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DEFLATION AND MONETARY POLICY IN TAIWAN

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ABSTRACT

From 1999 to 2003, Taiwan faced a deflationary situation. The reasons for this deflation can be attributed to both domestic and global factors. Domestic changes including local political unrest, tensions with China, outbound investment to China, a weakened financial system, and a deteriorating government financial situation, provided the backdrop for the economic slowdown and corresponding deflation. A number of global factors, especially the bursting of the Internet and IT bubbles in late 2000 and the rise of China's economy, also heavily influenced both global and Taiwanese prices. This paper adopts a simplified aggregate demand and aggregate supply model to derive a deterministic equation of the GDP deflator (PGDP), and then applies quarterly data covering the period from 1982 to 2003 to estimate the PGDP equation using 2SLS. The empirical results are used to identify the sources of PGDP deflation in Taiwan. In addition, the phenomenon of price divergence appears since 2002 where the WPI increased and the CPI decreased. The causes of the WPI-CPI divergence are also investigated in this paper.

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I. Foreword

Ever since the Great Depression of the 1930s drew to a close, inflation has been one of major headaches for financial and economic decision-makers. Inflation and the unemployment rate have been the two major elements that make up the misery index, while deflation has never seriously been considered a threat. However, by the end of the 1990s, Japan, China, and Hong Kong had exhibited a phenomenon of price decreases for many years running, and the rate of price increases in both European and American countries had also started to slow down. The issue of deflation therefore gradually drew the attention of economists and policy-makers. The November 2002 issue of The Economist even went so far as to suggest that deflation had become a serious threat to the global economy.

In Taiwan, the GDP deflator has decreased in four out of five years from 1999 to 2003, the exception being 2001. The CPI also declined in each of the years from 2001 to 2003. In April 2003, Rogoff, an expert associated with the International Monetary Fund, published a research report in which Taiwan, together with Japan, Hong Kong, and Germany, were ranked as high-risk countries for deflation. The core CPI, published by the Directorate-General of Budget, Accounting and Statistics of the Executive Yuan in Taiwan , exhibited negative growth in each quarter in 2003. These findings have made deflation a cause for concern among both scholars and the media. Although the Central Bank of China in Taiwan has never admitted that Taiwan is suffering from a deflation problem, it has tried very hard to promote domestic economic activity and avoid price decreases.

Several international research institutions have engaged in research on deflation; see, for instance Ahearne, et al. (2002) and Rogoff (2003). The Bank of Japan (2001) also convened a symposium on the issue - “The Role of Monetary Policy under Low

Inflation: Deflation Shocks and Policy Responses" - in 2000, where participating scholars emphasized the importance of monetary policy in guarding against and dealing with deflation.[1]

In Taiwan, however, there have been no government reports on the domestic deflation issue, probably because the government has denied that the problem exists. Similarly, very few studies have been performed by domestic scholars. Research reports compiled by the Department of Economic Research of the Central Bank of China (2002) and the Council for Economic Planning and Development of the Executive Yuan (2003) have merely tried to explain the causes of and responsive strategies to deflation in the light of the experiences of other countries. Wu (2003), for instance, not only analyzed the reasons why the global price growth had slowed since 1997, but he also discussed the causes of low prices in Taiwan. Huang (2003) probed long-term, medium-term, and short-term causes that led to the price decreases in Taiwan and provided policy recommendations. However, although Wu and Huang talked about the causes of Taiwan's deflation, they simply presented narrative explanations or arguments, without engaging in any in-depth or detailed analysis.

In the early part of the year 2004, the CPI in Taiwan reversed its downward trend and started to rise. The government and various research institutions in Taiwan also predicted that the CPI would rise in 2004. Although the problem of deflation in Taiwan appears to no longer exist, there are several questions that are worth looking

[1] The theme of the seminar held by the Bank of Japan (2001) was "Monetary Policy under a Low Inflation Rate," in which participants mostly emphasized the importance of monetary policy during a period of deflation. For example, Cargill thought that central banks generally focused more on policies to control the monetary environment during periods of inflation, while neglecting the seriousness of the problem of deflation, therefore seldom utilizing monetary policy tools to prevent the deflation phenomenon. This is considered to be one of the main reasons for the Great Depression of the 1930s. Cargill thought that Sweden differed from the U.S. in that it laid emphasis on the price level, paying close attention to deflation. As for Japan, he offered the same suggestion, calling for emphasis on the importance of monetary policy during a period of deflation. Goodfriend also thought that monetary policy was the fundamental reason for deflation and economic stagnation.

into. How serious has the deflation problem in Taiwan really been in the last few years? What are the fundamental reasons for the deflation? How has the Central Bank in Taiwan responded to deflation? How effective have the Central Bank's policies been? This paper aims to answer these questions.

Since deflation is usually accompanied by recession, Section II of this paper briefly introduces the changes in the political and economic environment in Taiwan that have taken place in recent years, thereby providing the background for Taiwan's unsatisfactory economic performance since 1999. Section III explains two phenomena associated with macro-price changes. One is deflation, and the other is price divergence. Price divergence refers to the phenomenon that the three macro-price indices, i.e. the CPI, WPI and GDP deflator (PGDP), have been moving in different directions. In this section, major global factors that have affected Taiwan's prices are emphasized, and the causes of the WPI-CPI divergence are also investigated. Section IV sets up a simplified AD-AS model that is used to estimate the deterministic equation for Taiwan's PGDP, and uses the empirical results to explain why the PGDP has fallen since 1999. Section V explains how Taiwan's Central Bank operates its monetary and exchange-rate policies, and then discusses its policy responses to deflation, while also carefully reviewing their effectiveness. The final section presents the conclusions.

II. The Political and Economic Environment in Recent Years

Taiwan's economic growth used to be regarded by foreign scholars and decision-makers as a "miracle" or taken as a "model" for developing countries to study or follow. Due to its sound economic fundamentals, quick policy responses, and other reasons as mentioned in Shea and Shih (1999), Taiwan was also relatively immune from the attack of the East Asian financial crisis in 1997-1998, performing better in terms of its economic growth rate, unemployment rate, currency depreciation and falling stock prices than its East Asian neighbors.

As Table 1 shows, however, Taiwan's economic performance since 1999 has never returned to the illustrious growth of the past three to four decades. The economic growth rate has yet to again exceed 6%, and even recorded its first negative growth rate of -2.18% in 2001 in Taiwan's post-war history. The unemployment rate has also climbed steadily and remained at a level of around 5% in 2003. Although the stock price index and the total stock trading volume recovered a little in 2000, they have both decreased in other years. The New Taiwan dollar (hereafter the NT dollar) has also remained weak relative to the U.S. dollar during this period.

There have been several factors that have served to bring about Taiwan's unsatisfactory economic performance since 1999. The poor performance in 2001 can be partly explained by a gloomy world economy caused by the bursting of the Internet and IT bubbles in late 2000 and the 911 terrorist attacks in 2001. The SARS epidemic also hampered Taiwan's economic growth in 2003. In addition to these two well-known factors, the deterioration in the political and economic environment in Taiwan is also a fundamental reason.

Since the early 1990s, the ruling power in Taiwan has gradually shifted from

those who migrated from mainland China to Taiwan in the late 1940s together with the KMT (Kuomintang) government, to the so-called “native Taiwanese.” During the process of this power transition, an ongoing confrontation between the two camps has never been resolved. Although a significant proportion of the people in Taiwan would like to maintain Taiwan’s status quo, there is major division among the people on the issue of whether Taiwan should pursue independence from China or be unified with China at some point in the future. Constant friction between the two camps as well as disputes between them in major elections, which Taiwan has held almost annually in recent years, have caused Taiwan to degenerate into a society that lacks any consensus or harmonization. The switch in the ruling party from the KMT to the DPP (Democratic Progressive Party) for the first time in 2000 has only further complicated the situation. KMT and DPP legislators have since then fought tooth and nail almost irrationally on any issue in the Legislative Yuan (the law-making body in Taiwan). The result is a semi-paralyzed government without much determination or executive power. This phenomenon of political unrest is certainly a negative factor in relation to private investment.

The rise of China’s economy has also affected Taiwan’s own economy in many ways. China’s cheap labor and land have provided Taiwan’s fading labor-intensive industries with an opportunity to revitalize themselves. A big China market has also been attractive to capital- and technology-intensive product manufacturers. Therefore, huge numbers of business people flooded into China to invest in the 1990s. This massive investment in China gave rise to concerns over whether Taiwan’s economy would be “hollowed out.” This hollowing-out concern plus the bad feeling regarding China on its political stance of constantly repressing Taiwan in international affairs finally led former President Teng-Hui Lee to adopt a “no hurry, be patient”

policy to guide economic relations with China. However, due to the huge potential profits from investing in China and the advantage of sharing the same language and culture enjoyed by Taiwan businessmen in competing with investors from other countries, this “no hurry, be patient” policy did not effectively counter the huge-flow of westward-bound investment from Taiwan to China.

After the opposition DPP candidate won the presidential election in 2000, the DPP’s stance of leaning toward Taiwan’s independence from China has enhanced China’s hostility toward Taiwan. No official dialogue between the two sides of the Taiwan Strait has ever been resumed. China has even strengthened its threat of military reprisals against Taiwan. A large number of the DPP’s loyal supporters also oppose any closer economic ties with China. Tension with China of this sort has not only put an end to the potential role that Taiwan can play as a medium or bridge for foreign investors entering the China market, but it has also discouraged private and direct foreign investment in Taiwan.

