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8 Money and Prices in Taiwan in the 1980s

Ya-Hwei Yang and Jia-Dong Shea

8.1 Introduction

Taiwan's experience with economic development has been unique and surprising in many respects. In the 1980s, another surprising phenomenon took place in Taiwan. As reported in table 8.1, the average annual growth rate of the money supply in the period 1981–89 was as high as roughly 20 percent, while the GDP deflator and CPI had grown only 2.99 and 3.10 percent, respectively, on average. The WPI had even fallen by an average rate of 0.49 percent annually. If we consider only the years 1986 and 1987, the difference between the growth rates of the money supply and those of prices is even more astonishing. In these two years, the M1A, M1B, and M2 supplies increased 39.24, 44.62, and 25.93 percent, respectively, on average, while the GDP deflator, WPI, and CPI increased merely 1.94, −3.30, and 0.84 percent.[1]

A high growth rate in the money supply accompanied by a low inflation rate was not a new experience in Taiwan. As table 8.1 shows, during the period 1962–80, the money supply in Taiwan increased by an average annual rate of around 21–24 percent, while domestic prices only grew by an average rate of

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1. M1A includes currency outside monetary institutions, checking accounts, and passbook deposits. M1B includes M1A and passbook savings deposits. M2 includes M1B, time deposits, time savings deposits (including deposits replaced by the postal savings system), foreign currency deposits, foreign exchange proceeds deposits, foreign exchange trust funds, negotiable certificates of deposit, and foreign currency certificates of deposit of enterprises and individuals in monetary institutions; in addition, bank debentures issues, savings bonds, and Treasury bills–B issued by the central bank held by enterprises and individuals are included.

Table 8.1 **Annual Growth Rate of Prices and Money Supply (%)**

	Prices			Money Supply		
Period or Year	GDP Deflator	WPI	CPI	M1A	M1B	M2
1962–70[a]	3.62	1.86	2.92	17.21	18.15	21.10
1971–80[a]	10.32	10.66	11.07	24.04	26.34	26.44
1962–80[a]	7.14	6.49	7.21	20.80	22.46	23.91
1981–89[a]	2.99	−0.49	3.10	18.13	20.88	21.98
1981–93[a]	3.22	−0.46	3.31	13.97	17.01	19.90
1981	12.07	7.63	16.33	9.03	13.79	18.65
1982	3.43	−0.19	2.96	5.91	14.60	24.29
1983	1.91	−1.17	1.37	14.73	18.44	26.42
1984	0.89	0.46	−0.03	5.75	9.25	20.06
1985	0.59	−2.59	−0.16	7.93	12.22	23.38
1986	3.38	−3.34	1.16	46.14	51.42	25.29
1987	0.49	−3.26	0.52	32.34	37.82	26.56
1988	1.07	−1.56	1.29	23.41	24.37	17.86
1989	3.11	−0.37	4.40	17.89	6.06	15.26
1990	3.80	−0.61	4.13	−9.45	−6.62	9.86
1991	3.90	0.16	3.62	6.61	12.08	19.28
1992	3.72	−3.67	4.47	8.34	12.43	16.60
1993	3.53	2.51	2.94	12.95	15.28	15.13

Sources: GDP deflator (PGDP), *Quarterly National Income Statistics in Taiwan Area, R.O.C.* (Taipei: Directorate-General of Budget, Accounting and Statistics [DGBAS], Executive Yuan, Republic of China, various issues); WPI and CPI, *Commodity-Price Statistics Monthly in Taiwan Area, R.O.C.* (Taipei: DGBAS, Executive Yuan, Republic of China); M1A, M1B, and M2, *Financial Statistics Monthly, Taiwan District, R.O.C.* (Taipei: Central Bank of China, various issues).

[a]Average annual value.

about 6.5–7.2 percent. Economists in Taiwan used to explain this phenomenon by pointing out that the income elasticity of money demand in Taiwan was as high as 1.2–1.5 and the economic growth rate was also quite high.[2] By multiplying the average economic growth rate of 1962–80, 9.8 percent, by the income elasticity, 1.5, they argued that economic growth alone had produced an increase in real money demand of 14.7 percent annually on average, which left a discrepancy of about 6–9 percent with the average annual growth rate of the money supply, 21–24 percent. This discrepancy is roughly equal to the average rate of increase in the deflator of 7.14 percent in this period.

2. Several scholars have put forward different views to explain this high income elasticity of money demand. Tsiang (1977) argues that import and export transactions create extra demand for money that is not taken care of by the national income variable. Shea (1983) shows that the processes of monetarization, financial development, and specialization in the production process have all contributed to the high income elasticity of money demand in Taiwan. Further, as Wing Woo pointed out during the discussion at the EASE conference in Singapore, Taiwanese residents were prohibited from holding foreign assets before the mid-1980s, so that a large proportion of accumulated wealth must have taken the form of money. This also helps to explain Taiwan's high income elasticity of money demand.

