) and the total government expenditures. Both nominal series were divided by the GDP deflator (1991 = 1), respectively, to obtain real M1 and real expd series.

The Perron test in time series (Perron, 1989) is an appropriate method to examine the stationarity (no unit-root) of time series with the structure changes due to the lifting of martial law in 1987. We test unit-root with one-time break and changes in the intercept and slope of each time series. The test equation is,

$$y_t = a_0 + \mu_1 D_P t + \mu_2 D_L t + \mu_3 t^* D_L t + a_1 y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta y_{t-i} + \epsilon_t$$

(2)

where $y_t$ is natural logarithm of a time series, $D_P t$ is a pulse dummy variable, taking 1 at year 1987 (for one-time break, $t_B = 1986$) and 0 otherwise. It is the dummy for the possibility of one-time pulse or break in the year 1987. $D_L t$ is a level dummy variable, taking 1 for 1987 and after, and 0 otherwise. It is the dummy variable for changes in the level of $y_t$ for 1987 and after as compared with the level before 1987. Variable $t$ is time trend, $t^* D_L t$ is an interaction variable to measure the structural change in the slope (* shows multiplication), $y_{t-1}$ is the one-period lag dependent variable, and $\Delta y_{t-i}$ is the $i^{th}$ lag of the first-difference of dependent variable. The value of lag length $k$ is chosen by following the method suggested in Perron (1989) and Enders (1995). $\lambda$ in Table 1 is the proportion of the observations prior to the break to the total number of observations.

------------------------

Insert Table 1 here
------------------------

For a unit-root test, the null hypothesis is $H_0$: $a_1 = 1$ against the alternative hypothesis, $H_1$: $a_1 < 1$. All other coefficients are tested for the null hypothesis of the coefficient being zero against the alternative hypothesis that the coefficient is non-zero. The OLS estimated coefficients, the t-statistics, and adjusted coefficients of determination (adj $R^2$) are listed in Table 1. For convenience, the numerical results in Table 1 are summarized and interpreted in Table 2.
From Table 2, we find that three series, gdp, ypw, and dfi are stationary, as the null hypothesis of a unit root can be rejected either at 1% or 5% level. The other three series, outinv, m1, and expd, are non-stationary. The gdp series is a trend stationary series with significant structural changes in constant term and slope, without significant pulse. The ypw series is also a trend stationary series with significant structural changes in the constant, slope, and pulse. The dfi series is not trend stationary, and has no significant structural changes in constant, slope, or pulse. For other series, m1, expd, and outinv, we cannot reject the null hypothesis of a unit-root at the 10% level. They are not stationary series, but have significant structural changes in constant, slope (m1), and pulse (expd). The regression results of these non-stationary series should be interpreted with caution.

The Perron test shows the properties of time series. We found all the series, except dfi present structural changes of one kind or other. These structural changes can be considered as those induced by the lifting of martial law in 1987. However, the general practice is to reexamine the structural changes without the terms of testing unit-root in equation (2). For this purpose, we will present the next two sections.

VIII. Tests of Structural Changes with Regression

We first assume that the structural changes in the above time series are due to a big bang effect in 1987 by using linear regression with time and dummy variables. The model is,

\[ y_t = a_0 + \mu_1 D_P t + \mu_2 D_L t + a_1 t + \mu_3 t^* D_L t + \epsilon_t \] (3)

The estimated results are presented in Table 3. Among the six series, each one has two estimated results. Part A estimates equation (3) with all independent variables in the equation, and Part B re-estimates the equation by dropping the insignificant variables. Thus, the interpretation of structural changes should be based on the results in Part B. The numerical results are summarized in the last three columns.

---

23 In Taiwan, the second oil price crisis (1979) was much less severe than the first (1973), as per capita GDP growth rate did not dip, the inflation rate was well in control, and balance of trade did not become negative (Hsiao and
We found that there are pulses only in the government expenditure (expd) and outward investment (outinv). There are no pulses in other series, that is, no significant dips in 1987. All the series have an upward shift in constant term, and the level of the series is significantly different before and after 1987. There are, to our surprise, downward shifting in the slopes of real GDP (gdp), real money supply (m1), and inward direct foreign investment (dfi). For these three series, the growth rates have decreased after 1987. There also has downward shifting tendency in the slopes of real GDP per worker (ypw) and outward foreign investment (outinv), but they are not significant.

