Deflation and Price Divergence in Taiwan

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Abstract

Since 1999, Taiwan has experienced deflation, but prices have gradually stabilized, increasing slowly in 2004. During the period of deflation, the price structure changed. The GDP price deflator (PGDP) decreased as did the CPI by a smaller margin. WPI, however, increased. In fact, this kind of price divergence has happened frequently.

This paper adopts theoretical and empirical analyses from 1982 to 2003 to study domestic and foreign factors that cause deflation, and further reviews deflation since 1999, when PGDP dropped. During this period, aggregate market demand was insufficient, fiscal expenditures were cut, unit output labor cost (substituting production technology and key cost factors) decreased, the Internet bubble popped, cheap Chinese products drove down global prices and the NT Dollar appreciated. All of these forced PGDP down.

This paper also analyzes why WPI and CPI trends have diverged since 2002. WPI increased because when the economy recovered as an improved investment and production environment pushed up prices of domestic products. Furthermore, China's growing economic development raised the price of imported raw materials, which further increased WPI. The main reason why CPI decreased was that service prices and general domestic prices decreased. Service prices dropped because of decreases in rent and interest rates.

I. Foreword

Since the Great Depression ended, inflation has been the major headache for and economic decision-makers. Inflation and unemployment rate were as the two major elements constituting the misery index, while deflation was never seriously considered a threat. However, at the end of the 1990s, Japan, China and Hong Kong experienced price decreases, and the rate of price increases in Europe and America also slowed, causing economists and policy makers to pay attention to deflation. The November 2002 issue of *The Economist* even indicated that deflation had become a serious threat to the global economy.

Since 1999, except in 2001, Taiwan's GDP deflator has decreased for four years. The CPI also dropped from 2001 to 2003. Many people in Taiwan are worried about deflation. Although the Central Bank denies that Taiwan is suffering deflation, claiming that core prices, excluding fresh vegetables and fruits, fish and shellfish and energy, showed slightly positive growth in 2001 and 2002, the government has been trying hard to stimulate the domestic economy by expanding public expenditures and maintaining ample funds.

However, Kenneth Rogoff, an expert with the International Monetary Fund, published a report in April 2003, in which he ranked Taiwan, Japan, Hong Kong and Germany among high-risk countries for deflation. Also CPI and core prices published by the Directorate General of Budget, Accounting and Statistics (DGBAS) indicated negative growth in every quarter of 2003. Therefore, deflation became a hot issue of discussion in Taiwan.

However, global and Taiwan prices changed in 2004. Starting from the second half of 2003, the global economic situation gradually improved, and China has been

consuming a lot of global resources like raw materials. In addition, the U.S. dollar depreciation has caused prices of global raw materials to surge, while prices in various countries gradually rose. To prevent inflation, countries like the United Kingdom and Australia have taken precautions, raising interest rates at the end of 2003. China raised deposit reserve rates twice in September 2003 and April 2004 to reduce money supply. In April 2004, Alan Greenspan, chairman of the U.S. Federal Reserve Board, announced that the threat of deflation was gone, so experts generally expect the United States to raise interest rates in Fall, 2004. In Taiwan, CPI and core prices in the first quarter of 2004 rose 0.51 percent and 0.12 percent, respectively, from the same quarter in 2003. The DGBAS forecast in February 2004 also predicted that CPI will rise slightly by 0.48 percent in 2004.

International research institutions are conducting research on deflation, such as 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 2002, where participating scholars emphasized importance of monetary policy in guarding against and dealing with deflation[1].

In Taiwan, on deflation we see only discussions in newspapers and magazines, but not in-depth research. Few references published by government department focus on this issue probably because they deny that Taiwan has a problem. We also see very few studies done by domestic scholars. Among the few research reports, 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) tried to explain each country's experience, causes and responsive strategies to deflation. Chong-Shu Wu (2003) not only analyzed reasons why global price growth since 1997

slowed, but also discussed causes of low prices in Taiwan. Chih-Jia Huang (2003) probed long-term, medium-term and short-term causes leading to the decrease of prices in Taiwan, and provided policy recommendations. Although Wu and Huang talked about causes of Taiwan's deflation, they merely carried out narrative explanations or arguments, without in-depth and careful analysis.

On the other hand, the fact that the three macro-price indexes—PGDP, CPI and WPI showed divergence trends in recent year were also viewed with interest and concern in Taiwan. Nevertheless, it seems that very few scholars in Taiwan have conducted research on price divergence[2].

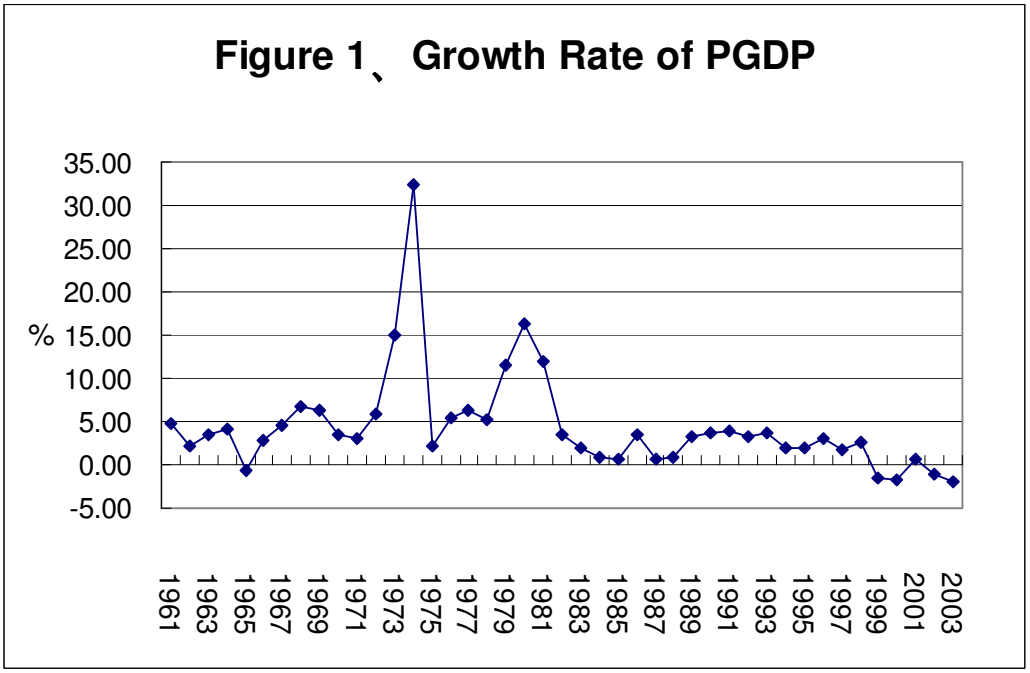
The goals of this article include, applying an aggregate-supply and aggregate-demand (AD-AS) model to use empirical results to explain PGDP slide after 1999 and analyzing causes of price divergence through relation among various price indexes. Given that no serious empirical study on the two phenomenons of deflation and price divergence in Taiwan has been made, this article had no precedent so it may induce further studies.