This line of argument explains the relationship between the money supply and prices during 1962–80 in Taiwan reasonably well. However, its power to explain the experience in the 1980s seems much weaker. In 1981–89, if the income elasticity of money demand remained at 1.5, an 8.0 percent average growth rate of real GDP should have increased real money demand by 12 percent. Subtracting from the average growth rate of the money supply of about 20 percent the average growth rate of real money demand and the average growth rate of the GDP deflator of about 3 percent, we obtain a significant discrepancy of 5 percent. Thus, we need other factors to explain why money demand in this period increased at a higher rate and created this discrepancy. Alternatively, we need to examine whether there were other factors beneficial to the stabilization of prices.

This issue has attracted the attention of numerous scholars in Taiwan. Many of them, such as Wu (1989), Huang and Ouyang (1989), Lin and Lee (1989), Shih (1990), Chiu and Hou (1993), and Wu and Shea (1993), emphasize that prosperous stock and real estate transactions in this period created a great deal of transactional demand for money.[3] Although there are no official data on the value of real estate transactions, table 8.2 shows that the total trading value of listed stocks increased drastically from NT$195.2 billion in 1985 to NT$25,408 billion in 1989.

It is generally believed that a large proportion of the investment in stocks and real estate in this period was motivated by speculation. In fact, this period, especially the latter half of the 1980s, can be called an era of speculation. In addition to speculative transactions in stocks and real estate, other gambling activities, such as the "everybody-happy lotto" (*ta-chia-lo*) in the first half of the 1980s and the "six-combination lotto" (*liou-her-tsai*) in the latter part of the 1980s, were also very popular. Although, again, official data are unavailable on the volume of these gambling activities, they absorbed an enormous amount of money balances.

In addition, since the mid-1980s, Taiwan's currency has been "locally internationalized" in the sense that it has been circulating in Southeast Asian countries and in part of mainland China, especially the newly developing southeastern provinces. There are also reports that some commodity or real estate transactions in mainland China between Taiwanese businessmen have been paid in Taiwanese money in Taiwan. These factors have also created additional demand for money in Taiwan.

3. Empirical evidence supporting the argument that the trading value of stocks would "absorb" money can also be found in Field (1984), Wenninger and Radecki (1986), Friedman (1988, appendix B), and Allen and Connolly (1989), all concerning the experience of the United States. As Friedman (1988) points out, there are several channels by which the stock market affects money demand. The transactional demand effect is just one of them. This paper will emphasize only the transactional demand effect. Empirical studies concerning the substitution effect of stock prices in Taiwan by regressing money demand or inflation rate on the expected increase rate of stock prices can be found in Liang (1989).

Table 8.2 Factors Contributing to Price Stabilization

Year	Total Trading Value of Listed Stocks (billion NT$)	Exchange Rate at End of Year (NT$/U.S.$)	Effective Tariff Rate[a] (%)	Import Price Index (1991 = 100)	Export Price Index (1991 = 100)
1980	162.1	36.01	8.88	131.13	110.34
1981	209.2	37.84	8.06	141.37	116.52
1982	133.9	39.91	7.85	139.80	117.73
1983	363.8	40.27	8.41	136.33	116.67
1984	324.5	39.47	8.68	135.13	116.91
1985	195.2	39.35	8.40	133.13	116.75
1986	675.7	35.00	8.44	115.79	111.80
1987	2,668.6	28.55	7.56	107.28	103.57
1988	7,868.0	28.17	6.12	106.22	100.82
1989	25,408.0	26.17	6.69	100.52	97.07
1990	19,031.2	27.11	5.74	102.89	99.46
1991	9,682.7	25.75	5.23	100.00	100.00
1992	5,917.1	25.42	5.40	93.08	94.62
1993	9,056.7	26.67	5.26	97.41	99.53

Sources: Total trading value of listed stocks, *Taiwan Stock Exchange Statistical Data* (Taipei: Taiwan Stock Exchange, various years); exchange rate, *Financial Statistics Monthly, Taiwan District, R.O.C.* (Taipei: Central Bank of China, various issues); tariff revenue, *Yearbook of Tax Statistics, R.O.C.* (Taipei: Department of Statistics, Ministry of Finance, Republic of China, various years); import value, *Monthly Statistics of Exports and Imports in Taiwan Area, R.O.C.* (Taipei: Department of Statistics, Ministry of Finance, Republic of China, various issues) (imports are recorded upon completion of all customs formalities); export price index and import price index, see source for WPI and CPI in table 8.1 (f.o.b. for export price index and c.i.f. for import price index).

[a]Effective tariff rate = Tariff revenue/(Import value − Tariff revenue).