Table 1: Key Economic Indicators

	Economic Growth Rate (%)	Changes in Price Indices (%)			Unemployment Rate (%)	Stock Price Index (1966=100)	Total Trading Volume in Stock Market (trillion NT$)
		GDP Deflator	WPI	CPI			
1991-1995 Average	7.12	2.94	1.71	3.76	1.56	5,043	10.724
1996	6.10	3.11	-1.01	3.08	2.60	6,004	12.908
1997	6.68	1.68	-0.45	0.89	2.72	8,411	37.241
1998	4.57	2.64	0.60	1.69	2.69	7,738	29.619
1999	5.42	-1.42	-4.55	0.17	2.92	7,427	29.292
2000	5.86	-1.73	1.82	1.26	2.99	7,847	30.527
2001	-2.18	0.57	-1.34	-0.01	4.57	4,907	18.355
2002	3.59	-1.01	0.05	-0.20	5.17	5,226	21.874
2003	3.31	-2.13	2.48	-0.28	4.99	5,254	20.333

Table 1: Key Economic Indicators (continued)

	Exchange Rate at Year-end (NT$/US$)	ROA of Domestic Banks (%)	ROE of Domestic Banks (%)	Non-Performing Loan Ratio of Financial Institutions at Year-end (%)	Growth Rate of Private - Enterprises Fixed Investment (%)	Direct Investment Abroad (million US$)	Tax Burden (Tax and Monopoly Revenue/GNP) (%)	Outstanding Central Government Debt as a % of GNP
1991-1995 Average	27.265[a]	0.71[a]	11.87[a]	3.00[a]	14.28	2,451	18.0[a]	12.36[a]
1996	27.491	0.73	11.36	4.15	3.44	3,843	16.1	16.5
1997	32.638	0.85	12.23	4.18	18.61	5,243	15.7	17.2
1998	32.216	0.71	9.29	4.93	11.88	3,836	16.0	15.8
1999	31.395	0.54	6.91	5.67	-0.68	4,420	14.7	14.5
2000	32.992	0.47	6.05	6.20	15.76	6,701	13.2	25.3
2001	34.999	0.26	3.61	8.16	-29.29	5,480	13.0	28.9
2002	34.753	-0.47	-7.35	6.84	2.50	4,886	12.3	29.0
2003	33.978	0.21	3.50	5.00	-1.47	5,679	12.2	31.3

Note: a. Figure for 1995

Sources: Various data from the Directorate-General of Budget, Accounting and Statistics, Council for Economic Planning and Development, Ministry of Finance, and the Central Bank of China.

Table 2: Contribution to Economic Growth Rate of Expenditure Items[a,b]

Unit: %

Year	Economic Growth Rate	Domestic Demand					Net Exports
		Subtotal	Private Consumption	Public Expenditure[c]	Private Sector Fixed Investment	Increase in Inventory	
1996	6.10	5.58 (91.48)	3.85	0.87	0.46	0.40	0.52 (8.52)
1997	6.68	8.43 (126.20)	4.30	0.75	2.48	0.90	-1.75 (-26.20)
1998	4.57	6.38 (139.61)	3.88	0.70	1.75	0.05	-1.81 (-39.61)
1999	5.42	1.87 (34.50)	3.25	-0.38	-0.11	-0.89	3.55 (65.50)
2000	5.86	3.89 (66.40)	2.98	-0.28	2.36	-1.17	1.97 (33.60)
2001	-2.18	-4.93 (272.02)	0.62	-0.26	-4.78	-0.51	2.75 (-126.15)
2002	3.59	0.96 (26.74)	1.23	-0.73	0.30	0.16	2.63 (73.26)
2003	3.31	0.36 (10.88)	0.42	-0.07	-0.17	0.18	2.95 (89.12)

Note: a. Calculated by (real growth rate of expenditure item x share in GDP of previous year)

b. Figures in parentheses are contribution shares to the economic growth rate of that specific year.

c. Public expenditure includes government consumption, government investment, and public-enterprise investment.

Source: Directorate-General of Budget, Accounting and Statistics.

The financial sector in Taiwan has also encountered a number of problems. Allowing new private banks to be set up in 1991 suddenly increased the number of domestic commercial banks from 17 in 1991 to 33 in 1993. Some credit cooperatives and investment and trust companies were also allowed to be converted into commercial banks in subsequent years. Therefore, the total number of domestic banks, including commercial banks and medium-business banks, increased from 25 in 1991 to 41 in 1993 and to 52 in 1999 – more than double the original number. The resulting fierce competition among banks led to credit expansion and prosperous stock and real estate markets in the mid-1990s.

In the years that followed, although Taiwan remained relatively insulated from the East Asian financial crisis, the contagion effects of the crisis still caused Taiwan's stock and real estate prices to fall and the non-performing loans ratio of its financial institutions to rise in 1998. Furthermore, between the end of 1998 and early-1999, several listed companies and business groups, which had been found guilty of misconduct in fund management (such as engaging in cross investments in the stocks of group members, being highly leveraged, borrowing short to invest long, being involved in stock-price supporting activities, or over-investing in the slackening housing industry), sank into heavy financial trouble. These so-called "land-mine" companies or business groups not only adversely affected the financial condition of the domestic banks, but also accelerated the downturn in stock prices.

Fierce competition among banks together with the accidents caused by these "land-mine" companies steadily lowered the return on assets (ROA) and the return on equity (ROE) of domestic banks, and raised the non-performing loans ratios of financial institutions during the 1998-2002 period, as Table 1 indicates. The willingness and ability of financial institutions to grant loans to the business sector, especially those invested in China, therefore shrank during this same period.

All of the above-mentioned factors including political unrest, tensions with China, out-bound investments attracted by China, and a weakened financial sector, had a detrimental impact on private and foreign investment in Taiwan. As shown in Table 1, the growth of fixed investment on the part of private enterprises slowed down or even turned negative, while direct investment abroad grew significantly after 1999.

When faced with a deflationary situation, a government is usually expected to adopt an expansionary fiscal policy to stimulate the economy. Unfortunately, Taiwan's government has been constrained by its deteriorating financial condition,

such that it has not been able to afford to expand public expenditure. Under China's threat of military action, Taiwan has had no room to cut its national defense expenditure. Moreover, political parties have been competing for votes by writing checks for welfare programs, cutting tax rates, and by providing tax holidays or tax exemptions to please the voters. As a result, the tax burden in Taiwan, as Table 1 shows, has fallen year after year to reach a level of 12.2% in 2003, one of the lowest in the world. The outstanding central government debts as a percentage of GNP have also been increasing very rapidly from 14.5% in 1999 to 31.3% in 2003.

Due to such financial constraints, Taiwan's public expenditure including government consumption, government investment, and public-enterprise investment in fact fell during 1999-2003, bringing a negative contribution to economic growth in this period, as Table 2 shows. We can also see from this table that the private sector's fixed investment in addition contributed little or even negatively to economic growth, except in the year 2000. Another conclusion we can draw from Table 2 is that the major driving force behind economic growth on the expenditure side during the period 1999-2003 was net exports instead of domestic demand.

III. Macro-price Changes in Taiwan

1. Deflation as a New but Short-term Concern

In April 2003, Taiwan was listed by the IMF as a country that faced a high risk of deflation, along with Japan, Hong Kong, and Germany. The IMF calculated the deflation risk index for 35 countries, and classified the results into four categories as high-, medium-, low-, and very low-risk countries. Among the countries categorized as being high-risk, Japan scored the highest, followed by Hong Kong, Taiwan, and Germany.[2]

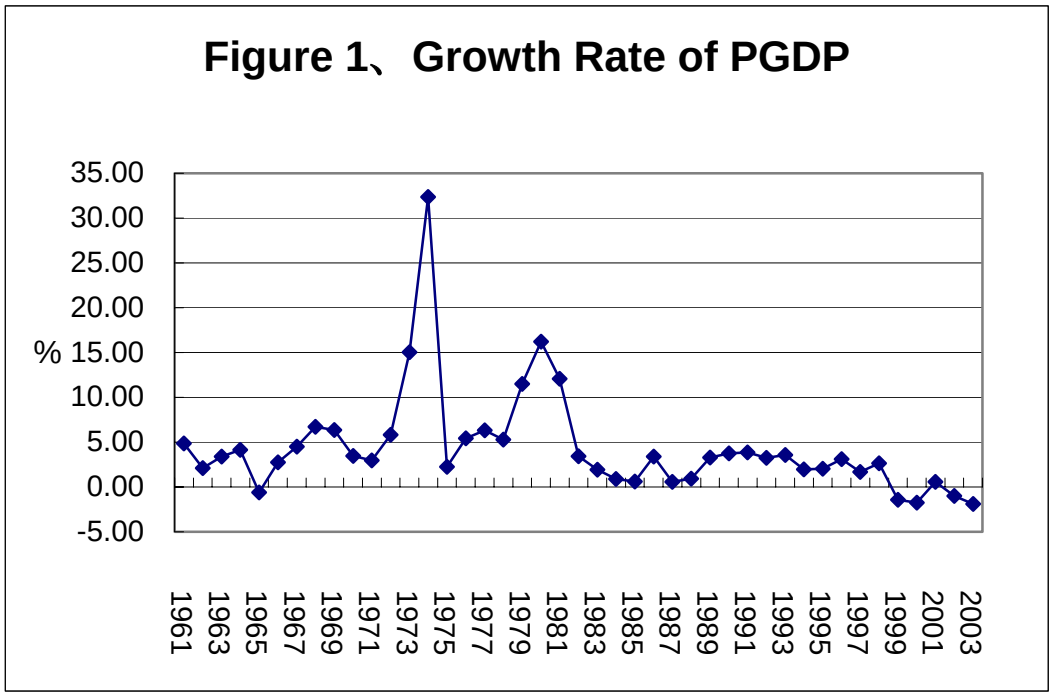


Figure 1 depicts the growth rate of Taiwan's GDP deflator (hereafter PGDP) from 1961 to 2003. Except for 1965 when its value was negative (-0.61 %), the

[2] See Kumar (2003) and Rogoff (2003).

PGDP annual growth rates before 1998 were positive. During this period of the PGDP's growth, the annual growth rate seldom exceeded 5 percent, except for the two oil crisis years. However, there has been an obvious change since 1999. That is, PGDP growth turned negative in most of the subsequent years. The annual PGDP growth rate was -1.42 percent in 1999, -1.73 percent in 2000, 0.57 percent in 2001, -1.01 percent in 2002, and -2.13 percent in 2003. The CPI also exhibited a negative growth rate for three consecutive years in 2001-2003, as Table 1 indicates. The IMF and scholars in Taiwan thus worried that Taiwan might have started to experience deflation.[3]

Since 2003, however, the global as well as domestic economic situation has improved. Starting with the second half of the year 2003, the global prices of raw materials like steel, cement, petroleum, coal, wheat, soybeans, butter, and paper pulp have been surging. During the first quarter of 2004, the CPI in Taiwan increased by 0.51 percent as compared with the same quarter in 2003. During that same time, the core CPI rose by 0.12 percent and the WPI increased by 2.37 percent. The government and various research institutions in Taiwan have each forecast that both the CPI and WPI will exhibit positive growth rates in 2004. The period of deflation is therefore generally believed to be over.