Section 2 introduces deflation and price divergence shown in Taiwan's macro prices. Section 3 explains two global factors that closely affect Taiwan price change—the burst of the Internet bubble in 2000 and rise of China. The global environment is something that must be understood before analyzing Taiwan's price change in recent years. Section 4 adopts the simplified AD-AS model to conduct estimation of the deterministic equation for Taiwan's PGDP, and uses empirical results to explain PGDP deflation. Section 5 adopts the regression results to explain relation among price indexes, and then uses values and data of related variables to probe main reasons for divergence between WPI and CPI. The final section offers conclusions.

II. Macroprice Change in Taiwan in Recent Years

1. Inflation as Historical Worry and Deflation as New Concern

In April 2003, Taiwan was listed by the IMF as a country that faced high deflation risk, along with Japan, Hong Kong and Germany. The IMF determined degree of deflation in 35 economics based on its deflation risk index, as well as dividing those economics into four categories of high, medium, low and very low risk. Among the economics categorized as high-risk, Japan scored the highest mark, followed by Hong Kong, Taiwan and Germany[3].



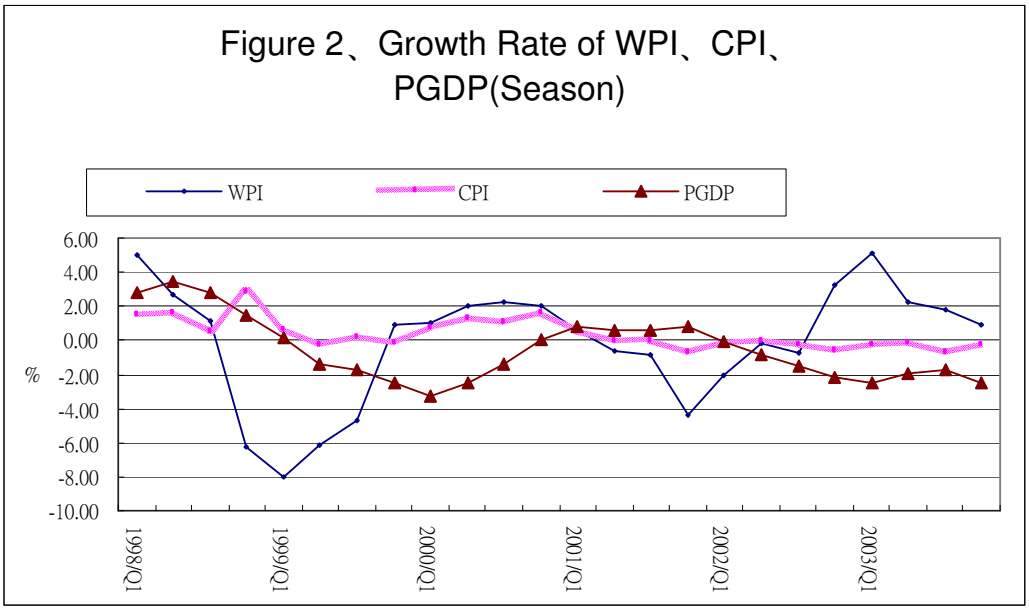
Regarding annual growth rates shown in Fig. 1 for Taiwan's GDP deflator or PGDP from 1961 to 2003, except for 1965 when value was negative (-0.61 percent), all PGDP annual growth rates before 1998 were positive. In other words, prices all surged. Fortunately, for long time inflation was not serious and price increases were steady. The exception was during the two oil crises when prices increased by double

digits. In other years, however, the rate rarely exceeded 5 percent. However, there has been an obvious change since 1999, when PGDP turned negative. Annual PGDP growth was -1.42 percent in 1999, -1.74 percent in 2000, 0.57 percent in 2001, -1.01 percent in 2002 and -1.90 percent in 2003. The IMF and scholars in Taiwan worried that Taiwan may have fallen into deflation[4].

Since 2003, the global economic situation has improved, as has the domestic economic situation. The government optimistically announced that Taiwan had shaken off deflation, though this requires further monitoring. In the last half-year, prices of global prices are rising for raw materials like steel, cement, sandstone, petroleum, coal, wheat, soybeans, butter and paper pulp. In the first quarter of 2004, CPI increased by 0.51 percent from the same quarter in 2003. The core CPI, excluding fresh vegetables, fruits, fish, shellfish and energy, increased by 0.12 percent, and WPI increased by 2.37 percent. The DGBAS forecast that, in 2004, CPI will rise by 0.48 percent and WPI by 0.51 percent. Meanwhile, Academia Sinica forecast that CPI will rise 0.67 percent in 2004 and WPI 0.91 percent. In April 2004, the Chung-Hua Institution for Economic Research forecast that CPI will rise by 1 percent to 1.44 percent in 2004.

2. Divergence of PGDP, CPI and WPI

In recent years, PGDP, CPI and WPI in Taiwan also show divergence, that is PGDP, CPI and WPI are moving in different directions[5]. Fig. 2 indicates that the three price indexes show different floating conditions. For example, from 1999 to 2000, PGDP declined, but WPI and CPI rose slightly. In addition, from 2002 to 2003, PGDP and CPI dropped, leading to concern about deflation. WPI, however, raised—an obvious price divergence.



The fact is that price divergence happens all the time (see Table 1). Since 1982, price divergence has occurred several times, among which the most obvious occurred from 1985 to 1987, 1996 to 1997, and 2002 to 2003 (see Fig. 3). For example, from 1985 to 1992, CPI and PGDP went up, while WPI went down.