As for price-stabilizing factors, the factors most often emphasized include the appreciation of the NT dollar, import decontrol, and the stabilization of international prices. These factors have all contributed to the lowering or stabilization of prices for traded goods. According to table 8.2, the exchange rate of the U.S. dollar relative to the NT dollar dropped steadily from 40.27 at the end of 1983 to 26.17 in 1989 and, after a short rebound, to 25.42 in 1992. The effective tariff rate, defined as the proportion of total revenue of customs duties relative to total import value, also fell, from 8.68 percent in 1984 to 5.23 percent in 1991. These factors pushed the import price index from 141.37 in 1981 to 100.52 in 1989 and, after a rebound in 1990, further to 93.08 in 1992. The export price index also dropped, from 117.73 in 1982 to 97.07 in 1989 and, after a two-year rebound, to 94.62 in 1992.

Since imported goods constitute a large proportion of the commodities covered by both the WPI and CPI measures and exported goods are also included in the measure of WPI, the lowering of the import price index and the export price index in the 1980s naturally had the effect of stabilizing the WPI and CPI. However, among the components of final demand on GDP, imports is a subtracting term. To argue that the lowering of import prices is beneficial to

the stabilization of the GDP deflator therefore requires further theoretical justification.

Chen and Chen (1989) follow the quantity theory of money under an open economy to set up the following commodity market equilibrium condition

$$MV/P + T(Y, P_m/P) = Y,$$

where M is the money supply, V is the income velocity of money, P is the GDP deflator, T is the balance of trade, P_m is import prices, Y is real GDP, and MV/P denotes domestic expenditure. Based on this equation, Chen and Chen show that money supply and import prices have positive impacts, while real GDP has a negative impact on the GDP deflator. Further, they show theoretically, as well as empirically with Taiwanese data from 1962 to 1986, that as the ratio of imports relative to GDP increases, the impact of import prices on the GDP deflator rises and the impact of the money supply falls. Their results therefore support the argument that the lowering of import prices in Taiwan in the 1980s helped stabilize the GDP deflator. Ou's (1991) empirical study covering the period from 1970.1 to 1990.4 also concludes that import prices had more influence than money supply on both the GNP deflator and the CPI, by comparing the accumulated impacts over eight quarters.

This paper intends to resolve the above-mentioned puzzle of how Taiwan could have a high growth rate of money supply and a low inflation rate at the same time in the 1980s, by adding stock trading value and import prices into the list of explanatory variables in the domestic price equation. Since the impact of import prices on the WPI and CPI is so apparent, we take the GDP deflator as the measure of domestic prices. Although, as mentioned above, several studies have stressed the extra money demand caused by stock and real estate transactions, Huang and Ouyang (1989) is the only one that takes price change rather than money demand as the dependent variable in the estimated equation and includes both stock transactions and import prices as explanatory variables. However, in that paper the price variable considered is the CPI, and no adequate theoretical foundation is given to justify the inclusion of both import prices and stock transactions as explanatory variables. This paper will first propose in section 8.2 a theoretical model that relates the GDP deflator to money supply, stock transactions, and import prices, as well as other traditional variables. In section 8.3, the actual data for Taiwan over the period from 1978.1 to 1993.2 are then applied to estimate the price equation. Section 8.4 summarizes the major findings of this paper.

8.2 The Model

In order to examine the money and price phenomenon in the 1980s, our model will incorporate the stock transaction and import price factors that played an important role in Taiwan then. To include the factors mentioned above as explanatory variables, we follow the tradition of equating money de-

mand and money supply to determine the general price level, which is defined as the GDP deflator in this paper.

We break down the demand for money into transactions demand and portfolio demand. The former covers money that is held for the purpose of paying for domestic purchases of production factors, intermediate inputs, final products, and assets. The total payment for the purchase of production factors and intermediate inputs is closely related to the value of nominal GDP; the domestic purchase of final products is measured by total nominal domestic expenditures in national income accounting; and asset transactions can be proxied by the trading values of listed stock and real estate.

Assume the transaction velocities of circulation of money held for the above four categories of transactions differ among themselves and are all negatively related to the interest rate. Then, the transactions demand for money in nominal terms MT can be written as[4]

$$\mathrm{MT} = f(\mathrm{PGDP}^*\mathrm{GDP},\ \mathrm{PGDP}^*\mathrm{GDP} - \mathrm{BT}(\mathrm{GDP}, \mathrm{PGDP}, \mathrm{PM}),\ \mathrm{S},\ \mathrm{RET},\ r),$$

where PGDP is the GDP deflator; GDP is real GDP; PM is import prices; BT is the nominal balance of trade with $\partial \mathrm{BT}/\partial \mathrm{GDP} < 0$, $\partial \mathrm{BT}/\partial \mathrm{PGDP} < 0$, and $\partial \mathrm{BT}/\partial \mathrm{PM} > 0$ if the Marshall-Lerner condition holds; S is the total transaction value of listed stocks; RET is the value of real estate transactions; and r is the interest rate.[5] The partial derivatives of this transactions demand equation with respect to the first four explanatory variables are all positive, and the partial derivative with respect to the interest rate is negative. Thus, the equation for the transactions demand for money can be reexpressed as

$$\mathrm{MT} = f(\underset{+}{\mathrm{PGDP}},\ \underset{+}{\mathrm{GDP}},\ \underset{+}{\mathrm{S}},\ \underset{+}{\mathrm{RET}},\ \underset{-}{\mathrm{PM}},\ \underset{-}{r}). \tag{1}$$

The plus or minus sign above each right-hand-side variable denotes the sign of the partial derivative of the left-hand-side variable with respect to that particular variable.