2. Global Factors Affecting Taiwan Prices

Taiwan is a highly open economy. Since the 1970s, the ratios of exports and imports to GDP have almost always remained above 40 percent, sometimes even exceeding 50 percent. The macro economy of Taiwan has thus been deeply affected by the global economic situation and prices. For example, during the periods of the

[3] Deflation is defined as a phenomenon where general price levels continue to drop. To facilitate the analysis, the International Monetary Fund defines deflation as occurring when annual price growth is negative for two consecutive years. Please see IMF (1999), p. 106.

two oil crises, Taiwan encountered the problem of so-called “imported inflation”. Macro-price changes in Taiwan in recent years have not only been caused by domestic factors, but have also been closely related to two factors that have affected global prices — the bursting of the Internet bubble in 2000 and the rise of China’s economy.

Excessively optimistic expectations on the future of the Internet, communications, and the IT industries resulted in over-investment and caused stock prices to soar in the late-1990s. After the economic bubble burst at the end of 2000, the huge excess capacities of these industries led to their prices dropping. The bursting of the bubble also caused stock prices to sink and wealth to shrink. Furthermore, the global economic situation worsened and unemployment rose. All of these factors caused world consumption to fall. In addition, excess capacity contributed to a pessimistic outlook, so that willingness to invest decreased. Therefore, the bursting of the Internet and IT bubbles brought about a weakening in world consumption and investment, which further caused global prices to fall.

Ever since China accelerated its transition from a controlled economy to a market economy in 1992, and reinforced its trade and investment relations with the rest of the world, it has had a significant impact on the global economy. The rise of China’s economy has affected global and Taiwanese prices in several ways.

China has a huge pool of cheap labor. Labor-intensive products produced in China and exported to the world market have forced the global prices of those products, mostly final consumer goods, to fall. On the other hand, the rise of China has caused the prices of China’s major imports, mostly raw materials, agricultural products, and capital- or technology-intensive goods (regarding which China has a comparative disadvantage) to rise. China’s rapid economic development has also raised the purchasing power and hence private consumption of the Chinese people,

which has further increased the demand for and the global prices of raw materials and agricultural products. To prepare for the 2008 Olympic Games in Beijing and the 2010 Shanghai World Exposition, China has begun large-scale public construction projects, which have given rise to even higher increases in the global prices of raw materials such as minerals, cement, and petroleum.[4]

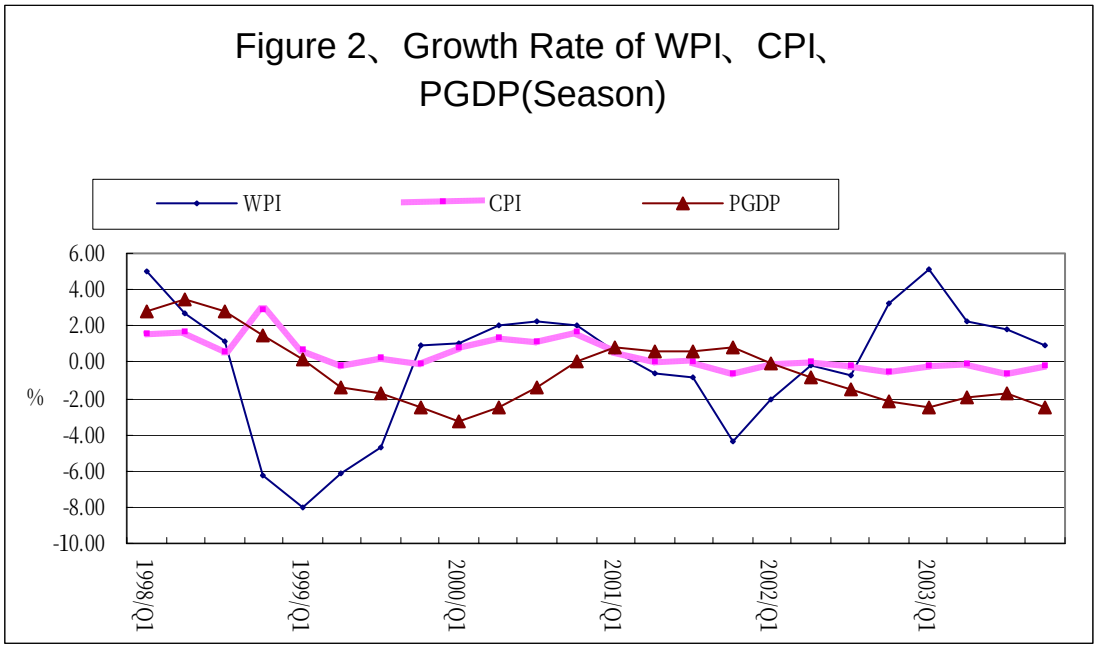
In sum, due to the rise of China's economy, the global prices of China's exports (most are manufactured as final consumer goods) are decreasing, while the prices of China's imports (mainly upstream raw materials, intermediate, and agricultural products, and machinery and equipment) are rising. However, because China enjoys a huge trade surplus, the price decreases have outweighed the increases. Therefore, global prices are on average falling, which represents deflation.

China's renminbi is pegged to the U.S. dollar. While its balance of payments has recorded a surplus for years and the U.S. dollar has been depreciating, China has still not allowed the renminbi to appreciate. The undervaluation of the renminbi has not only reinforced China's export competitiveness, but has also enhanced the pressure of global deflation. In the last two years, world leaders and economists have often charged that China's cheap exports have interrupted the global price structure. China's "so-called" manipulation of the renminbi exchange rate (which is in fact fixed, just like that of the HK dollar) has become a target of criticism and discussion.

[4] China consumed approximately 50 percent of the world's cement, 36 percent of its steel products, and 30 percent of its coal in 2003. In 2003, China's demand for steel products amounted to about 38,000,000 tons. In the first quarter of 2004, China imported 10,080,000 tons of steel products worth US$5.72 billion. The quantity of steel products imported increased by 17.5 percent compared with the first quarter of 2003, with the total value going up by 28.4 percent. In 2003, China imported 91,120,000 tons of crude oil (representing annual growth of 30 percent). In the first quarter of 2004, China imported 30,140,000 tons of crude oil worth US$7.15 billion. The volume of crude oil imports increased by 35.7 percent compared with the first quarter of 2003 and its total value by 41.2 percent. This shows that unit prices for steel products and crude oil have surged.

3. Divergence of PGDP, CPI, and WPI

In recent years, the macro-price indices in Taiwan have exhibited a divergence, appearing that the PGDP, CPI, and WPI have been moving in different directions.[5] As Figure 2 indicates, from 1999 to 2000, the PGDP declined, but the WPI and CPI rose slightly. In addition, from 2002 to 2003, both the PGDP and CPI declined, leading to a concern about deflation. The WPI, however, rose — an obvious price divergence.



In fact, price divergence happens all the time in Taiwan. As can be seen from Table 3 and Figure 3, since 1982, price divergence has occurred many times, of which the most obvious occurred in 1985-1987, 1992, 2000, and 2003. For example, from 1985 to 1992, the CPI and PGDP went up, while the WPI went down.

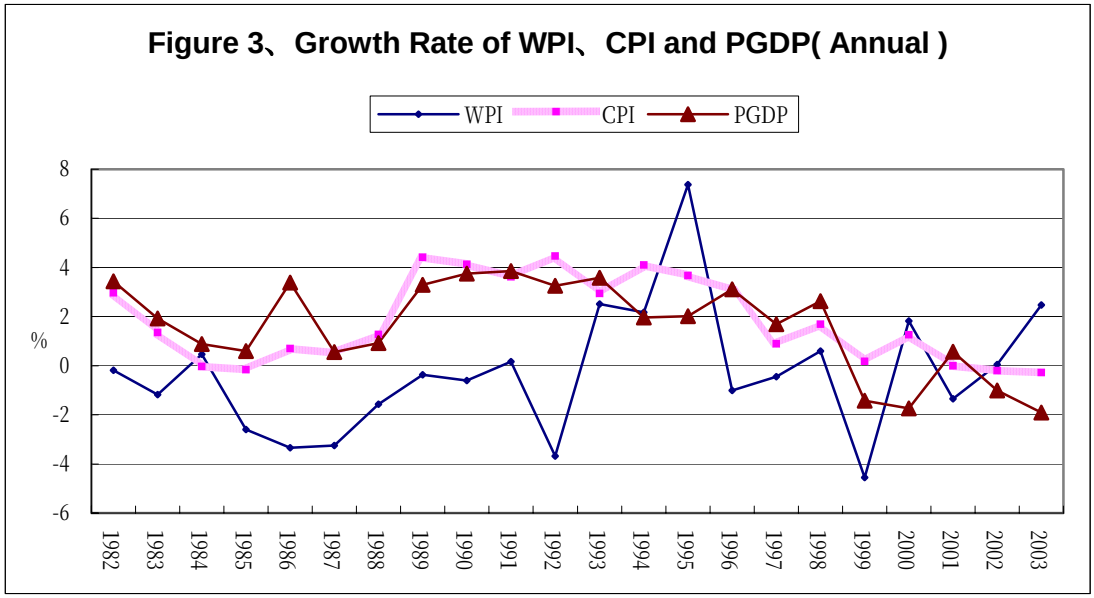
[5] When there is price divergence, which price index is a proper indicator for inflation or deflation becomes the issue.

Table 3: Moving Directions of WPI, CPI, and PGDP (1982 to 2003)

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
WPI	−	−	+	−	−	−	−	−	−	+	−	+	+	+	−	−	+	−	+	−	+	+
CPI	+	+	−	−	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	−	−	−
PGDP	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	−	−	+	−	−
Divergence	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
From 1982 to 2003, only five years have experienced a simultaneous movement in the same direction for three price indices.																						

Note: 1: '+' means positive growth, '-' means negative growth.

2: 'Yes' means a simultaneous movement in the same direction for the three price indices. 'No' means no such co-movement.



4. Causes of WPI-CPI Divergence

This subsection intends to explain the possible factors that caused a divergence between the WPI and CPI during the period extending from the fourth quarter of 2002 to the third quarter of 2003. During this period, the CPI slowly declined, while the WPI rose.

What the WPI measures is the factory price or wholesale price of three categories

of products: domestically-produced and domestically-sold (DPDS) products, imported goods, and exported goods. It is a weighted average of the above three categories of price indices. Let WPId, PM, and PX represent the price index of DPDS products, the import price index, and the export price index, respectively. These three components enjoy roughly equal weights in the current calculation of the WPI in Taiwan.