Table 1: 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 simultaneous movement in the same direction for the three price indexes.																						

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

2: 'Yes' means simultaneous movement in the same direction for the three price indexes. 'No' means not.

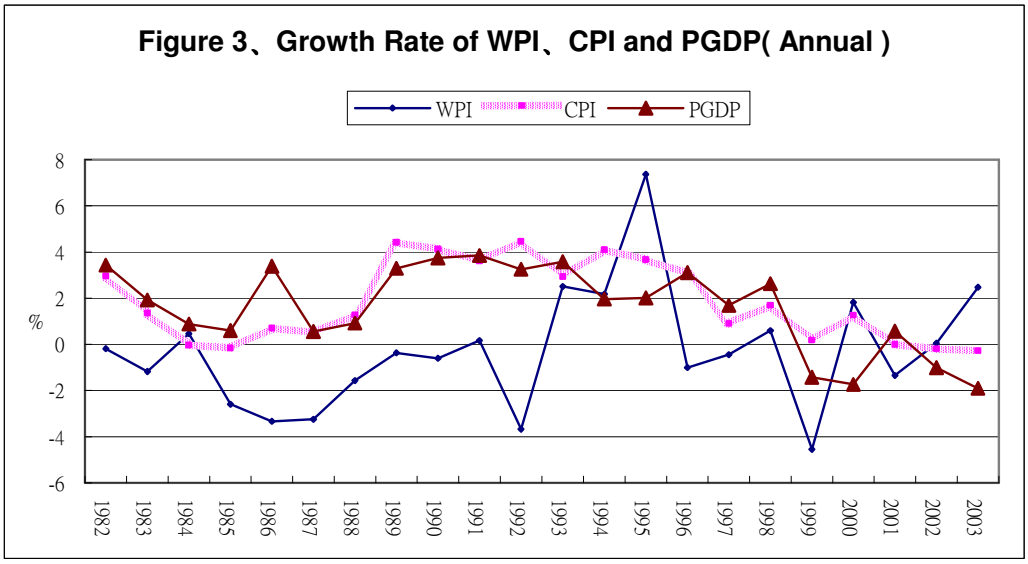


Figure 3、Growth Rate of WPI、CPI and PGDP(Annual)
WPI
CPI
PGDP
%
8
6
4
2
0
-2
-4
-6
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003

III: Global Factors Affecting Price Change

Taiwan is a highly open economy. Since the 1970s, ratio of exports and imports to GDP respectively has almost always remained above 40 percent, sometimes even exceeding 50 percent. The macro economy of Taiwan is thus deeply affected by the global economic situation and prices. At the time of the two energy crises in the 1970s and beginning of the 1980s, prices in Taiwan were seriously affected by global prices. This was called 'imported inflation'. Macroprice decreases and price divergence in recent years are not only caused by domestic factors, but also closely related to two factors that affected the global price change—the bursting of the Internet bubble in 2000 and the rise of China's economy.

An excessively optimistic expectation of the future in technology industries caused excessive investments. After the economic bubble burst at the end of 2000, huge excess capacity was hard to digest so global prices dropped. The bursting of the bubble caused stock markets to sink, wealth to shrink and consumption to wither. Furthermore, the economic situation worsened and unemployment rose, causing consumption to fall.

In addition, producers had excess capacity, profitability dropped and economic outlook was generally pessimistic, so willingness to invest decreased. Therefore, the bursting of the economic bubble resulted in weak consumption and investment, which further caused global prices to drop.

Since China accelerated steps toward a market economy in 1992 and reinforced its dealings with the global economic community in trade and investment, it has had a significant impact on the global economy. With respect to price, rise of China's economy affects global prices in the following ways:

1. China has a huge pool of cheap labor. China has integrated itself into the global economic system, which provides labor to the global market, so its wages cannot rise easily, and may even go down. Even if labor cannot move internationally with ease, free trade makes the wage rate of more-advanced countries to drop (while China's wage rate goes up) according to the factor-price-equalization theorem, further affecting production costs and prices in other countries.

2. Labor-intensive products produced by using China's cheap labor are relatively competitive in terms of price on the global market, lowering the global price of China's exports (mostly finished consumer goods).

3. Most raw materials and parts and components needed for China's public investment and production processes are capital-intensive, technology-intensive or natural-resource-intensive. China lacks comparative advantage for these products. China's massive imports have caused global prices of these products to soar.

4. China's rapid economic development has raised national income and hence private consumption, which has further increased demand for global raw materials.

5. After its WTO accession by the end of 2001, China must accelerate opening its domestic market. In addition, China has procured a lot more from the United States to lower its huge trade surplus, especially for agricultural products such as wheat and soybeans, driving up prices.

6. To prepare for the 2008 Olympic Games and 2010 Shanghai World Exposition, China has begun large public construction projects, which have

caused even higher increases in global prices of raw materials like minerals, cement and petroleum[6].

In general, global prices of China's exports (most are manufactured finished consumer goods) are decreasing, while global price of China's imports (most are upstream raw materials, intermediate products, and machinery and equipment) are rising. However, because China enjoys a huge trade surplus, global price decreases have had a greater impact than increases. Therefore, global prices on average are dropping, which represents deflation.

Besides, China's Renminbi is pegged to the U.S. dollar. While its balance of international payments has been in surplus for years and the U.S. dollar has been depreciating, China still has not allowed the Renminbi to appreciate. The undervalued Renminbi not only reinforces export competitiveness, but also raises global deflation. In the last two years, world leaders and economists have charged that China's cheap exports have interrupted the global price structure. China's manipulation of the Renminbi rate is also a target of criticism and discussion.

IV: Analysis of GDP Deflator Change

1. Theoretical Model

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

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

- + + + + +

(1) Y＝AD (PGDP; GEXP, MS, Pf, Yf, EXR,…)

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 price and global economic situation, respectively; EXR is the exchange rate measuring the value of U.S. dollar in NT dollar. On the right side of the equation, positive or negative symbols on each independent variable represent impact direction of variable to Y. To simplify the analysis, AD in the equation omits certain independent variables that cannot be precisely measured in the empirical study such as expectation of future economic situation or real wealth.