According to portfolio theory, the portfolio demand for money is a decreasing function of interest rate, expected inflation rate, and expected returns, including capital gains and dividends or rental of stock and real estate investments. Since the values of the expected inflation rate and the expected return on stocks and real estate are very difficult to measure, this paper omits these variables and simply defines the equation of portfolio demand for money MP as

4. Since each category of transaction applies a different price deflator, it is difficult to define an appropriate deflator for the demand for money, if we specify the money demand equation in real terms. Based on the same argument, Field (1984) and Wenninger and Radecki (1986) specify their money demand equations in nominal terms like ours when they incorporate asset transactions into their equations.

5. Note that PGDP*GDP − BT denotes total nominal domestic expenditures. Examples of relating nominal money demand to nominal domestic expenditures can be found in Dornbusch (1980, chap. 7) and Chen and Chen (1989).

$$MP = f(\bar{r}) . \tag{2}$$

Let us equate money supply M and money demand M^d, which is the sum of transactions demand MT and portfolio demand MP:

$$M = M^d = MT + MP. \tag{3}$$

We solve this equation for PGDP with the allowance of an one-period lag of influence of import price, yielding

$$PGDP = f(M, GDP, S, RET, PM(-1), \bar{r}), \tag{4}$$
$$(+ \quad - \quad - \quad - \quad + \quad +)$$

where PM(−1) denotes import prices of the last period. This equation indicates that money supply, import prices of the last period, and interest rate all have positive effects on the GDP deflator of the current period, while real GDP and the total values of stock transactions and real estate transactions have negative effects on the GDP deflator.

The above four equations constitute the theoretical model in this paper. In macroeconomic theory, the price level or inflation is determined by a complete aggregate demand–aggregate supply (AD-AS) model. Our model of equating money demand and money supply presents only the LM equation in the complete AD-AS system. However, the relationship among macrovariables that holds in a complete macrosystem should also hold in each equation of the system. To avoid complicating the discussion by introducing other variables into the model, we stick to this simple LM equation rather than using a complete macromodel in the analysis, so that we can concentrate on the impacts of money supply, stock trading value, and import prices on the GDP deflator.

8.3 Empirical Results

We apply the actual data for Taiwan to estimate equation (4). However, since data for real estate transactions are not available and are very difficult to estimate accurately, the variable RET will be omitted in the estimation equation.[6] In addition, to make the estimated coefficients more meaningful, the logarithmic form is taken for all variables except interest rate. The period encompassing the 1980s is our key period of study. Quarterly data from 1978.1 to 1993.2 are analyzed. Both narrow and broad definitions of money, M1A, M1B, and M2, are used in this empirical study in logarithmic form, LM1A, LM1B, and LM2.

6. A general impression in the 1980s was that the value of real estate transactions usually moved closely with stock transactions. In other words, the value of real estate transactions was highly correlated with that of stock transactions. Therefore, omitting the variable RET in the equation estimation should not affect our results much.

We rewrite the empirical model as follows:

$$\text{LPGDP}_t = f(\text{LGDP}_t, r_t, \text{LM}_t, \text{LS}_t, \text{LPM}_{t-1}),$$

where LPGDP, LM, LGDP, LS, and LPM are the logarithmic forms of PGDP, M, GDP, S, and PM, respectively. It deserves mentioning that PM is expressed by an index transformed from NT dollars after tariff, therefore NT dollar appreciation and import decontrol are already taken into consideration. Data sources of variables are reported in the notes to tables 8.1, 8.2, and 8.5.

There is now much evidence that many macrovariables are nonstationary. We first examine the existence of unit roots using the augmented Dickey-Fuller test as shown in table 8.3. It is found that all the variables in logarithmic form have a unit root and that the first differences of these variables do not possess unit roots. In other words, these variables should be differenced once to obtain stationary variables.