In general, there are different responses of economic time series to the lifting of martial law. While the level of the series has increased, the growth rate has decreased after 1987. The decrease in growth rates may be due to factors other than the lifting of martial law, such as increases in land price, shortage of labor supply and rapid wage increase, resulting in increase in Taiwanese outward foreign direct investment to China and Southeast Asia, and decrease in domestic capital formation. Clearly, after mid-1980s, the Taiwanese economy has gradually matured, and the growth rate of series, especially real GDP, has started to taper off.

Our finding of the decrease in the growth rate of real GDP and real per worker GDP is not consistent with the findings from the cross-country data compiled by Gwartney et al. (1996, xxiii). They reveal that, so far as economic freedom is concerned, the effect is clearly positive. The 1994 per capita GDP of six persistently high-rated countries from 1975 to 1995 are Hong Kong, Switzerland, Singapore, the United States, Canada, and Germany. The average per capita GDP is US$ 16,600. They then compare these with the nine persistently low-rated countries during the same period. The nine countries are Somalia, Zambia, Hungary, Romania, Brazil,  


24 We owe this explanation to a referee. Chang (1996a, 26) has pointed out that the Taiwanese economy reversed its characteristics after 1987. “Export expansion slackened while domestic demand strengthened; imports shot up. .. The dampening of exports reversed manufacturing-industry growth, resulting in as appreciable reduction in its share of real GDP... The rapid expansion of domestic demand spurred vigorous development of the service sector…” A slowdown in exports may result in slowdown in GDP growth rates. However, Chang also found that, for shorter period, the real GDP growth rate was 6.7% from 1981 to 1985 and 8.1% from 1986 to 1994 (ibid., 47), as compared with our estimated results which shows 7.3% from 1977 to 1986 and 6.4% from 1987 to 1997 (see equation 1B in Table 3).
Syria, Uganda, Zaire, and Zimbabwe. The average per capita GDP is only US$ 2,600. The average growth rate for persistently high-rated countries is 2.6%, while that of persistently low-rated countries is –0.6%. Thus, from this very crude comparison, we may expect a positive correlation between increase in economic freedom and per capita GDP growth rate. As we have pointed out in the previous section, their cross-country analysis does not take other factors into consideration and relation between economic growth and liberalization may also depend on the stage of economic development.

IX. Tests of Smooth Transition

The tests of structural changes we have applied in the previous section assume that the changes occurred in 1987. Could these changes also be interpreted as a smooth transition? In this section, we would like to take a step further to examine this possibility. We will employ the logistic smooth transition regression model (LSTR) explained in Granger and Terasvirta (1993) to test the six time series. There are advantages of using LSTR model. First, it does not require to set a priori assumption on specific time of the break. Second, the mid-time of transition, the speed of adjustment, and the structural changes of level and slope are all incorporated into one model.

The model is specified as follows:

$$y_t = b_1 + b_2 f_t(\gamma, \tau) + b_3 t + b_4 t f_t(\gamma, \tau) + \varepsilon_t$$  \hspace{1cm} (4)

where $f_t(\gamma, \tau) = \{1 + \exp[-\gamma (t - \tau)]\}^{-1}$ is a logistic function of time in the unit interval. The coefficient $\gamma$ is the smoothness parameter. If it is positive and small, then the model transition occurs smoothly. The coefficient $\tau$ is the location parameter that determines the midpoint of transition.

Table 4 shows the estimated results of the six time series using the nonlinear least squares method (NLS). The results are summarized in the last column of the table. We find that the

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25 GDP per capita figures are measured in 1985 U.S. dollars, and are updates of the Summers and Heston data derived by the purchasing power parity method. (Gwartney, 1996, xxiii).

26 In the original version of this paper, we have presented a section on the relationship between civil liberties, economic freedom, and endogenous growth. Since our data consist of only 20 years, we have decided to treat the impact of freedom on long-run economic growth in a separate paper.
estimated $\gamma$ is positive and significant in gdp, ypw, m1, and outinv series. Hence, we may say that real GDP, real GDP per worker, real money supply, and outward foreign investment may also be interpreted as having a smooth transition from 1977 to 1997.

------------------------

Insert Table 4 here

------------------------

For real GDP and real money supply, smooth transition occurred in both constant term and slope. As in the previous section, the level moved up and the growth rate decreased smoothly. For real GDP per worker and outward foreign investment, smooth transition occurred only in the constant term, that is, only the level moved upward smoothly. These findings are consistent with those we have found in Table 3. As we have observed in the previous sections, economic liberalization occurred slowly over three decades. Thus, we consider that the interpretation of the smooth transition, rather than the big bang, is more appropriate for these economic variables. Notice also that for these four series, the midpoint of transition, $\tau$, occurs at 9 to 11. Since we assign $t = 0$ at 1977, the implied $\tau$ is around 1986 to 1988. This means that the smooth transition have occurred around the midpoint of the sample, which is what we have expected.