Furthermore, general equation of aggregate-supply function AS can be presented as follows:

+ - + +

(2) Y＝AS (PGDP; W, K, T)

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

+ -

(3) Y＝AS* (PGDP; LC)[7]

Out of equations 1 and 3, PGDP determining equation implied in the AD-AS model derived by us is

+ + + + + +

(4) PGDP＝f (GEXP, MS, Pf, Yf, EXR, LC,…)

Because increase in the first five independent variables at the right end all causes AD curve to move to the right, rise of LC causes AS curve to move to the left, so the six independent variables all have positive impact on PGDP.

2. Empirical Analyses

Based on the above theoretical models, this section conducts empirical analysis. Sources of relevant variables are explained in Table 2. Because the United States and China are Taiwan's most important export markets, this study uses total value of imports (Yf_{US} and Yf_{C}) of the United States and China as representative variables for the global economic situation (Yf) that affects Taiwan PGDP. Data period adopted is from the first quarter of 1982 to the second quarter of 2003.

Table 2: Explanation of Variables

Variable	Definition	Source
PGDP	GDP deflator	Compiled from data on the Web site of the Directorate General of Budget, Accounting and Statistics, Executive Yuan, ROC.
GEXP	Total real expenditure of government	1. Government consumption expenditure is from the database of the Directorate General of Budget, Accounting and Statistics Executive Yuan, ROC. 2. Governmental 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 GDP deflator.
Pf	World export price index	IFS
Yf_{US}	Total U.S. import value	IFS
Yf_{C}	Total Chinese import value	IFS
LC	Indexes 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 Web site.
EXR	Exchange Rate	Central Bank of China Web site.

Because most macroeconomic variables do not conform to the stationary series, this study first uses Augmented Dickey-Fuller Unit Root Tests to examine whether each variable conforms to the stationary series before conducting regression analysis. Here, we apply level value after Log procedure in examining each variable, and apply the first differences of the logged value in examining each variable.

Neither variable reaches a significant level value after the Log procedure, indicating existence of unit-root for each variable. This means that it does not conform to the stationary series. Each variable is significant after the Log procedure and first difference, indicating lack of unit-root after first difference for each variable,

which means that it conforms to the stationary series (see Table 3).

Table 3: Stationarity and Unit-Root Test for PGDP regression

Variables	Level	First Difference
LPGDP	-0.467557	-3.993915**
LGEXP	-1.972623	-4.724681***
LPf	-1.497358	-7.296725***
LYf_{US}	-2.621343	-4.271671***
LYf_{C}	-1.845000	-17.713300***
LLC	0.014136	-4.749465***
LMS	0.444041	-3.448888*
LEXR	-1.054539	-6.053496***

Note: All variables are calculated at Log.
This table uses Augmented Dickey-Fuller Unit Root Tests.
*Significant at 10 percent level, ** significant at 5 percent level,*** significant at 1 percent level.

Table 4: Regression of PGDP

Period	1982 2nd quarter to 2003 2nd quarter	
Dependent Variable	D（LPGDP）	
Independent Variable	C	0.007337 (1.473)*
	D（LGEXP）	0.072041 (6.146)***
	D（LMS）	0.109214 (1.821)**
	D（LLC）	0.059430 (4.491)***
	D（LEXR）	0.105333 (2.436)***
	D（LPf）	0.008425 （0.198）
	D（LYf_{US}）	0.003400 （0.115）
	D（LYf_{C}）	0.015765 （2.107）**
	D2 （2nd Q ＝1, others＝0）	-0.024148 (-3.125)***
	D3 （3rd Q ＝1，others＝0）	0.008843 (1.633)*

	D4 （4th Q ＝1，others＝0）	-0.018573 (-4.134)***
Adjusted R-squared	0.8627	
No. of observations	85	

Note：1. All variables are calculated at Log and First Difference (not including constant C and seasonal dummy variables D2, D3 and D4).

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

3. () is t-value, * significant at 10 percent level, ** significant at 5 percent level,*** significant at 1 percent level (one-tail test)

The regression results of equation (4) are as shown in Table 4. From Table 4, we can induce that variables LGEXP, LYf_C, LLC, LMS and LEXR all present significant positive impact on PGDP, while LPf and LYf_{US} both present positive values albeit not at the significant level. Regarding impact directions of each factor to PGDP, they all conform to the theoretical expectation. As for domestic factors, government expenditures, unit output labor cost and money supply (adopting M2 daily average) all have significant positive impact on Taiwan's PGDP, so it is evident that fiscal and monetary policy all achieve certain effects.

With respect to global factors, exchange rate (NT dollar: U.S. dollar exchange rate) and China's economic situation (applying China's total import value) have significant positive impact on Taiwan's PGDP, while foreign prices (adopting global export prices) and the U.S. economic situation (applying total value of U.S. imports) tend to have positive impact albeit not significant.

PGDP impact factors include domestic and global factors. Among domestic factors, aggregate demand (AD) can be affected by government fiscal and monetary policy, affecting price. Aggregate supply (AS) is affected by unit output labor cost variables, including change of production technology and labor costs, which may have