Engle and Granger (1987) point out that nonstationary variables may be cointegrated in the sense that certain linear combinations of these variables are stationary and hence suggest some long-run equilibrium relationships. We

Table 8.3 **Augmented Dickey-Fuller *t*-Statistics**

Variable	Level	First Difference
LPGDP	−2.3429	−5.4023***
LGDP	−2.3240	−10.4494***
r	−2.1168	−3.3080*
LM1A	−1.1367	−3.7300**
LM1B	−1.1590	−3.6791**
LM2	−0.6647	−3.8373**
LPM	−2.6715	−3.3530*
LS	−1.6548	−4.1901***

Note: MacKinnon critical values: 1 percent, −4.1109; 5 percent, −3.4824; 10 percent, −3.1689.
*Significant at 10 percent level.
**Significant at 5 percent level.
***Significant at 1 percent level.

Table 8.4 **Engle-Granger Cointegration Test**

Vector	LPGDP LGDP *r* LPM(−1) LS LM1A	LPGDP LGDP *r* LPM(−1) LS LM1B	LPGDP LGDP *r* LPM(−1) LS LM2
Dickey-Fuller *t*-statistic	−3.5373	−3.7289	−3.4625

Note: MacKinnon critical values: 1 percent, −6.0487; 5 percent, −5.3332; 10 percent, −4.9786.

execute the cointegration test and show the results in table 8.4. We found that there is no cointegration among these variables, regardless of the definition of money. Therefore, we take differences of all variables before we perform the regression analysis, so as to avoid the problem of spurious regression (Granger and Newbold 1974).

One other thing deserving attention is the structural change in stock trading. The stock market was stable before the mid-1980s. It started to rise around 1986, and the boom continued for several years. The stock price index rose almost steadily from 746 in 1985 to 8,616 in 1989. Then, the central bank adopted a contractionary monetary policy in 1989 by raising the rediscount rate and the required reserve ratio of deposits. This contractionary policy did have its effect. The stock market bubble burst in 1990. The stock price index fell almost 80 percent from its peak of 12,495 in February 1990 to a low of 2,560 in October. By March 1991, it had recovered to 5,000, and stock trading became stable again. Therefore, when we consider the influence of the stock market, the period between 1986 and 1991 should be taken into special consideration. In the regression equation, we add a dummy variable T, with the value of 1 for this period, and 0 out of this period, to capture the effect of this structural change.

We thus summarize the above factors to express the regression equation as the following:

$$D(\text{LPGDP}) = f(D(\text{LGDP}), D(r), D(\text{LPM}(-1)), T, D(\text{LS}), TD(\text{LS}), D(\text{LM})). \tag{5}$$

$D(X)$ denotes the first difference of variable X. T is the dummy variable to capture the impact of structural change in the stock market on the constant term of the equation. $TD(\text{LS})$ is the product of T and $D(\text{LS})$, which is added to capture the impact on the coefficient for stock trading value.

The empirical results by ordinary least squares (OLS) are reported in table 8.5. It shows that all the estimated coefficients are correct in sign, although some are insignificantly different from zero.

As explained at the end of section 8.2, our model is just part of a complete macrosystem. In a complete system, real GDP, money supply, and interest rate should all be endogenous variables. Since the purpose of this paper is to study price behavior, a complete macromodel is not specified. However, to circumvent the simultaneous-equation bias problem, an estimation method such as two-stage least squares should be adopted.

To implement two-stage least squares estimation, we include LPM(−1) and the last two period values of endogenous variables as exogenous or instrumental variables. In addition, in a highly open economy like Taiwan's, the prosperity of foreign economies, measured by the aggregate industrial production index of industrialized countries, is a very important influence on exports, GDP, trade surplus, and consequently money supply. Real government consumption is also important in determining GDP as well. Thus, these variables are also

Table 8.5 Ordinary Least Squares Results

Variable	*D*(LPGDP)	*D*(LPGDP)	*D*(LPGDP)
Constant	0.012***	0.009*	0.004
	(2.918)	(1.999)	(0.411)
D(LGDP)	−0.322***	−0.315***	−0.387***
	(−3.184)	(−3.815)	(−4.430)
D(*r*)	0.005	0.009**	0.006
	(1.375)	(2.237)	(1.332)
D(LPM(−1))[a]	0.216**	0.222***	0.220**
	(2.629)	(2.762)	(2.480)
T	−0.0005	0.0002	0.003
	(−0.095)	(0.039)	(0.565)
D(LS)	0.007	0.008	0.009
	(1.153)	(1.351)	(1.394)
TD(LS)	−0.032***	−0.032***	−0.027**
	(−2.777)	(−2.858)	(−2.205)
D(LM1A)	0.200***		
	(3.423)		
D(LM1B)		0.232***	
		(3.792)	
D(LM2)			0.300*
			(1.792)
Adjusted R^2	0.453	0.474	0.372
F	8.220***	8.867***	6.158***

Sources: GDP (real GDP at 1986 prices), *Quarterly National Income Statistics in Taiwan Area, R.O.C.* (Taipei: DGBAS, Executive Yuan, Republic of China, various issues); *r* (interest rate of three-month time deposits of First Commercial Bank), *Financial Statistics Monthly, Taiwan District, R.O.C.* (Taipei: Central Bank of China, various issues).