The estimated $\gamma$ for inward direct foreign investment (dfi) and government expenditures (expd) are not significant at the 10% level, hence, there is no smooth transition. In view of deregulation and openness of the domestic market for foreign investment, sudden claims of entitlement by people, and increase in expenditures for social and economic infrastructures, inward direct foreign investment and government expenditures increased suddenly and considerably after 1987. These factors may contribute to the non-smooth transition of these series.

X. Some Concluding Remarks

In this paper, we have examined the origin of Taiwan’s authoritarian regime by tracing back to the Japanese period, and discussed the external and internal factors which prompted the authoritarian regime to reform its economic policy for rapid economic growth. We also considered the process of economic liberalization and the external and internal factors that led
to the lifting of martial law. We see the accelerated liberalization and democratization after martial law was lifted in 1987.

Our observations that economic liberalization occurred gradually and democratization happened rather abruptly have been confirmed by the indexes of civil liberties, political rights, and economic freedom compiled by some international organizations which compared various aspects of freedom in other countries. We then reviewed some literature on the impact of economic liberalization on economic performance and structural changes. We found that the previous findings are valuable and informative in understanding the impact. However, they are mainly analysis of descriptive statistics, devoid of statistical inferences.

We have chosen six economic time series to test their stationarity and structural changes. Among them, three series, real GDP, real per worker GDP, and direct foreign investment are trend stationary. They show no one-time pulse in 1987, but have increase in the constant term. The growth rates of real GDP and direct foreign investment decreased after 1987, but no change for the growth rate of real per worker GDP. The first two series also show a smooth transition over time, but not for the third series.

The other three variables, namely, real money supply M1, total government expenditures, and outward investment are not trend stationary. Hence, the regression results must be interpreted with caution. For levels, all three of them increased with statistical significance, and for the growth rate, all have decreased, but only the money supple has decreased statistically significantly. In general, all six series we have tested show increase in the constant terms, but either no change or decrease in the growth rates after 1987. Increase in constant terms mean that the levels of the values of these six time series data have increased after martial law was lifted. However, their rates of growth have not increased probably due to changes in international trading environment not specifically related to the lifting of martial law.
REFERENCES


Taiwan Statistical Data Book (TSDB), Council for Economic Planning and Development, Taiwan: Republic of China.


Figure 1. Indexes of Political Rights, Civil Liberties and Economic Freedom in Taiwan
Table 1. Perron Test for A Unit-Root and Structural Changes, 1977-1997