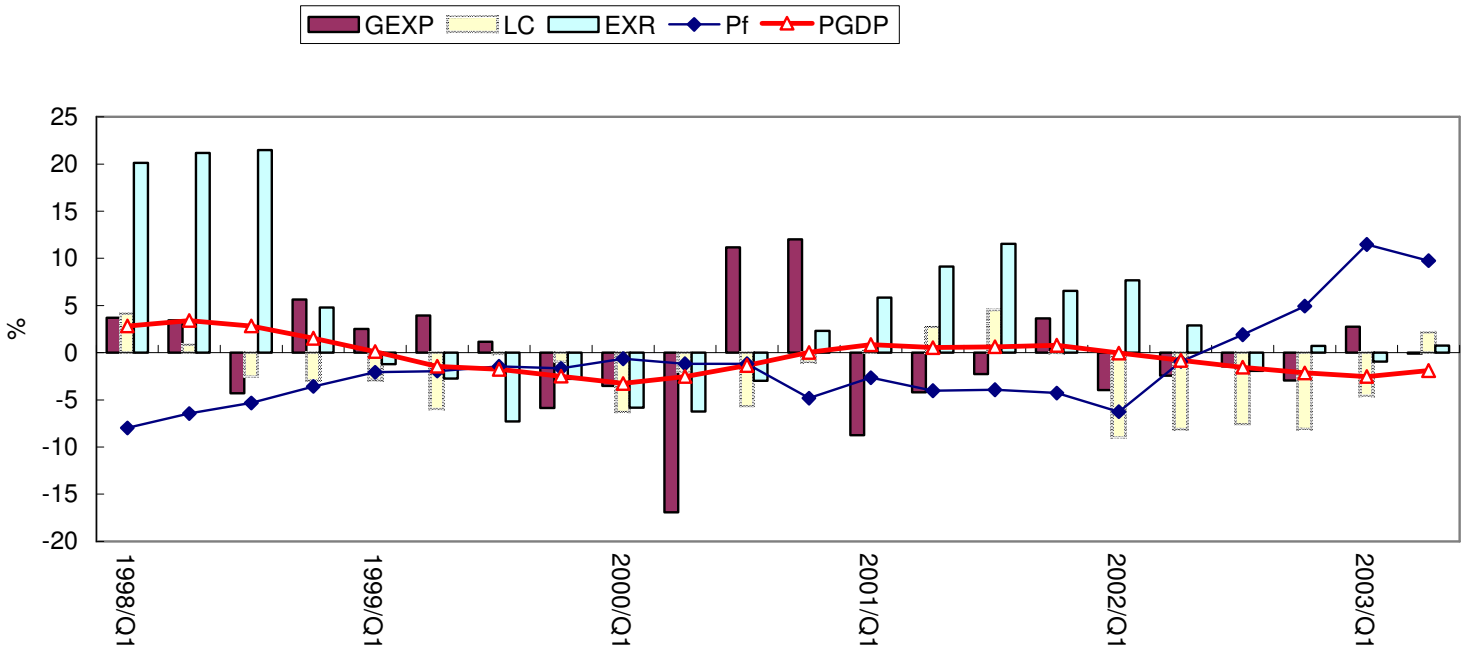
significant impact on price. While global factors have an impact, it is difficult to find representative accurate variables, weakening significance of empirical-result coefficients. It is noticeable that coefficient of China's import value is significant, showing the importance of the China factor.

Since 1999, PGDP has been dropping. This has been affected by several factors. During this period, government expenditures went down (delay in public-construction projects), advanced production technology caused unit output labor costs to go down (2002 negative growth rate of -7.23 percent), the bubble economy collapsed, rise of China's economy depressed prices of finished consumer goods for the global manufacturing industry, and NT dollar began to appreciate in 1999. All these factors caused PGDP to decrease.

Figure 4 shows trends of the three most significant variables (GEXP, LC, EXR). Since 1999, the global export price index has experienced deflation, and this was also one of the reasons contributing to fall in PGDP. However, since 2003 and before Taiwan’s prices rose, global price were already rising.

Besides the explanatory variables mentioned, other variables, such as effect of wealth shrinkage (recession lowered wealth and consumption) and impact of political instability (turbulent political environment fostered outward investment and immigration, and reduced domestic consumption) resulted in weak PGDP. This study, however, does not include the above factors in the model because accurate data is difficult to find, and too many variables might make the model too complicated to handle.

Figue 4、Component of PGDP (Annual Growth Rate)



V. Causes of Price Divergence

1. Regression Analysis of WPI, CPI and Ps

Section 2 of this article discusses how often the divergence among Taiwan's macro-price indexes. Why PGDP, WPI and CPI have shown divergence in recent years deserves further study. We have already explained determinants in PGDP trends. This section analyzes causes of divergence regarding constituent factors of only WPI and CPI.

If we take the period from the fourth quarter of 2002 to the third quarter of 2003 to explain possible factors that cause mutual divergence between CPI and WPI, we find that during the period, CPI slowly dropped, while WPI rose. From the supply side, major WPI factors went up. Taiwan's raw-material and semi-product imports like crude oil, petrochemicals, steel products, natural gas and DRAM continued to rise. Meanwhile, prices of agricultural imports, like soybeans and corn, also rose. These factors are all related to rising demand in China.

The main reasons why CPI decreased, from the supply side, include price cuts for personal computers and peripherals, discounts for promotion of ready-made garments, decreases in certain entertainment service fees, decreases in prices of certain newspapers, drops in rent and fall in automobiles and household durable prices. At the same time, however, the Bureau of National Health Insurance raised self-payments for outpatient services starting in September 2002, causing price increase. From the demand side, the short-term impact of SARS, wage-growth decreases and increase in unemployment resulted in weak private consumption.

This section probes effects of these factors on WPI and CPI and relation among macroprice indicators regarding constituent factors of WPI and CPI. We explain the

main reasons for divergence between WPI and CPI by arrangement and analysis of empirical or related statistics and data.

What WPI measures is factory price or wholesale price of three categories of domestic-produced and domestic-sales (DPDS) products, imported goods and exported goods. It is the weighted average of the three categories of price indexes. Let WPId, PM and PX represent the price index of DPDS products, import price index and export price index, respectively. Take the Log of each variable. Regression analysis using data for the period from the first quarter of 1982 to fourth quarter of 2003 generates regression results shown in Table 5.

Table 5、Regression Resulf of WPI

independent variable / dependent variable	Price Index of DPDS Products LWPId	Price Index of Export LPM	Price Index of Import LPX	Constant C	Obs. Number	Adj-R^2
Wholesale Price Index LWPI	0.6602 *** (39.77)	0.1119 *** (18.80)	0.3151 *** (35.34)	-0.4053 *** (-5.82)	88	0.9958

All variables are calculated at Log, and numbers in parentheses are t-values

*Significant at 10 precent level，**Significant at 5 percent level，***Significant at 1percent level (one-tail test)

Table 5 indicates that the three constituent factors of WPI all have significant positive impact. Looking at each coefficient value as the average of weight of each impact variable during sampling period (1982-2003), weight of the price index of DPDS products (WPId) is 66 percent, weight of the import price index (PM) is 11 percent and weight of the export price index (PX) is 31 percent.

CPI measures include retail price of consumer goods and services, where consumer goods is further divided as local consumer goods and imported consumer goods. Because we cannot obtain data on the local consumer-goods price index, we use PGDP as a substitute variable for local consumer goods. We also use PMc and Ps to represent price indexes of imported consumer goods and services.