As Figure 4 shows, the WPId in Taiwan fell during 1998 and 1999, began to rise slightly in 2000, to be followed by a further slight decline in 2001. Since then, the WPId has been rising. The reason why the WPId fell in 2001 was the recession in Taiwan. A lack of effective domestic demand caused the WPId to slide. Since 2003, the economy has slightly recovered. Domestic demand and the WPId are therefore rising.

In the case of import prices (PM), because agricultural and industrial raw materials constitute the largest portion of Taiwan's imports, followed by capital goods and consumer goods, PM is mainly affected by the global prices of agricultural and industrial raw materials as well as capital goods. It is also influenced by the global prices of consumer goods, the NT dollar exchange rate, and customs duties.

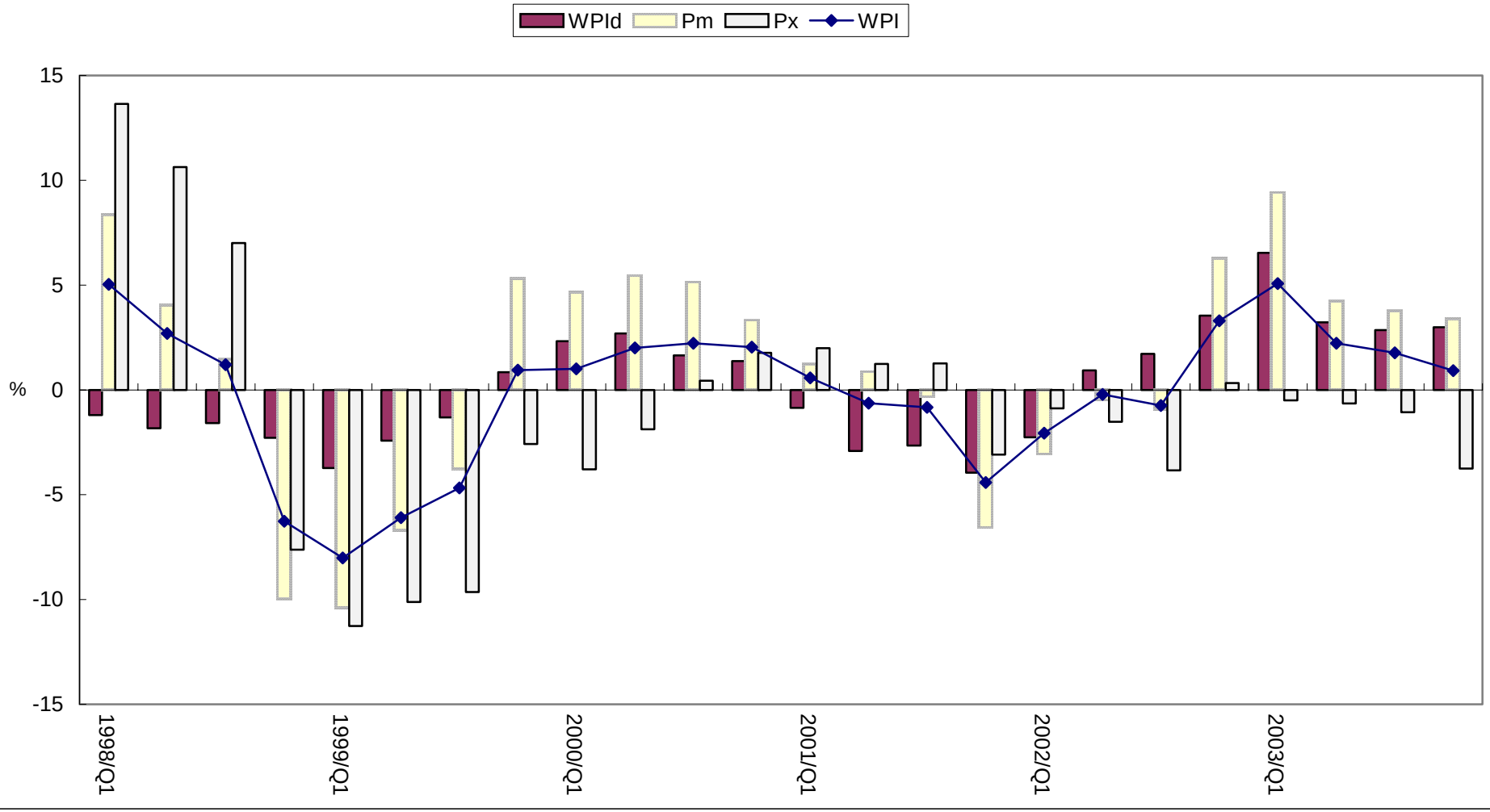
Since the 1980s, the effective customs duty rate has decreased, resulting in decreasing import prices. Since 2001, however, the NT dollar has depreciated, pushing up import prices. Strong Chinese demand for raw materials and capital goods has caused the global prices of that category of goods to soar, thus raising Taiwan's import prices and hence the WPI since the fourth quarter of 2002.

As for export prices (PX), Taiwan's exports are mainly composed of industrial products, the bulk of which are information industry and electrical machinery or

electronics products. The former has been affected by the bursting of the Internet bubble, and the latter by competition from China's exports in recent years. The PX has thus dropped since the second half of 2002.

Figure 4 summarizes the trend in the WPI and its components since 1998. During the period from the fourth quarter of 2002 to the third quarter of 2003, the WPI rose. Among its components, the wholesale price index for DPDS products (WPId) rose as well as the import price index (PM), while the export price index (PX) declined. Therefore, it is evident that the rise in the WPI was mainly caused by a rise in the prices of DPDS products and imported goods.

Figure 4: Change in WPI and Its Component (Annual Growth Rate)



CPI trends have differed from those of the WPI. From the fourth quarter of 2002 to the third quarter of 2003, the WPI surged, while the CPI fell. The CPI measures the retail prices of consumer goods and services. Consumer goods can be further divided into local consumer goods and imported consumer goods. Let PGDP be a proxy measure of the prices of local consumer goods, and PMc and Ps the prices of imported consumer goods and services, respectively. The CPI is then roughly a weighted average of PGDP, PMc, and Ps. The changes in CPI, PGDP, PM_C, and Ps are presented in Figure 5. This figure shows that the CPI's decrease since 2001 was closely related to the fall in PGDP and Ps.

Figure 5: Changes in CPI and Its Component (Annual Growth Rate)

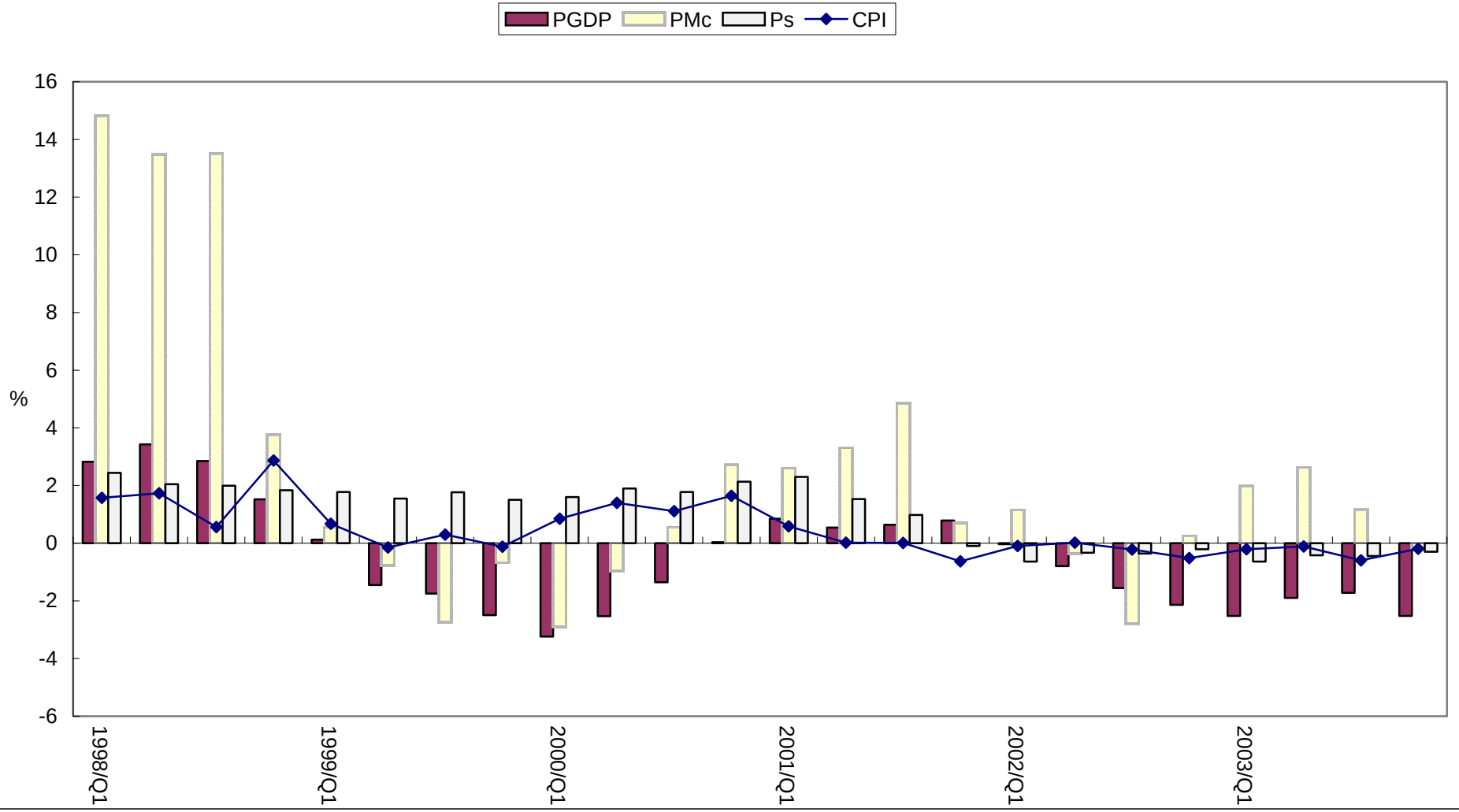


Figure 6: Changes in Ps and Its Components (Annual Growth Rate)