Note: Numbers in parentheses are *t*-values.

[a]PM = Import price index * (1 + Effective tariff rate).

*Significant at 10 percent level.

**Significant at 5 percent level.

***Significant at 1 percent level.

included as exogenous variables. Then, two-stage least squares estimation is implemented to derive table 8.6.

All the equations in tables 8.5 and 8.6 have a good fit, according to the *F*-statistics. The empirical results in the two tables are similar, except for a few differences in the significance of *t*-values. The following results are observed:

1. *D*(LGDP) has a negative and significant coefficient. It shows that higher income can result in lower inflation pressure. Higher income makes money demand higher, negatively influencing the price level.

2. The interest rate *r* has a positive coefficient. Thus, a rise in the interest rate pushes up the price level. The influence of interest rates on price levels is active through the money demand function.

3. The coefficients of *T* and *D*(LS) are insignificant. However, the coefficient of *TD*(LS) is significantly negative. This result indicates that the influence

Table 8.6 Two-Stage Least Squares Results

Variable	*D*(LPGDP)	*D*(LPGDP)	*D*(LPGDP)
Constant	0.014**	0.010	−0.012
	(2.266)	(1.469)	(−0.618)
D(LGDP)	−0.360**	−0.317*	−0.300
	(−2.036)	(−1.684)	(−1,413)
D(*r*)	0.012*	0.014*	0.017*
	(1.740)	(1.904)	(1.828)
D(LPM(−1))	0.175*	0.193**	0.216**
	(1.891)	(2.090)	(2.049)
T	−0.001	−0.0004	0.005
	(−0.208)	(−0.077)	(0.735)
D(S)	0.009	0.009	0.011
	(1.442)	(1.583)	(1.672)
TD(S)	−0.036***	−0.035***	−0.041**
	(−2.813)	(−2.863)	(−2.530)
D(LM1A)	0.167*		
	(1.937)		
D(LM1B)		0.199**	
		(2.166)	
D(LM2)			0.606*
			(1.741)
Adjusted R^2	0.413	0.451	0.295
F	4.978***	5.061***	3.668***

Sources: GC (real government consumption expenditures at 1986 prices), *Quarterly National Economic Trends, Taiwan, R.O.C.* (Taipei: DGBAS, Executive Yuan, R.O.C., various issues); IP (aggregate industrial production index of industrialized countries), *International Financial Statistics* (IMF).

Notes: Numbers in parentheses are *t*-values. Instrumental variables: *D*(LPGDP(−1)), *D*(LPGDP(−2)), *D*(LGDP(−1)), *D*(LGDP(−2)), *D*(*r*(−1)), *D*(*r*(−2)), *D*(LPM(−1)), *D*(LIP(−1)), *D*(LGC(−1)), *T*, *D* (LS), *TD*(LS), *D*(LM(−1)), *D*(LM(−2)); LM = LM1A or LM1B or LM2.

*Significant at 10 percent level. **Significant at 5 percent level. ***Significant at 1 percent level.

of stock trading had a significant impact on prices only in the period 1986–91. The implication is that stock trading does absorb the influence of money supply on prices when the stock market is very active; but when stock market trading is stable, its negative influence on prices diminishes.

4. LPM(−1) has a significant positive coefficient. This result supports the argument that import prices (after considering the appreciation of the NT dollar and import decontrol) will influence domestic prices with a one-period time lag.

5. Most coefficients for money supply (LM1A, LM1B, and LM2) are significantly positive. This means that too great a money supply does create inflationary pressure.

After obtaining these results, we would like to make a comparison between our model and the traditional one. Traditionally, the money demand equation is written as

$$M^d = f(GDP, r, PGDP) .$$

By equating M^d and money supply M, we can derive the price equation as follows:

$$PGDP = f(GDP, r, M) . \tag{6}$$

After considering partial adjustments and the logarithmic forms of the variables, we obtain the OLS regression results in table 8.7. We also apply two-stage least squares to estimate the traditional price equation, as our model does. The results are shown in table 8.8.

The relative performance of the different models can be measured by their predictive power. Four commonly used measures of predictive power, root mean square error, mean absolute error, mean absolute percentage error, and Theil's inequality coefficient, are calculated and reported in tables 8.9 and 8.10. These comparisons show that no matter which measure is used, and no matter which definition of money supply is considered, our model always has better forecasting performance than the traditional model.