CPI, by definition, is weighted average of PGDP, PMc and Ps. Results of the regression estimation conducted by using the double-logarithmic linear equation are presented in Table 6, which shows price indexes of the three kinds of goods indeed have significant positive impact on CPI, among which impact weight of service price to CPI is the highest.

Table 6、Regression Result of CPI

Independent Variable / Dependent Variable	GDP Deflator LPGDP	Price Index of Imported Consumer goods LPMc	Price Index of Service LPs	Constant C	Obs. Number	Adj-R^2
Consumer Price Index LCPI	0.1165 ** (1.72)	0.1313 *** (8.26)	0.5507 *** (15.22)	0.9343 *** (5.16)	88	0.9926

All variables are calculated at Log and numbers in parentheses are t-values.

*Significant at 10 percent level，**Significant at 5 percent level，***Significant at 1 percent level (one-tail test)

Because service price Ps is the major factor affecting CPI, and weight gradually goes up, this study further analyzes factors that affect Ps. Services include housing, transportation, medical and health care, education and entertainment as well as miscellaneous services, which are all formed by physical labor joined by place of business and business appliances. Production costs and prices are mainly determined by wage W, rent R and interest rate r.

This relation is a behavior equation, not definition, so we adopt an estimation method similar to that for PGDP, where we first take Log for all variables, then conduct first difference, making it conform to the stationary series (see Table 7) before conducting regression estimation. Results are presented in Table 8.

Table 7、Stationarity and Unit Root for Ps Equation

Variables	Level	First Difference
LPs	-2.0225	-6.9530***
LW	0.6399	-15.9343***
LR	-1.7398	-3.7801**
Lr	-0.9844	-4.1303***

Note: All variables are calculated at Log.
This table is using Augmented Dickey-Fuller Unit Root Tests
*Significant at 10 percent level, ** Significant at 5 percent level,*** Significant at 1 percent level

Table 8、Regression Result for Ps

Independent Variable / Dependent Variable	Wage D(LW)	Rent D(LR)	Interest Rate D(Lr)	Constant C	Obs. Number	Adj-R^2
Consumer Price Index D(LPs)	0.0234 *** (8.31)	0.6838 *** (7.88)	0.0334 *** (2.70)	0.0043 *** (5.80)	86	0.6708

All variables are calculated at Log and numbers in parentheses are t-value.
*Significant at 10 percent level，**Significant at 5 percent level，***Significant at 1percent level (one-ta

Table 8 shows that the three variables of wage, rent and interest rate all have

significantly positive impact on change in service price index.

2. Influential Factors of Price Divergence

We further explain causes of divergence in wholesale and consumer prices from 2002 to 2003. Components of wholesale price include price of domestic-produced and domestic-sale (DPDS) products (WPId), import price and export price, among which the most important factor is price of DPDS products, which fell during 1998 and 1999. This was the crucial factor in lowering wholesale price, though price began to rise slightly in 2000, before dropping a bit in 2001. Since then, WPI has been rising.

The reason why price of DPDS products dropped was the recession. Lack of effective domestic demand caused domestic prices to slide. Since 2003, the economy has recovered, stimulating domestic demand and price of DPDS products as well as raising WPI.

Import price (PM) is also an important factor affecting WPI. 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 global price of agricultural and industrial raw materials as well as capital goods. It is also affected by price of global consumer goods, exchange rate and customs duties.

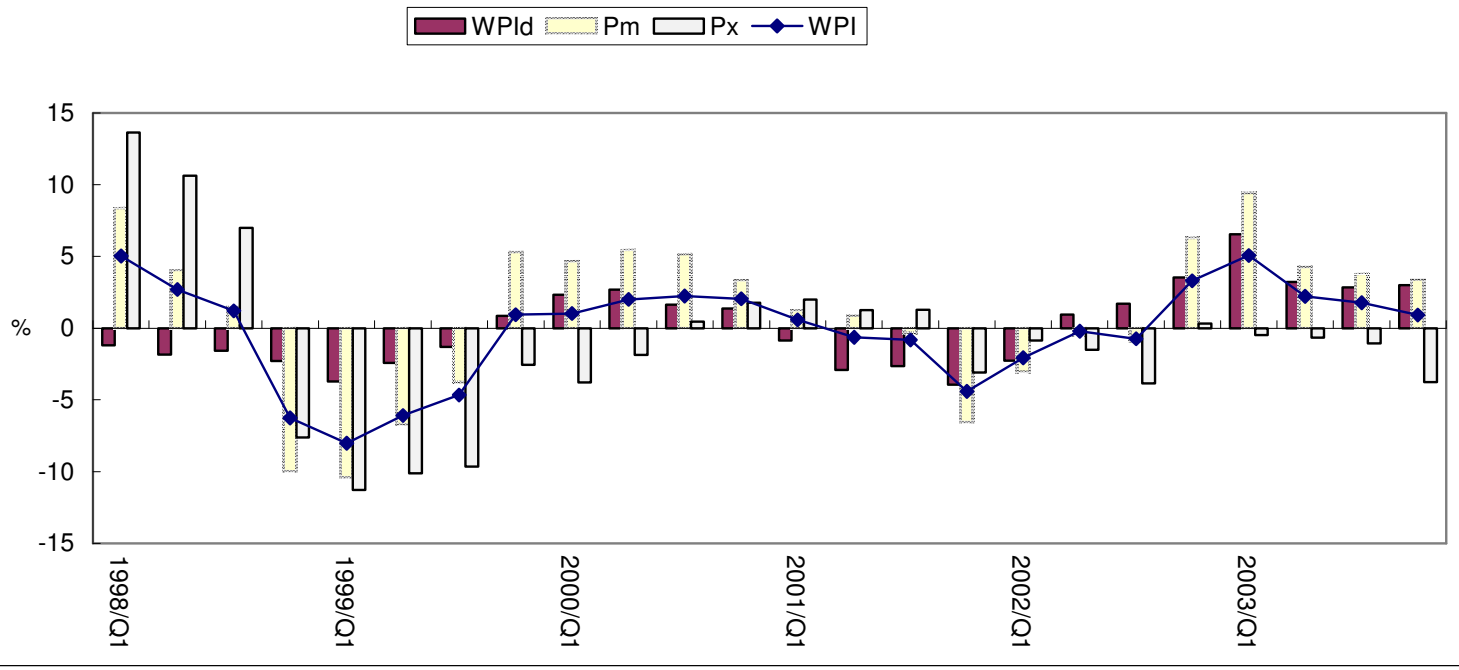
Since the 1980s, effective customs duty rate has decreased, resulting in decreasing import prices. Since 2001, however, the NT dollar has depreciated, pushing up import price. Strong Chinese demand for raw materials has caused global price of that category of goods to soar, thus raising Taiwan's import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