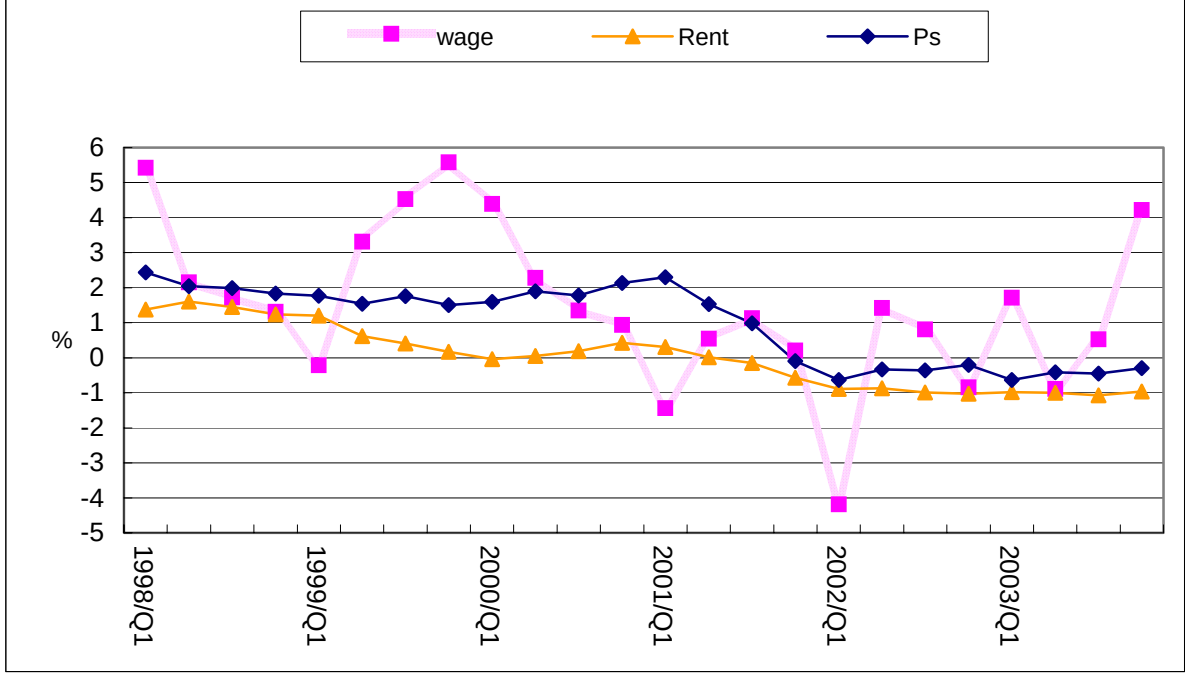
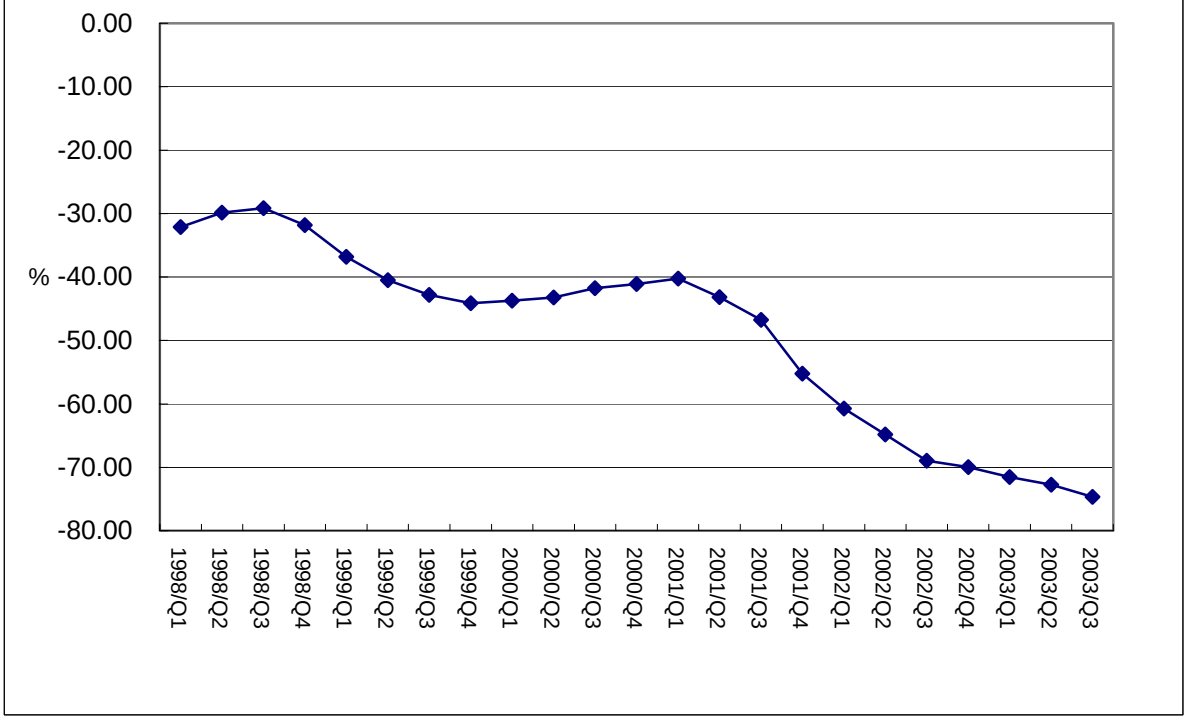


Figure 7: Growth Rate of Interest Rate (Annual Growth Rate)



Because the fall in the price of services (Ps) is a major factor causing the CPI to drop, we study the reasons for the decrease in Ps. The production costs and prices of services are mainly determined by the wage (W), rent (R), and the interest rate (r). Figures 6 and 7 indicate that Ps moves closely with rent R and the interest rate r. The wage has also been relatively stable since 2001.

Falling rents were mainly caused by factors such as weak domestic demand, the outward migration of companies and white-collar laborers, and an oversupply of houses and office buildings. The decline in the interest rate was due to the central banks of many countries adopting a low-interest-rate policy to stimulate their economies during this period, a path that Taiwan also followed. Stable wages were the result of competition from Chinese labor and an increase in domestic unemployment.

IV: Analysis of Deflation Based on the GDP Deflator

1. Theoretical Model of PGDP Determination

The GDP Deflator (PGDP) measures the price of final domestic products. According to the aggregate-demand and aggregate-supply (AD-AS) model, any factors that may cause the AD curve to move to the right (left) will lead PGDP to go up (down), while it may cause the AS curve to shift to the right (left), leading PGDP to go down (up).

The aggregate demand function AD which is derived from the IS-LM analysis can be presented as follows:

$$\underset{-}{} \quad \underset{+}{} \quad \underset{+}{} \quad \underset{+}{} \quad \underset{+}{} \quad \underset{+}{}$$

(1) $Y = AD(PGDP; GEXP, MS, Pf, Yf, EXR, \ldots)$.

In this equation, Y is real GDP; GEXP is government real expenditures, including government consumption expenditures, government investment, and public enterprise investment; MS is money-supply volume; Pf and Yf represent foreign prices and the global economic situation, respectively; and EXR is the exchange rate measuring the value of the U.S. dollar in terms of the NT dollar. On the right-hand side of the equation, a positive or negative symbol above each explanatory variable represents the direction of the impact of that variable on Y. To simplify the analysis, the AD equation omits certain explanatory variables that cannot be precisely measured in the empirical study, such as expectations regarding the future economic situation, or real wealth, etc.

A general equation of aggregate-supply AS can be presented as follows:

$$\underset{+}{} \quad \underset{-}{} \quad \underset{+}{} \; \underset{+}{}$$

(2) $Y = AS(PGDP; W, K, T)$.

In this equation, W is the nominal wage rate; K is the capital stock; and T is the technology level. Because it is difficult to measure the capital stock K and technology level T, and W, K, and T may jointly affect aggregate supply through unit output labor cost LC, the aggregate-supply function can be rewritten as

$$\underset{+}{} \quad \underset{-}{}$$

$$(3) \quad Y = AS^{*}(PGDP; LC).^{6}$$

From equations 1 and 3, the PGDP equation can be derived as

$$\underset{+}{} \quad \underset{+}{} \quad \underset{+}{} \quad \underset{+}{} \quad \underset{+}{} \quad \underset{+}{}$$

$$(4) \quad PGDP = f(GEXP, MS, EXR, Pf, Yf, LC, \ldots).$$

Because increases in the first five explanatory variables on the right-hand side all cause the AD curve to shift to the right, while a rise in LC causes the AS curve to shift to the left, six explanatory variables have a positive impact on PGDP.

2. Empirical Analyses

The sources of the relevant variables used to conduct an empirical estimation of equation 4 are summarized in Table 4. Because the United States and China are Taiwan's most important export markets, this study adopts the real value of imports of the United States (Yfus) and China (Yfc) as representative variables for the global economic situation (Yf) that affects Taiwan's PGDP. The data period adopted extends from the first quarter of 1982 to the second quarter of 2003.

[6] In theory, it is not difficult to infer that the impact of the wage rate W on unit output labor cost LC is positive, and the impact of the capital stock K and the technology level T on LC is negative. Furthermore, because LC affects aggregate supply negatively, Equation 3 implies that the impact of W on Y is negative, and the impact of K and T on Y is positive, which is consistent with Equation 2.

Table 4: Explanation of Variables

Variable	Definition	Source
PGDP	GDP deflator	Compiled from data on the website of the Directorate-General of Budget, Accounting and Statistics, Executive Yuan, ROC.
GEXP	Total real expenditure of the government	1. Government consumption expenditure is from the database of the Directorate-General of Budget, Accounting and Statistics, Executive Yuan, ROC. 2. Government investment and public enterprise investment are from the table of Gross Fixed Capital Formation, Monthly Bulletin of Statistics. 3. Real Government Expenditure is deflated by the GDP deflator.
Pf	World export price index	IFS
Yfus	Real US import value = Total US import value / US import price *100	IFS
Yfc	Real China import value = Total China import value / China CPI index*100[7]	IFS
LC	Index of unit output labor cost for industry	Database of the Directorate-General of Budget, Accounting and Statistics, Executive Yuan, ROC.
MS	M2 daily average	Central Bank of China website.
EXR	Exchange Rate (NT$/US$)	Central Bank of China website.

In this empirical study, all economic variables are used in logarithmic form. Since there is much evidence that many macro-variables are non-stationary, this study first uses Augmented Dickey-Fuller tests to examine the existence of unit roots before conducting a regression analysis. As the results summarized in Table 5 show, there exists a unit root for all the variables in logarithmic form, and the first differences of these variables do not possess unit roots. In other words, these variables should be differenced once to obtain stationarity.