8.4 Conclusions

Taiwan has maintained both a high growth rate and stable prices for decades. In the 1980s, a high money growth rate and a low inflation rate appeared at the same time. Explanations based on traditional money demand theory cannot be applied to explain this phenomenon well. This paper sets up a theoretical

Table 8.7 **Traditional Model by Ordinary Least Squares**

Variable	*D*(LPGDP)	*D*(LPGDP)	*D*(LPGDP)
Constant	0.014***	0.012***	0.012
	(3.644)	(2.789)	(1.454)
D(LGDP)	−0.393***	−0.383***	−0.438***
	(−4.299)	(−4.242)	(−4.782)
D(*r*)	0.004	0.006	0.004
	(0.871)	(1.486)	(0.880)
D(LM1A)	0.122**		
	(2.103)		
D(LM1B)		0.156**	
		(2.457)	
D(LM2)			0.143
			(0.872)
Adjusted R^2	0.330	0.346	0.288
F	10.993***	11.776***	9.214***

Note: Numbers in parentheses are *t*-values.

*Significant at 10 percent level.

**Significant at 5 percent level.

***Significant at 1 percent level.

Table 8.8 Traditional Model by Two-Stage Least Squares

Variable	D(LPGDP)	D(LPGDP)	D(LPGDP)
Constant	0.015**	0.013*	−0.0002
	(2.419)	(1.870)	(−0.013)
D(LGDP)	−0.423**	−0.396*	−0.450**
	(−2.220)	(−1.938)	(−2.040)
$D(r)$	0.012*	0.013*	0.018*
	(1.681)	(1.780)	(1.902)
D(LM1A)	0.104		
	(1.178)		
D(LM1B)		0.122	
		(1.281)	
D(LM2)			0.419
			(0.234)
Adjusted R^2	0.280	0.305	0.156
F	4.982*	4.429***	4.027***

Notes: Numbers in parentheses are t-values. Instrumental variables: D(LPGDP(−1)), D(LPGDP(−2)), D(LGDP(−1)), D(LGDP(−2)), $D(r(-1))$, $D(r(-2))$, D(LIP(−1)), D(LGC(−1)), D(LM(−1)), D(LM(−2)); LM = LM1A or LM1B or LM2.

*Significant at 10 percent level.

**Significant at 5 percent level.

***Significant at 1 percent level.

Table 8.9 Forecasting Performance by Ordinary Least Squares

Money Supply	Root Mean Square Error	Mean Absolute Error	Mean Absolute Percentage Error	Theil's Inequality Coefficient
M1A				
Our model	0.0485	0.0378	0.8320	0.0053
Traditional model	0.1215	0.0938	2.0705	0.0135
M1B				
Our model	0.0394	0.0306	0.6759	0.0043
Traditional model	0.1124	0.0858	1.8928	0.0125
M2				
Our model	0.0710	0.0583	1.2867	0.0078
Traditional model	0.1223	0.0981	2.1644	0.0136

model and executes an empirical study to analyze the phenomenon.

In the 1980s, stock market fever and real estate speculation were rampant; both constitute an important portion of the transactions demand for money. Therefore, inflationary pressure was eased. In addition, appreciation of the NT dollar and import decontrol contributed to price stability to some extent. In our theoretical model, the above-mentioned factors are included as influences on money demand. And by equating money demand and money supply, the GDP

Table 8.10 Forecasting Performance by Two-Stage Least Squares

Money Supply	Root Mean Square Error	Mean Absolute Error	Mean Absolute Percentage Error	Theil's Inequality Coefficient
M1A				
Our model	0.0501	0.0417	0.9158	0.0056
Traditional model	0.1145	0.0914	2.0131	0.0127
M1B				
Our model	0.0407	0.0329	0.7244	0.0045
Traditional model	0.1085	0.0861	1.8963	0.0120
M2				
Our model	0.0495	0.0393	0.8683	0.0055
Traditional model	0.0935	0.0751	1.6544	0.0103

deflator equation is derived.

Quarterly data in Taiwan from 1978.1 to 1993.2 are used. Unit root tests, cointegration tests, ordinary least squares, and two-stage least squares estimation methods are applied to estimate the GDP deflator equation. The empirical results support the theoretical model to a great extent. Decreases in import prices (considering NT dollar appreciation and import decontrol) can result in decreases in the GDP deflator with a one-period time lag. Stock trading had a strong influence on the demand for money in its feverish period 1986–91. Therefore, stock trading can explain price stabilization to some degree. Comparing the predictive power of our model with the traditional model, we also find that our model performs better.

Our results have not only provided theoretical and empirical support for the idea that import price affects the GDP deflator but also indicated that in a developing country with a fast-growing financial or stock market, it may not be proper to analyze the impact of money supply on domestic prices by following the quantity theory of money or the traditional money demand theory, without incorporating the element of money demand for asset transactions.