Another factor affecting WPI is export price (PX). Taiwan’s exports mainly include industrial products, among which information industry and electrical

machinery or electronic products constitute the bulk. The former was affected by the Internet bubble collapse, the latter by competition from Chinese exports. Prices were and overall PX has dropped since the second half of 2002. However, because PX has a lower impact weight in WPI than price of DPDS products and PM, WPI has continued to rise since the fourth quarter of 2002.

Figure 5 shows the trend of WPI and its components. WPI rose from the fourth quarter of 2002 to the third quarter of 2003, and during the period, wholesale price index (WPId) for DPDS products rose as well as did the import price index (PM), while export price index (PX) declined. Therefore it is evident that rise in WPI was mainly affected by rise in price of DPDS products and import price.

Figure 5、 Component of WPI (Annual Growth Rate)



CPI trends were different from those of WPI. From the fourth quarter of 2002 to the third quarter of 2003, WPI surged, while CPI fell. Composition of CPI price includes consumer-goods and service price. Consumer-goods price encompasses local consumer goods and imported consumer goods.

Trends of CPI, PGDP, PM_C and Ps are presented in Fig. 6, where PGDP is the substitute variable of domestic-consumer-consumption goods price. The figure shows CPI and Ps trends nearly follow each other. CPI decrease since 2001 was closely related to service-price decrease. And the decrease of CPI was affected by decrease in GDP deflator.

Figure 6、Component of CPI (Annual Growth Rate)

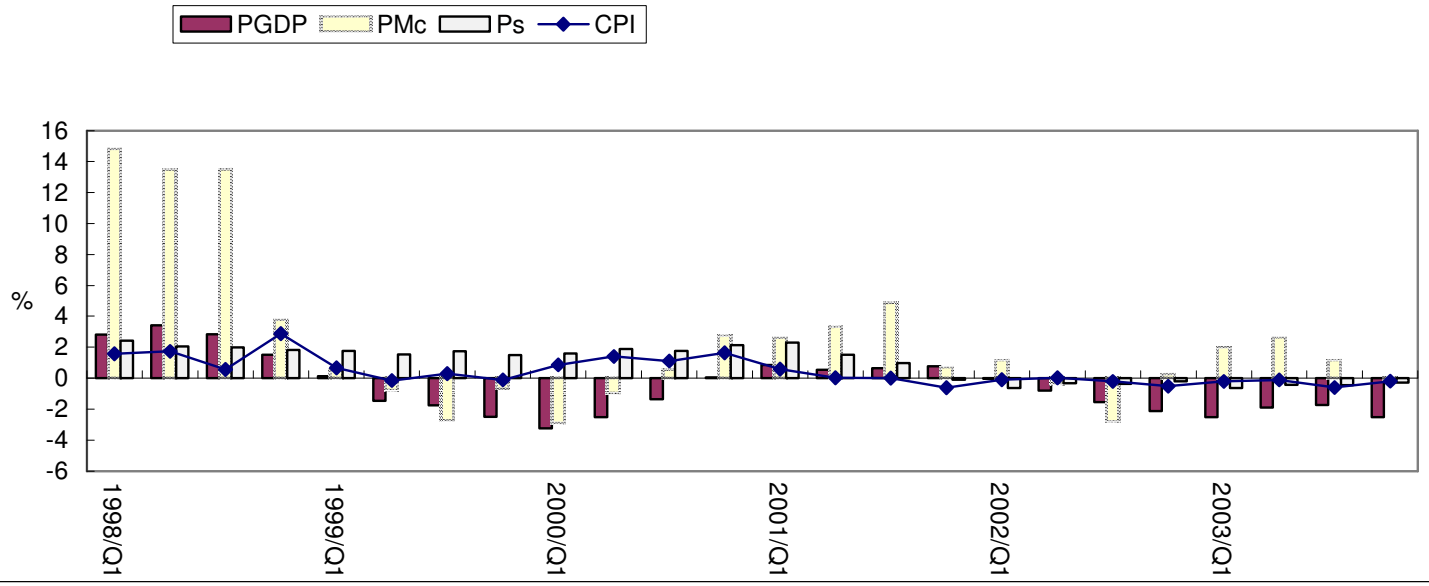


Figure 7、Component of Ps (Annual Growth Rate)

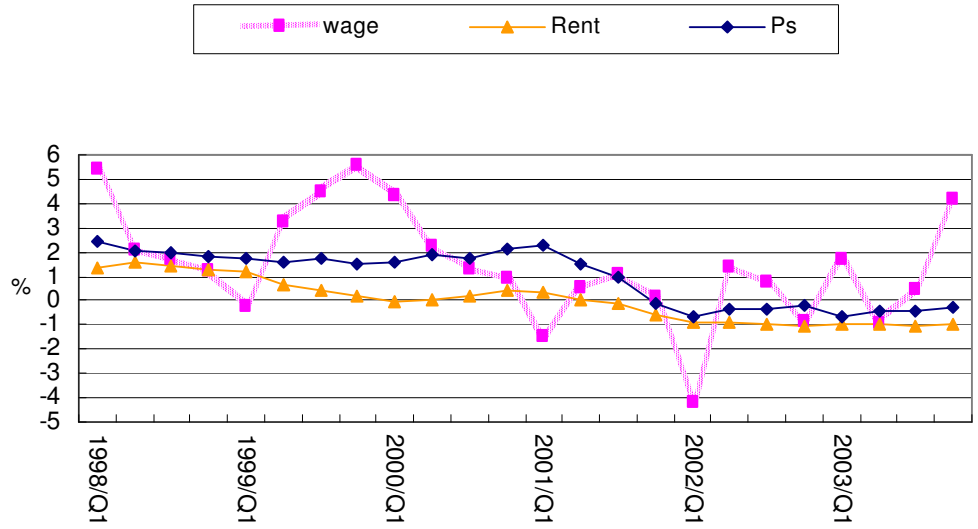
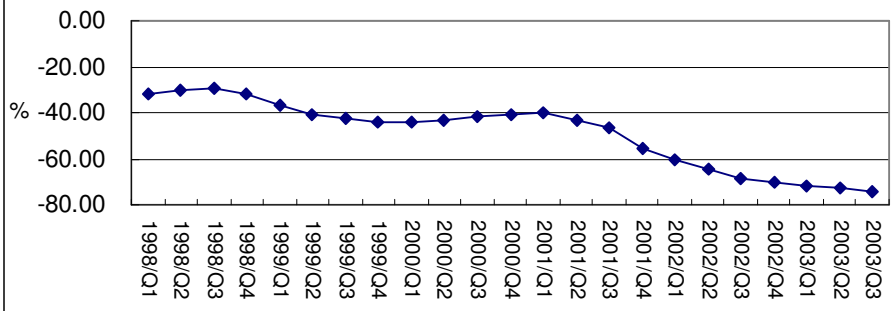