[7] Since the data on China's import price index are not obtainable, this paper adopts the CPI as a substitute variable.

Table 5: Stationarity and Unit-Root Tests

Variables	Level	First Difference
LPGDP	-0.468	-3.994**
LGEXP	-1.973	-4.725***
LPf	-1.497	-7.297***
Lyfus	-2.703	-3.736**
Lyfc	-1.996	-5.254***
LLC	0.014	-4.749***
LMS	0.444	-3.449*
LEXR	-1.055	-6.053***

Note: All variables are calculated in log-form.
This table uses Augmented Dickey-Fuller unit root tests.
* denotes significance at the 10 percent level, ** significance at the 5 percent level, and *** significance at the 1 percent level.

Our PGDP equation is derived from a simplified AD-AS model. Some of the explanatory variables in the equation, such as MS, LC and EXR, should be endogenous variables in a complete macro-system. To circumvent the simultaneous-equation bias problem, a two-stage least squares (2SLS) technique is adopted to estimate the PGDP equation. The last two-period values of the endogenous variables MS, LC, and EXR are included as instrumental variables in the 2SLS estimation.[8] The results are reported in Table 6. From Table 6, we can deduce that variables LGEXP, LMS, LEXR, LYfus, LYfc and LLC all exert a significantly positive impact on PGDP, while the respective impacts of LPf is are positive, though not significant. Regarding the signs of the regression coefficients, they all conform to the theory.

[8] We also adopt the OLS technique to verify our model. The results are consistent with those of the

Table 6: Regression Results for PGDP Using 2SLS

Period	4th quarter 1982 to 2nd quarter 2003	
Dependent Variable	D(LPGDP)	
Independent Variables	C	-0.015 (-1.457)*
	D(LGEXP)	0.075 (4.900)***
	D(LMS)	0.268 (2.229)**
	D(LEXR)	0.322 (2.444)***
	D(LPf)	0.078 (1.207)
	D(LYfus)	0.064 (1.518)*
	D(LYfc)	0.033 (3.307)***
	D(LLC)	0.127 (4.576)***
	D2	0.010 (0.661)
	D3	0.021 (2.563)***
	D4	-0.006 (-0.791)
Adjusted R-squared	0.785	
No. of observations	83	

Note：1. All variables are calculated using logs and first differences (not including the constant C and seasonal dummy variables D2, D3, and D4).

2. Since economic interaction between Taiwan and China began in 1991, variable D(LYc) is set at 0 before 1990.

3. The figures in parentheses are t-values, where * denotes significance at the 10 percent level, ** significance at the 5 percent level, and *** significance at the 1 percent level (one-tail test).

4. List of instruments: D(LLC(-1)), D(LLC(-2)), D(LMS(-1)), D(LMS(-2)), D(LEXR(-1)), D(LEXR(-2)), D(LGEXP), D(LPf), D(LYfus), D(LYfc), D2, D3, D4.

The 2SLS results therefore show that, for domestic factors, government expenditures, unit output labor cost, money supply, and the NT exchange rate all have

2SLS technique.

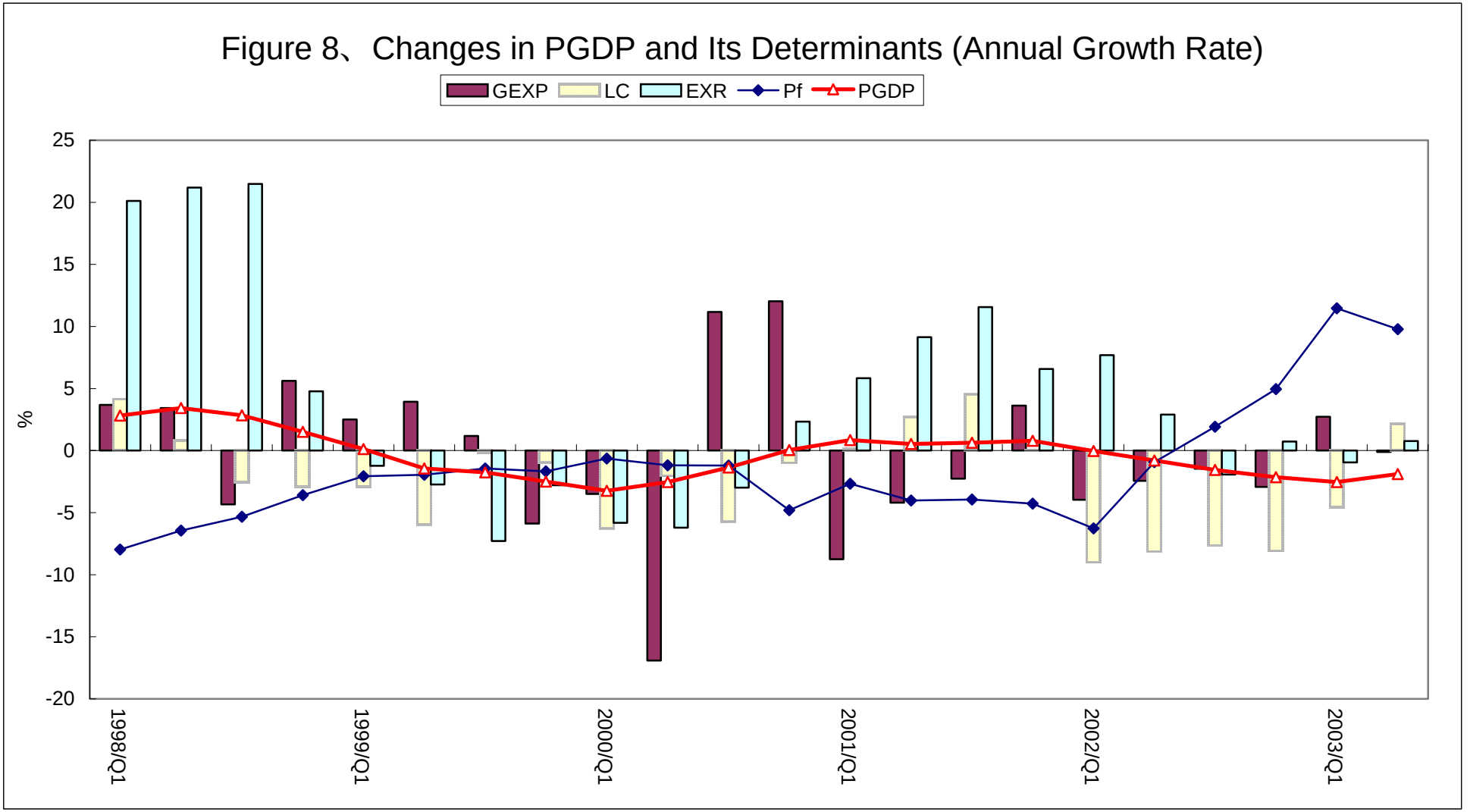
a significantly positive impact on Taiwan's PGDP. It is clear that fiscal, monetary, and exchange rate policies do matter in affecting PGDP.

With respect to global factors, China's economic situation (applying China's total real import value) and the U.S. economic situation (applying the total real value of U.S. imports) have a significantly positive impact on Taiwan's PGDP, while foreign prices (adopting global export prices) tend to have a positive impact, although it is not significant. It is worth noting that the coefficient of China's import value is significant, thus showing the importance of the China factor.

Based on the regression results, we can identify the sources of PGDP deflation in Taiwan. Since 1999, PGDP has been declining except in 2001. This phenomenon of a declining PGDP has been caused by several factors. Figure 8 shows the changes in the three most significant explanatory variables (GEXP, LC, EXR), together with that of world export prices Pf. As explained in Section II, mainly due to a finance constraint, government expenditures decreased during this period. Furthermore, improvements in production technology caused unit output labor costs to go down except in 2001. The bursting of the Internet and IT bubbles and the rise of China's economy also depressed world export prices before 2003. Furthermore, the NT dollar appreciated relative to the U.S. dollar in 1999 and 2000. All of these factors contributed to PGDP's decline.

In addition to the explanatory variables incorporated in the model, other factors, such as the shrinkage of wealth due to the falling stock and real estate prices, political instability, and increased tensions with China, should also have had a negative impact on Taiwan's GDP and PGDP. This study, however, does not include these factors in the empirical analysis for reasons of simplicity and a lack of appropriate data.

Figure 8、Changes in PGDP and Its Determinants (Annual Growth Rate)



V. The Central Bank's Policy Responses to Deflation

Although the Central Bank in Taiwan (formally the Central Bank of China, hereafter the CBC) has never admitted that Taiwan has encountered the problem of deflation, the CBC implemented some measures to stimulate aggregate demand for Taiwan's products, in order to promote the economic growth rate as well as counter the problem of deflation.[9] The deterioration in the government's financial situation as explained in Section II restricted the government's ability to adopt an expansionary fiscal policy to promote the economy. The CBC's monetary and exchange rate policies therefore became the major policy instruments for the government to rely on.

1. The Formation of Monetary Policy

According to the Central Bank Act, the CBC has the obligation to maintain price as well as exchange rate stability and to assist in economic development. To achieve these final goals, the CBC chooses monetary-aggregate targeting as the basic framework of its monetary policy, instead of inflation, exchange-rate, or interest-rate targeting. Since 1992, the monetary aggregate M2 has been chosen as the intermediate target of monetary policy to achieve the final goals.

Before the end of each year, the CBC (often after having consulted with scholars and experts) sets and publicly announces the target zone of the M2 growth rate for the subsequent year based on the government's target figures of the economic growth rate and inflation rate, as well as other factors influencing the demand for money such as the opportunity cost of holding money and the diversification of financial assets. Using a zone, rather than a specific number, as the M2 growth target, the CBC is endowed with the flexibility to maintain the stability of interest rates, the exchange

[9] When deflation became a public concern in Taiwan in 2002 and 2003, the CBC several times tried to downplay the issue by pointing out either that the core CPI was still rising or that the falling CPI was just a temporary phenomenon.

rate, and other major financial indicators in the year.

The actual M2 growth rate is very carefully observed each month by the CBC. In order to effectively control M2, the CBC adopts reserve money as the operational target. At the beginning of each month, the CBC has a monetary estimation and forecasting meeting to determine the target value of reserve money for that month. A reference target for the inter-bank overnight call-loan rate is also derived in the meeting. The CBC then applies a variety of operational instruments, including required reserves, discounts and accommodations, open-market operations, re-deposits from financial institutions, selective credit management, and moral suasion, to fine-tune the daily figures of reserve money and the inter-bank overnight call-loan rate.