There are some limitations in our research. The impact of financial liberalization policies, such as interest rate deregulation in the 1980s and bank entry decontrol in the early 1990s, on the demand for money in Taiwan have not been considered.[7] Real estate trading and inflation expectation factors are omitted because pertinent data are unavailable. The lag patterns of the effects of money supply and import prices have not been well dealt with. A general-equilibrium

7. Since World War II, Taiwan's financial system has been strictly controlled. Although financial liberalization has been demanded by the public, its speed was not accelerated until the late 1980s. The government in Taiwan has controlled bank interest rates and blocked the new entry of banks for a long time. Most banks were government-owned. Since the promulgation of the new Banking Law on July 19, 1989, both the ceiling and floor limits for interest rates on deposits and loans have been abolished, and interest rate liberalization has finally been completed. In June 1991, 15 new banks were approved. By April 1993, 17 new banks were established and operating.

macromodel has not been set up to analyze all endogenous economic variable behaviors. All these problems will need further study in the future.

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Comment

Kenjiro Hirayama

The focus of Yang and Shea's paper is the combination of high money growth and low price inflation in Taiwan in the 1980s. The authors' approach is to modify the traditional specification of money demand by including the trading value of stocks and import prices. They solve the money market equilibrium condition for the price level and estimate this price equation by two-stage least squares, with generally satisfactory results. The authors also report the dynamic forecasting performances of the modified model and of a traditional model estimated by ordinary least squares. Again, the model with the trading value of stocks and import prices has a better forecasting performance. The theoretical framework is reasonable, and the empirical results lend strong support to Yang and Shea's hypothesis.

Despite the empirical success of focusing on stock trading and import prices, the feature I find difficult to understand is their use of a price equation rather than a straightforward money demand function. Their premise is that price is the equilibrating variable in the money market. I do not deny the role of price adjustment in equilibrating the money market. However, the bulk of any price adjustment would be a response to conditions in the goods market. It would be the interest rate that the money market determines in equilibrium.

A more standard approach to analyzing the combination of high money growth and low inflation would be to ask, Was the high money growth absorbed by the concomitant rise in the demand for money? The reverse case of missing money was extensively studied in the United States. The same line of research might be more appropriate as a first step in answering the question. For example, one can run structural break tests to see whether there was a significant shift in money demand that can explain the low inflation with high money growth.

Arguments traditionally specified in the money demand function are income, interest rate(s), and wealth. Income is included to capture the transactions demand for money. This represents settlement needs for transactions in goods and services, but not for asset trading. In light of a phenomenal rise in stock trading in Taiwan in the 1980s, it seems appropriate that the authors incorporate the trading value of stocks in the demand for money function, which is vindicated clearly by the empirical results. However, they do not utilize a wealth variable in their specification. Their portfolio demand for money as given by equation (2) includes an interest rate only. Without a wealth variable, the trading value might be proxying for this wealth. In the case of Japan, where there was also a stock market rally in the 1980s, for instance, Ueda (1988) and Corker (1990) find that a wealth variable can explain the apparent upward shift in the money demand function.

Although the authors devote little attention to the interest rate variable, there

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are potentially important issues involved in the choice of this variable. They have chosen the three-month deposit rate as the interest rate variable, but this is partly the own rate of return on money. One should probably search for the interest rate on an asset that is most likely to be the alternative to money holding. Trials with a few different interest rates might be informative.

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Comment Muthi Samudram

This paper surveys the role of money and prices in Taiwan during the period 1960–93. Episodes of past excessive growth of money supply with low inflation, particularly during the period 1960–80, have been explained by the high income elasticity of demand for money. The paper indicates that similar reasons for the behavior of money and prices in later periods did not hold. There has been evidence that because of strong stock market growth, demand for transaction balances has been significant during the 1980s and 1990s. Yang and Shea believe that in spite of the excessive growth of the money supply, prices have been very low and that the traditional demand for money function cannot explain this phenomenon.

The authors derived the price equation from the demand for money equation, where demand for money was disaggregated into transactions and portfolio demand. The final price equation was derived from the transactions demand for money, taking into consideration the role of the interest rate in the demand for overall money balances.

In deriving the price equation from the transactions demand for money, one is led to believe that developments in the labor market, such as wages and employment, and fiscal policy measures, such as tax cuts, subsidies, and deficit spending, are not relevant in determining the overall GDP deflator. Even if all these factors are subsumed into money supply, one would have expected a significant but large coefficient. Even the real GDP variable is not significant in the two-stage least squares estimation procedure.

Given the large data set available, cointegration analysis would have enabled the authors to determine not only the functional form of estimation but also whether a long-run relationship exists between prices and other variables. In

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the present context of the formulation, the money supply variable should have been an excess supply/demand variable rather than money supply itself.

A similar phenomenon of low prices in the face of strong money growth has occurred in Malaysia in the 1990s. We believe that the effect of a significant rise in transactions can be explained by a bullish stock market and the concomitant rise in M1. But this did not affect prices at all. This episode happens to be a one-off event, and therefore prices need not reflect that increase. Similarly in Taiwan's case, there was a significant increase in M1 in 1986 and a slow decline to the trend of growth by 1991.

Therefore the derivation of the price equation in this paper is not complete without the labor market. Even the results do not significantly support the hypothesis of strong monetary effects, with the estimated coefficient being no more than 0.2.