<table>
<thead>
<tr>
<th>Series/Coeff</th>
<th>Lag</th>
<th>Coeff</th>
<th>Series</th>
<th>Const</th>
<th>DP</th>
<th>DL</th>
<th>t</th>
<th>t*DL</th>
<th>y(t-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>tB = 1986</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 gdp</td>
<td>0</td>
<td>13.495</td>
<td>y</td>
<td>0</td>
<td>-0.019</td>
<td>0.159</td>
<td>0.066</td>
<td>-0.006</td>
<td>0.059</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.36)</td>
<td></td>
<td>(0.80)n</td>
<td>(3.47)</td>
<td>(4.21)</td>
<td>(2.18)</td>
<td>(-4.33)b</td>
<td></td>
</tr>
<tr>
<td>2 ypw</td>
<td>5</td>
<td>14.993</td>
<td>y</td>
<td>5</td>
<td>-0.090</td>
<td>0.491</td>
<td>0.087</td>
<td>-0.034</td>
<td>-0.263</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(7.13)</td>
<td></td>
<td>(-4.64)</td>
<td>(7.91)</td>
<td>(7.55)</td>
<td>(7.04)</td>
<td>(-7.08)a</td>
<td></td>
</tr>
<tr>
<td>3 dfi</td>
<td>6</td>
<td>17.511</td>
<td>y</td>
<td>6</td>
<td>0.985</td>
<td>3.087</td>
<td>1.095</td>
<td>-0.375</td>
<td>-3.506</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5.36)</td>
<td></td>
<td>(2.00)n</td>
<td>(1.94)n</td>
<td>(2.74)n</td>
<td>(1.70)n</td>
<td>(-4.37)b</td>
<td></td>
</tr>
<tr>
<td>4 outinv</td>
<td>0</td>
<td>1.401</td>
<td>y</td>
<td>0</td>
<td>-1.298</td>
<td>2.503</td>
<td>0.203</td>
<td>-0.074</td>
<td>0.182</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.32)</td>
<td></td>
<td>(-1.72)n</td>
<td>(2.29)</td>
<td>(2.48)</td>
<td>(-0.74)n</td>
<td>(-3.70)</td>
<td></td>
</tr>
<tr>
<td>5 m1</td>
<td>1</td>
<td>9.432</td>
<td>y</td>
<td>1</td>
<td>-0.073</td>
<td>0.795</td>
<td>0.096</td>
<td>-0.054</td>
<td>0.260</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.17)</td>
<td></td>
<td>(-0.46)n</td>
<td>(2.51)</td>
<td>(3.48)</td>
<td>(-3.47)</td>
<td>(-2.20)</td>
<td></td>
</tr>
<tr>
<td>6 expd</td>
<td>0</td>
<td>6.902</td>
<td>y</td>
<td>0</td>
<td>-0.260</td>
<td>0.339</td>
<td>0.035</td>
<td>-0.011</td>
<td>0.467</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.42)</td>
<td></td>
<td>(-2.15)</td>
<td>(1.84)</td>
<td>(1.67)n</td>
<td>(-0.62)n</td>
<td>(-2.39)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: 1. t-value is in the parentheses, n = not significant at 10% level.
2. For all coefficients, except a1, the null hypothesis is that the coefficient = 0 in the t-test.
3. a and b denote that we can reject H0: a1 = 1 (a unit-root) at 1% and 5% level, respectively. At l = 0.5, the critical values are -4.90, -4.24, and -3.96 at 1%, 5%, and 10% level, respectively. (See Perron, 1989)

Table 2. Summary of Perron Test

<table>
<thead>
<tr>
<th>Series/Coeff</th>
<th>Stationarity</th>
<th>Trend</th>
<th>Structural Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a1 &lt; 1</td>
<td>a2</td>
<td>Pulse</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>μ1</td>
</tr>
<tr>
<td>1 gdp</td>
<td>y b</td>
<td>y a</td>
<td>n</td>
</tr>
<tr>
<td>2 ypw</td>
<td>y a</td>
<td>y a</td>
<td>y a</td>
</tr>
<tr>
<td>3 dfi</td>
<td>y b</td>
<td>n d</td>
<td>n</td>
</tr>
<tr>
<td>4 outinv</td>
<td>n</td>
<td>y b</td>
<td>n d</td>
</tr>
<tr>
<td>5 m1</td>
<td>n</td>
<td>y a</td>
<td>n</td>
</tr>
<tr>
<td>6 expd</td>
<td>n</td>
<td>n d</td>
<td>y b</td>
</tr>
</tbody>
</table>

Notes: y = yes, n = no.
a, b, and c = significant at 1%, 5%, and 10% level, respectively.
d = significant at 15% level.
Table 3. OLS Regression with Time and Dummy Variables, 1977-1997