Among these operational instruments, open-market operations are the most frequently-used instruments. Re-deposits from financial instruments, selective credit management, and adjusting the discount and accommodation rates are sometimes adopted. The required reserve ratios are adjusted only occasionally for special cases as a strong monetary policy measure. For open-market operations, the CBC before 1992 relied on the issuance of savings bonds, treasury bills, and certificates of deposit (CDs) as tools to manage the liquidity situation in the financial market. However, the issuance of savings bonds and treasury bills was terminated in 1992 and 1998, respectively. In recent years, the CBC has either issued or redeemed CDs almost every day to affect the liquidity and inter-bank overnight call-loan rate. Since 1999, the CBC has depended heavily on the issuance of CDs and on receiving re-deposits from financial institutions in order to sterilize the impact of the accumulation of foreign exchange reserves on reserve money, such that the CBC's outstanding CDs and re-deposits from financial institutions have increased very rapidly. The outstanding CDs had even reached NT$2.99 trillion, equivalent to 185% of total

reserve money; and re-deposits from financial institutions amounted to NT$2.06 trillion, or 127% of reserve money, as of the end of 2003.[10]

2. Exchange Rate Policy

The authorities in Taiwan shifted from a fixed exchange rate system to a floating exchange rate system in July 1978. The purpose behind introducing a floating exchange rate was to make Taiwan's economy less vulnerable to external disturbances. However, in a highly open economy like Taiwan, the exchange rate is a key factor affecting its trade balance, economic growth, and domestic price level. The exchange rate is therefore frequently regarded as an important policy instrument to promote economic growth or stabilize prices. According to the Central Bank Act, the CBC also has the obligation to stabilize the external value of the NT dollar, i.e. the exchange rate. Hence, since the adoption of a floating exchange rate in 1978, the CBC has frequently intervened in the foreign exchange market in order to affect the level of the exchange rate or its fluctuations. The final purpose of the CBC is either to promote exports and economic growth, to stabilize domestic prices, or to stabilize the exchange rate. In other words, what is adopted by the CBC is in fact a managed floating exchange rate.

The general impression and feeling derived by scholars and experts in Taiwan from the CBC's foreign exchange operations may be summed up as follows. First, the CBC has usually adopted a strategy of repressing the NT dollar, aiming to promote exports. Therefore, the NT dollar has been characterized as being "easy to depreciate, difficult to appreciate." Second, when domestic prices face any serious

[10] Re-deposits from financial institutions constitute a very powerful and effective operational instrument for the CBC to adjust reserve money. The CBC is entitled to receive or return re-deposits from the postal savings system, three specialized agricultural banks, and other approved banks when the CBC concludes that the domestic financial situation requires it to do so. To increase (decrease) reserve money, the CBC can simply return (receive) re-deposits to (from) the financial instiutions.

inflation problem, the CBC is then more willing to allow the NT dollar to appreciate. Third, when major events such as political unrest, a military threat from China, and the East Asian financial crisis in 1997-1998 occurred, so that the NT dollar faced serious pressure to depreciate, the CBC was obliged to defend the exchange rate.

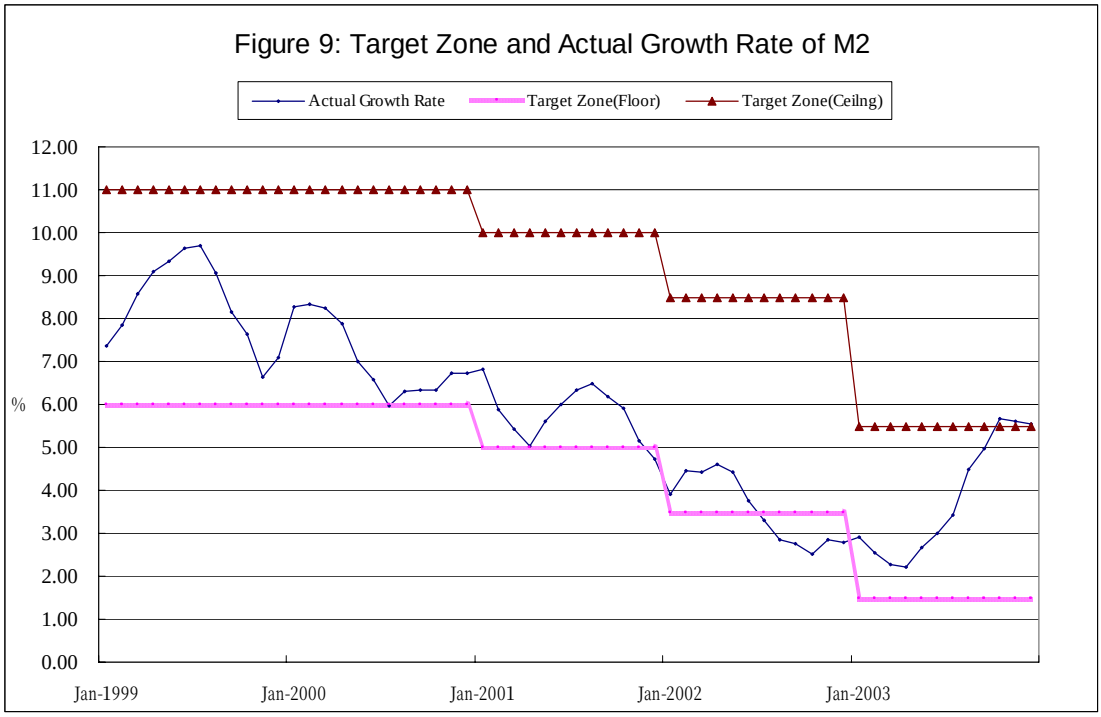
Since the CBC has kept information on foreign exchange intervention a secret, the impact of CBC's intervention on the exchange rate is difficult to estimate. In a recent study on the NT dollar exchange rate, Yang and Shea (2005) set up an optimal intervention model to introduce three variables, representing three purposes of CBC intervention, into the determination equation of the NT dollar exchange rate, together with the standard factors affecting the exchange rate, such as the relative price level, interest-rate gap, and export-competing countries' exchange rates. The empirical estimation results of this paper show that each of the three intervention-purpose variables played a significant role in the determination of the NT dollar exchange rate. The model incorporating the intervention-purpose variables performed far better, in terms of both explanatory power and forecasting power, than the model that excluded the intervention-purpose variables. These results clearly indicate that CBC's intervention is really a key factor affecting the NT dollar exchange rate, and that promoting economic growth, stabilizing domestic prices, and stabilizing the exchange rate are truly the main concerns of the CBC in exchange rate management.

3. Counter-Deflation Policies

By coping with the weakening demand for money caused by the slowdown of economic growth and the increase of substituting financial assets, the CBC gradually adjusted downward the target zone of its M2 growth rate during the period from 1999 and 2003, as shown in Figure 9. This figure also shows that the actual growth rate of M2 fell most of the time into the target zone, which indicates that the CBC's

management of money supply was, generally speaking, satisfactory during this period.

Figure 9: Target Zone and Actual Growth Rate of M2



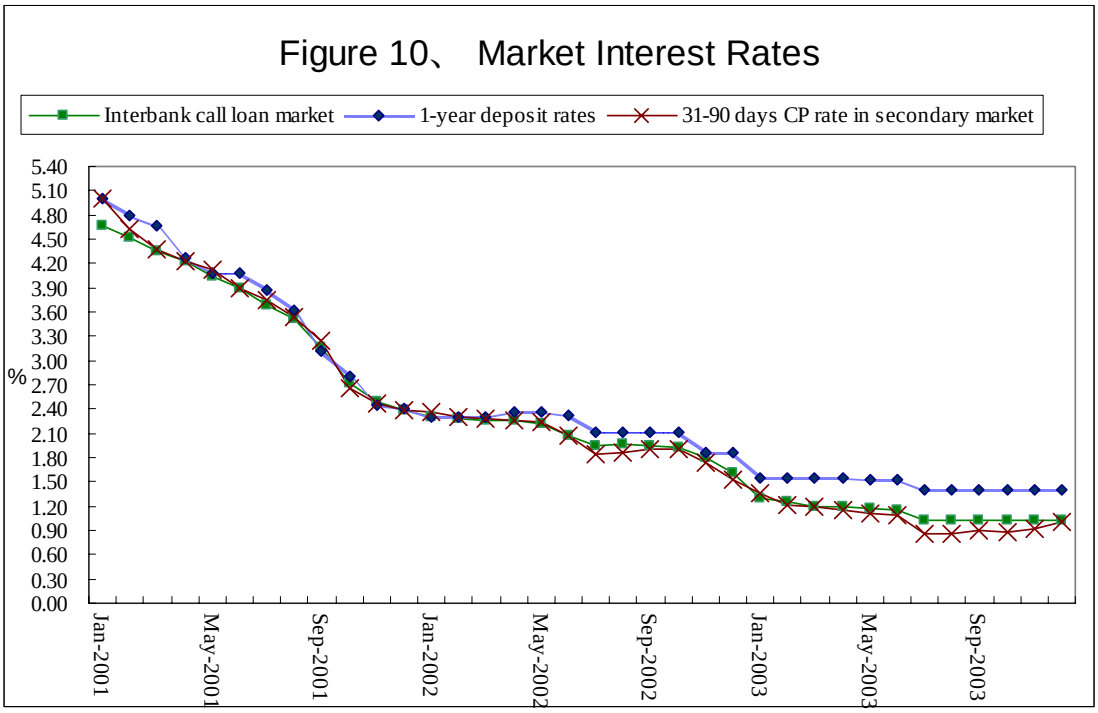
The expansionary monetary policy adopted by the CBC to stimulate domestic demand was revealed by the policy measures, which were intended to loosen the monetary environment and to guide the market interest rate in a downward direction. Between December 2000 and the end of 2003, the CBC lowered both the discount rate and the rate on accommodations on 15 occasions, as indicated by Table 7. In 2001-2003, the required reserve ratios of the NT dollar deposits and foreign currency deposits were reduced on one and three occasions, respectively. As a result, the market interest rates as represented by the inter-bank overnight call-loan rate, 1-year time deposit rate, and the 31-90 day CP rate in the secondary market all moved downward in 2001-2003 as Figure 10 shows.