Figure 8、Growth Rate of Interest Rates (Annual Growth Rate)



Because service price (Ps) is a major factor affecting CPI, we study reasons for decrease in Ps. Empirical results in Table 7 indicate that Ps is affected by wage (W), rent (R) and interest rate (r). Of these, rent R has highest degree of impact. Fig. 7 also indicates Ps and rent trends are close. Continuous decrease in interest rate (see Fig. 8) reinforced drop in Ps.

Falling rent was mainly affected by factors like weak domestic economy, migration of companies and labor, and oversupply of houses and office buildings. Low wage was influenced by competition from Chinese labor, increase in domestic unemployment and inflexibility of wage adjustment. The drop of interest rates was because central banks of many countries adopted low-interest-rate policy to stimulate the economy in reaction. Japan has maintained a low interest-rate policy for years. The United States has also adopted low interest-rate policy, with Taiwan following suit.

VI. Conclusions

Taiwan's price has shown fluctuation. Since 1999, Taiwan experienced deflation. Then, the price slowly stabilized, and rose in 2004. During this period, price configuration incurred change, where PGDP dropped and CPI decreased, but WPI went up. In fact, this kind of price divergence not only appeared during recent period of deflation, but several times before.

There are many causes of price fluctuation, including domestic and global factors. Factors that affect aggregate domestic demand include government expenditures and money supply. Factors that affect aggregate domestic supply include production cost and technology, which are represented by unit output labor cost. As for foreign factors, they include global economic situation and relative prices. Recently, China's economy has picked up steam, not only affecting global price trends, but also Taiwan prices.

This paper adopts the aggregate-demand and aggregate-supply (AD-AS) model, applying quarterly data from 1982 to 2003 to conduct empirical study and analyze impact factors of GDP deflator. We further analyze reasons why PGDP has dropped in recent years. Impact factors of PGDP include aggregate demand and aggregate supply. Aggregate demand is influenced by domestic and global factors. Among domestic factors, government fiscal and monetary policies and important factors affecting price.

Aggregate supply (AS) is affected by unit output labor cost, implying that change in production technology and labor costs may have significant impact on price. As for global price (represented by exchange rate and global-export price) and foreign economic condition (represented by U.S. and China import value), they have an impact on price, but empirical result coefficients are insignificant. This may be because it is hard to find representative precise variables. However, China variables

are significant and their impact should not be ignored.

We analyze the reasons for decrease of PGDP since 1999. During this period, government expenditures have decreased. In addition, development of production technology has caused unit output labor cost to drop as have collapse of the bubble economy and cheap Chinese products entering the market. NT dollar appreciation has also contributed to lower PGDP.

Analyzing the reasons why WPI and CPI trends have diverged since 2002, we find that WPI increased mainly because of huge Chinese demand for raw materials. This caused price of global raw materials and Taiwan's imports to rise, further causing WPI to rise. Another reason is that the domestic economy has been recovering since 2003, and the investment and production environment has pushed price of domestic products higher.

In terms of CPI decrease, it resulted from decrease in service price and domestic PGDP. Service-price decrease is related to falling rent and decreasing interest rates that lowered costs. Rise in domestic unemployment and China's cheap labor also kept domestic wages steady, lessening increase in service-production cost.

This study takes empirical regression to survey price configuration. However, there are many domestic and foreign factors that affect price. It is incomplete to leave out certain variables (such as wealth, expectation of future economic situation, industry outflow and impact of political factors) or applying substitute variables due to lack of precise measurement variables (such substituting PGDP for price of domestic consumer products). Further study can be tried to overcome these shortcomings.

Notes

[1] The theme of the seminar held by the Bank of Japan (2001) was "The Role of Monetary Policy under Low Inflation," where participants mostly emphasized importance of monetary policy during deflation. For example, Cargill thought that central banks focus more on monetary-environment control policy during inflation, but neglect seriousness of deflation, failing to actively use monetary-policy tools to prevent it. This was one of the main reasons for the Great Depression in the 1930s. Sweden is different from the United States in that it emphasizes price-level objective policy, paying close attention to deflation. Cargill suggested that Japan follow Sweden's example. Goodfriend also believed that monetary policy is the fundamental reason for deflation and economic stagnation.

[2] The ROC Directorate General of Budget, Accounting and Statistics analyzed domestic price divergence in October 2003, but did not publicly announce the results. Yang and Shea (1996) probed 1980s prices, indicating that the skyrocketing stock and real estate markets, appreciating NT dollar and reduced import duties were all reasons why money supply surged but prices remained steady. Monetary environment during the 1980s was very different from the period after 2000.

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

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

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

[6] China consumed approximately 50 percent of the world's cement, 36 percent of steel products and 30 percent of coal in 2003. In 2003, China's demand for steel products was 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. Quantity of steel products imported increased by 17.5 percent compared with the first quarter of 2003, with total value up by 28.4 percent. In 2003, China imported 91,120,000 tons of crude oil (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. Volume of crude oil imports increased 35.7 percent compared with the first quarter of 2003 and total value by 41.2 percent. This shows that unit prices for steel products and crude oil surged.

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

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