<table>
<thead>
<tr>
<th>Series</th>
<th>Coeff</th>
<th>cons</th>
<th>DP</th>
<th>DL</th>
<th>t</th>
<th>t*DL</th>
<th>Adj R^2</th>
<th>DW-d</th>
<th>Pulse</th>
<th>St. changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>gdp</td>
<td>14.311</td>
<td>-0.023</td>
<td>0.188</td>
<td>0.073</td>
<td>-0.010</td>
<td>0.998</td>
<td>1.651</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1B</td>
<td>gdp</td>
<td>14.311</td>
<td>0.170</td>
<td>0.073</td>
<td>-0.009</td>
<td>0.998</td>
<td>1.703</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2A</td>
<td>ypw</td>
<td>11.955</td>
<td>-0.023</td>
<td>0.124</td>
<td>0.051</td>
<td>-0.002</td>
<td>0.997</td>
<td>1.698</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2B</td>
<td>ypw</td>
<td>11.957</td>
<td>0.098</td>
<td>0.050</td>
<td>0.998</td>
<td>1.794</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3A</td>
<td>dfi</td>
<td>5.318</td>
<td>0.069</td>
<td>1.118</td>
<td>0.148</td>
<td>-0.073</td>
<td>0.902</td>
<td>1.220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3B</td>
<td>dfi</td>
<td>5.318</td>
<td>1.171</td>
<td>0.148</td>
<td>-0.076</td>
<td>0.907</td>
<td>1.244</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4A</td>
<td>outinv</td>
<td>2.059</td>
<td>-1.544</td>
<td>2.358</td>
<td>0.184</td>
<td>-0.008</td>
<td>0.935</td>
<td>2.061</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4B</td>
<td>outinv</td>
<td>2.077</td>
<td>-1.521</td>
<td>2.277</td>
<td>0.180</td>
<td>0.938</td>
<td>2.054</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5A</td>
<td>m1</td>
<td>12.950</td>
<td>-0.081</td>
<td>1.011</td>
<td>0.099</td>
<td>-0.049</td>
<td>0.983</td>
<td>1.652</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5B</td>
<td>m1</td>
<td>12.950</td>
<td>0.948</td>
<td>0.099</td>
<td>-0.046</td>
<td>0.984</td>
<td>1.926</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6A</td>
<td>expd</td>
<td>12.851</td>
<td>-0.316</td>
<td>0.297</td>
<td>0.072</td>
<td>-0.003</td>
<td>0.966</td>
<td>1.826</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6B</td>
<td>expd</td>
<td>12.858</td>
<td>-0.307</td>
<td>0.264</td>
<td>0.070</td>
<td>0.968</td>
<td>1.796</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
- p-value is in the parentheses, p=0 means that the coefficient is significant at less than 1% level.
- n = not significant at 10% level.
Table 4. Logistic Smooth Transition Regression (LSTR), 1977-1997

<table>
<thead>
<tr>
<th>Series</th>
<th>Coeff</th>
<th>b1</th>
<th>b2</th>
<th>( \gamma )</th>
<th>( \tau )</th>
<th>b3</th>
<th>b4</th>
<th>Adj R^2</th>
<th>DW-d</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 gdp</td>
<td>14.316</td>
<td>0.188</td>
<td>2.175</td>
<td>9.488</td>
<td>0.071</td>
<td>-0.008</td>
<td>0.999</td>
<td>1.558</td>
<td></td>
<td>near s. t.</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
<td>(0.11)</td>
<td>(0)</td>
<td>(0.02)</td>
<td>(0)</td>
<td>(0.02)</td>
<td>(cons, slope)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 ypw</td>
<td>11.962</td>
<td>0.123</td>
<td>1.922</td>
<td>9.311</td>
<td>0.048</td>
<td>0.001</td>
<td>0.998</td>
<td>1.650</td>
<td></td>
<td>s. t.</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
<td>(0.06)</td>
<td>(0)</td>
<td>(0)</td>
<td>(0.85)n</td>
<td>(0.85)n</td>
<td>(cons)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 dfi</td>
<td>5.186</td>
<td>-2.766</td>
<td>2.199</td>
<td>14.675</td>
<td>0.188</td>
<td>0.107</td>
<td>0.937</td>
<td>1.788</td>
<td></td>
<td>not s. t.</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0.11)d</td>
<td>(0.21)n</td>
<td>(0)</td>
<td>(0)</td>
<td>(0.25)n</td>
<td>(0.25)n</td>
<td>(cons)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 outinv</td>
<td>2.143</td>
<td>4.251</td>
<td>1.223</td>
<td>10.732</td>
<td>0.151</td>
<td>-0.088</td>
<td>0.949</td>
<td>2.193</td>
<td></td>
<td>near s. t.</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0.02)</td>
<td>(0.11)</td>
<td>(0)</td>
<td>(0.07)</td>
<td>(0.44)n</td>
<td>(0.44)n</td>
<td>(cons)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 m1</td>
<td>13.013</td>
<td>0.938</td>
<td>2.253</td>
<td>8.953</td>
<td>0.075</td>
<td>-0.024</td>
<td>0.992</td>
<td>1.778</td>
<td></td>
<td>s. t.</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
<td>(0.02)</td>
<td>(0)</td>
<td>(0.05)</td>
<td>(0.05)</td>
<td>(0.05)</td>
<td>(cons, slope)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 expd</td>
<td>12.858</td>
<td>0.676</td>
<td>14.557</td>
<td>11.239</td>
<td>0.070</td>
<td>-0.023</td>
<td>0.986</td>
<td>1.219</td>
<td></td>
<td>not s. t.</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
<td>(1.00)n</td>
<td>(0.96)n</td>
<td>(0)</td>
<td>(0.08)</td>
<td>(0.08)</td>
<td>(cons)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
P-value is in the parentheses.
n = not significant at 15% level.
s.t. = smooth transition.