Table 7: CBC Interest Rates

Unit: % per annum

Effective date of change	Discount	Accommodations with collateral	Accommodations without collateral
27 June 2000	4.750	5.125	9.625
29 Dec. 2000	4.625	5.000	9.625
2 Feb. 2001	4.375	4.750	9.625
6 Mar. 2001	4.250	4.625	9.625
30 Mar. 2001	4.125	4.500	9.625
23 Apr. 2001	4.000	4.375	9.625
18 May 2001	3.750	4.125	6.000
29 June 2001	3.500	3.875	5.750
20 Aug. 2001	3.250	3.625	5.500
19 Sep. 2001	2.750	3.125	5.000
4 Oct. 2001	2.500	2.875	4.750
8 Nov. 2001	2.250	2.625	4.500
28 Dec. 2001	2.125	2.500	4.375
28 Jun. 2002	1.875	2.250	4.125
12 Nov. 2002	1.625	2.000	3.875
27 Jun. 2003	1.375	1.750	3.625

Source: Financial Statistics Monthly, Taiwan District, Republic of China, The Central Bank of China.



As for its exchange rate policy, the CBC has been used to keeping the NT dollar undervalued in ordinary times in order to stimulate Taiwan's exports and economic growth, as explained above. When faced with a slowdown in economic growth in the period 2000-2003, the CBC was naturally more eager to intervene in the foreign exchange market than in any ordinary period by purchasing foreign exchange in the market to maintain an undervalued NT dollar or to prevent it from appreciating. Deflation in this period further strengthened the justification for the CBC's foreign exchange intervention. Without its intervention, the currency's appreciation would have caused domestic prices to go down, thereby worsening the deflation problem. Therefore, the CBC's foreign exchange intervention during this period was regarded as a good strategy for "killing two birds with one stone." That is, an undervalued NT dollar was believed to be beneficial both in promoting economic growth and in

combating deflation.

The CBC intervened heavily in the foreign exchange market to slow down the appreciation of the NT dollar during the period 2000-2003 when Taiwan enjoyed a huge balance-of-payments surplus. The result was a rapid piling up of foreign exchange reserves and a relatively stable NT dollar exchange rate. The foreign exchange reserves held by the CBC almost doubled from US$106.7 billion at the end of the year 2000 to US$206.6 billion at the end of 2003. The NT$/US$ exchange rate even fell from 32.992 to 33.978, a depreciation of 2.90% relative to the U.S. dollar, during the same period[11].

The by-product of foreign-exchange purchasing by the CBC was a pumping out of reserve money into the financial market. To control the growth of M2 within the target zone, the CBC was obligated to issue CDs and to receive re-deposits from financial institutions so as to sterilize the impact of foreign exchange intervention on reserve money. The CBC's outstanding CDs hence rapidly increased from NT$562 billion at the end of the year 2000 to NT$2,992 billion at the end of 2003, and re-deposits from financial institutions nearly doubled from NT$1,148 billion to NT$2,056 billion over the same three-year period.

Despite these efforts, the CBC's effectiveness in curbing deflation and stimulating economic growth might have been limited for several reasons. First, political unrest and tensions with China had not been eased, and these were major factors weakening private consumption and domestic investment in Taiwan. Second, in view of its high degree of openness, Taiwan's economic performance was closely

[11] During the same period from the end of the year 2000 to the end of 2003, the appreciation rates of the currencies of Taiwan's major export-competing countries relative to the U.S. dollar were as follows:

Japan	South Korea	Hong Kong	Singapore	Malaysia
7.01%	6.04%	0.51%	1.76%	0

linked with that of the global economy. Taiwan could hardly curb deflation based on her own efforts. Third, due to the restrictions imposed by a deteriorating government financial situation, an expansionary fiscal policy could not be implemented. By depending on the CBC's policies alone, the Taiwan economy could not have improved very much. However, we may state that CBC's efforts might have at least shielded the Taiwan economy from a more serious recession and deflation in 2000-2003.

VI. Conclusion

Taiwan is a small open economy that is characterized by an export-oriented path of development. Domestic investment also serves to stimulate the growth of the economy. In recent years, following the rising tide of local political unrest, tensions across the Taiwan Strait, tremendous outward investment to mainland China, and a global recession, Taiwan has also fallen into the trap of deflation.

There have been some major changes in the political and economic environment in Taiwan in recent years. These changes – including political unrest, tensions with China, outbound investment to China, a weakened financial system, and a deteriorating government financial situation – have provided the backdrop for an economic slowdown and deflation in Taiwan. Some global factors, especially the bursting of the Internet and IT bubbles in late 2000 and the rise of China's economy, have heavily influenced both global and Taiwanese prices.

This paper adopts a simplified aggregate demand and aggregate supply (AD-AS) model, and applies quarterly data for the period from 1982 to 2003 to estimate the deterministic equation of the GDP deflator using 2SLS. The empirical results comply with the theoretical model. The aggregate-demand factors, both domestic and foreign, and the aggregate-supply factor represented by the unit output labor cost mostly have a significant impact on deflation.

Based on the regression results, the sources of the decline in the GDP deflator since 1999 are identified. During this period, government expenditures are observed to have decreased. In addition, the development of production technology that has caused the unit output labor cost to fall, the collapse of the bubble economy, the influx of cheap products from China into the world market, and the NT dollar's appreciation

have all contributed to a lower PGDP.

In order to fight deflation, the Central Bank adopted several measures to reduce the extent of price decreases. It lowered the discount rate and the rate on accommodations on many occasions, and occasionally reduced the required reserve ratio to guide the market interest rates in a downward direction. The Central Bank also intervened in the foreign exchange market to maintain an undervalued NT dollar, so as to promote exports and combat deflation at the same time.

Although the Central Bank tried to help solve the deflation problem, its monetary policy could not serve as the only remedy. Various factors still needed to be added to strengthen the recession situation. Therefore, the expansionary effects of a loose monetary environment do not seem to be significant. Fortunately, since 2004, the Taiwan economy is no longer under the threat of deflation.

During this period of deflation, the price configuration has incurred a change, where the PGDP has gone down and the CPI has slightly decreased, but the WPI has gone up. In fact, this kind of price divergence phenomenon has not only appeared during the period of deflation, but has appeared repeatedly on several occasions according to historical data over the years.

In analyzing the reasons why the WPI and CPI trends have diverged since 2002, we find that the WPI increase is mainly due to the huge Chinese demand for raw materials. This has caused the prices of global raw materials and Taiwan's imports to rise, which has further caused the WPI to rise. Another reason is that the domestic economy has been recovering since 2003. As for the CPI decrease, this has resulted from a decrease in the prices of services and PGDP. A decrease in the prices of services is related to the decline in rents and the interest rate. A rise in domestic

unemployment and competition from China's cheap labor has also kept domestic wages steady.

This study has used regression analysis to analyze the decline in the PGDP. However, there are many domestic and foreign factors that affect prices. This study is incomplete in that it has left out certain variables, such as wealth, expectations of the future economic situation, industry outflows, and the impact of political factors. Further studies could focus on overcoming these shortcomings.

References

1. Ahearne, Alan, et al. (2002), “Preventing Deflation: Lessons from Japan’s Experience in the 1990s,” IFDP Paper-number 729, Federal Reserve Board, June.

2. Bank of Japan (2001), The Role of Monetary Policy under Low Inflation: Deflationary Shocks and Policy Responses, Monetary and Economic Studies, Special Edition, Vol. 19, No. S-1, Feb., (A Conference Sponsored by the Institute for Monetary and Economic Studies, Bank of Japan, held in Tokyo, July 3-4, 2000).

3. Cargill, Thomas F. (2001), “Monetary Policy, Deflation and Economic History: Lessons for the Bank of Japan,” in The Role of Monetary Policy under Low Inflation: Deflationary Shocks and Policy Responses, Bank of Japan.

4. Department of Economic Research, the Central Bank of China (2002), “The Deflation Phenomenon in Japan, Hong Kong and mainland China in Recent Years.” (In Chinese)

5. Goodfriend, Marvin (2001), “Financial Stability, Deflation and Monetary Policy,” in The Role of Monetary Policy Under Low Inflation: Deflationary Shocks and Policy Responses, Bank of Japan.

6. Hsu, Hsi-Chang (1992), “Analysis on the Economic Significance of Divergence between the Consumer Price Index and the Wholesale Price Index,” Industrial Economics, Taiwan Cooperative Bank, August, pp. 1-7. (In Chinese)

7. Huang, Chih-Jia (2003), “A Study on Taiwan’s Decreasing Price Trend in Recent Years,” Economic Research, Economic Research Department, Council for Economic Planning and Development, December. (In Chinese)

8. IMF (1999), World Economic Outlook, October.

9. Kumar, Manmohan S. (2003), “Deflation: The New Threat?” Finance & Development, IMF, June.

10. Liu, Shu-Min (2003), “Analysis of the Impact and Effects of Taiwan’s Wholesale Prices on Consumer Prices,” Central Bank of China Quarterly, Volume 25 Issue 2, pp. 37-47. (In Chinese)

11. Rogoff, Kenneth (2003), “Deflation: Determinants, Risks and Policy Options: Findings of an International Task Force,” IMF, April.

12. Shea, Jia-Dong and Tsuen-Hua Shih (1999), “Taiwan’s Financial Policies in Response to the Asian Financial Crisis,” Central Bank of China Quarterly, June, pp. 1-32.

13. The Council for Economic Planning and Development of the Executive Yuan (2003), “Analysis of the Threat of Global Deflation and Its Responsive Strategies,” Background Material, January. (In Chinese)

14. The Economist, “The Risk of Deflation—Comparing Symptoms,” Nov. 9, 2002.

15. Wu, Chung-Shu (2003), “Casting off the Shadow of Deflation,” The Republic of China Economic Yearbook, Economic Daily News, pp. 15-20. (In Chinese)

16. Yang, Ya-Hwei and Jia-Dong Shea (1996), “Money and Prices in Taiwan in the 1980s,” in Financial Deregulation and Integration in East Asia, edited by Takatoshi Ito and Anne O. Krueger, NBER – East Asia Seminar on Economics: Volume 5, The University of Chicago Press, Chicago and London, pp. 229-243.

17. Yang, Ya-Hwei and Jia-Dong Shea (2005), “The New Taiwan Dollar Exchange Rate and Central Bank Intervention,” paper presented at the 4th Symposium on Empirical Economic Papers, Tung-hua University, Taiwan, April; and is published on Taiwan Economic Forecast and policy, the Institute of Economics, Academia Sinica (March 2005). (In Chinese)