The Role of Macroeconomic Policies in the Economic Development of Taiwan, R.O.C.

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This paper tried to use a vector autoregression (VAR) model to describe the economic growth and fluctuations of the Taiwan economy. The Johanson cointegration test procedure allowed us to find the long-run relation of variables. The cointegration test result shows that common trend do exisit among these variables. The estimated results indicate that both fiscal and rediscount rate polices had strong effect on output growth during the last three decades. However, money supply did not play an important role in the economic growth. It did effect price stability. Moreover, the real variables such as export and import had effects on the output growth. Money supply was endogenous during this period. All these results seem to confirm the conjecture of the real business cycle theory. Our results also point out that macroeconomic policy have played an important role in the long-run economic growth of the Taiwan economy. This seems to support De Long and Summers' (1992) and Fischer's (1991) arguments. It is also ture for the common view that export oriented policy also matters to the economic growth. (*JEL* Classifications: O53, E52)

I. Introduction

Economic development is a very complex process involving not only economic, but also many social, political, technological and cultural changes. However, it is usually defined economic development as the process of increasing the degree of utilization and improving the productivity of the available resources of a country which leads to an

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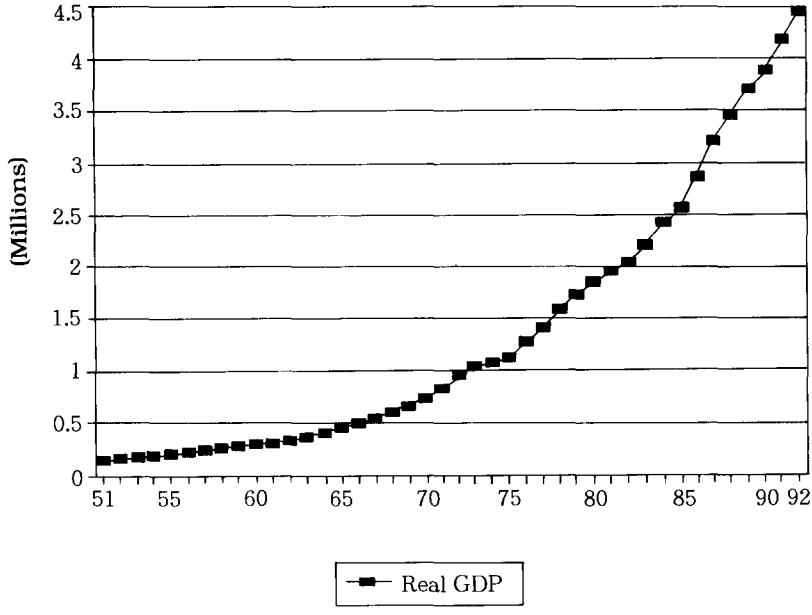
increase of the economic welfare of the community by stimulating the growth of GNP.

During the last three decades (from 1966 to 1992), Taiwan, R.O.C. is experienced a high growth rate of GNP. The average annual growth rate of real GNP is 8.9%, while the average annual growth rate of real per capita income is 6.9%. The inflation rate was lower than 5% in most of these years. Main contributions to the economic growth came mainly from exports and capital formation. Among capital formation, the government and public enterprises shared about 50% each year. And the ratio of exports to GNP maintained at more than 40% each year.

It is argued that government policies make it possible to raise the volume of savings and investment and thus promote economic growth. This seems to be true when the total resources of one country are scarce and the industrialization is just at its early stage. It is also argued that industrialization provides stability through diversification of economic activity. However, industrialization needs adequate resources to finance requisite investment without engendering inflation. Savings and net capital receipts from abroad are needed to finance the domestic physical investment. The role played by fiscal and monetary measures in determining the volume of savings and foreign capital was thought to be one of the key elements during the economic growing path of Taiwan, R.O.C.. Moreover, macroeconomic policies can influence the pattern of investment. Especially, public investment in infrastructure, such as transport and power, can promote economic growth. It is therefore the common view in Taiwan, R.O.C. that a balanced growth between the private and government sectors of the economy is needed to prevent a persistent occurrence of serious production bottlenecks in the course of economic development.

This paper tries to examine the hypothesis that macroeconomic policies have played important roles in the economic development of Taiwan, R.O.C. during the last three decades. A vector autoregression (VAR) model with cointegration tests will be used to test this hypothesis. It is found that we cannot reject this hypothesis.

It is worthy of nothing that cointegration analysis deals with the low frequency properties of economic variables. Thus, it is better to apply this analysis to an economy with stable long-term equilibrium growth disturbed only occasionally be external shocks. As we can see from Figure 1, the Real GDP in terms of 1986 real NT dollar value grows quite steadily. Hsu (1994) extended King-Plosser-Rebelo (1988) and Barro (1989) real business cycle models to a small open economy and



Note: NT dollars in terms of 1986 price.

FIGURE 1
THE REAL GDP

found that most of the key statistics of the basic model are closely related to those of the real data of the Taiwan Economy. This might justify the cointegration analysis using in this paper.

This paper will be organized as follows. Section I is the introduction. In the following section, i.e. section II, a basic econometric model will be set up. In section III, we will use the quaterly data of the Taiwan Economy to test the hypothesis mentioned above. The last section is the concluding remarks.

II. The Basic Econometric Model and Preliminary Tests

Lex X_t be an eight by one vector. Its elements are composed of the following eight variables, i.e. real export (*EX*), real government expenditure (*G*), redicount rate (*R*), nominal exchange rate (*E*), monetary aggregate (*M2*), real import (*IM*), GNP deflator (*P*) and real GNP (*Y*). Government expenditure includes both public consumption and investment. And the rediscount rate policy has been utilized as the main monetary

TABLE 1
ADF UNIT ROOT TEST RESULTS

Variables	$P = 3$	$P = 4$
EX	-1.733	-2.065
	(0.789)	(0.622)
G	-1.702	-2.114
	(0.802)	(0.592)
R	-0.574	-2.740
	(0.985)	(0.236)
E	-2.309	-1.203
	(0.474)	(0.932)
M2	-1.447	-1.133
	(0.884)	(0.943)
IM	-2.697	-2.982
	(2.55)	(0.145)
Y	-1.347	-3.084
	(0.911)	(0.116)
P	-0.564	-1.778
	(0.985)	(0.770)

Note: Figures presented in parantheses are *P* values.

policy instrument, while *M2* was used as the main intermediate target of monetary policy. Since not all nonstationary time series can be cured by differencing, we will use a logarithmic trasnformation as variance stabilizing transformation. Thus all variables in this paper were taken in log forms. The data that we use are quarterly ones which span from 1966 I to 1992 III. So we have 107 data points for each variables. All data come from EPS Data Bank of the Ministry of Education, R.O.C..

Unit root tests are important in examining the stationarity of a time series. Among many unit root tests, we will use an Augmented Dickey-Fuller (ADF) test for a unit root. The ADF test consists of running a regression of the first difference of the series against the series lagged once, lagged difference terms, and optionally, a constant and a time trend. We use the following equation to test each series.

$$\Delta X_{i,t} = \alpha_{i,0} + \alpha_{i,1} t + \beta_{i,0} X_{i,t-1} + \sum_{j=1}^{p-1} \beta_{i,j} \Delta X_{i,t-j} + \varepsilon_{i,t}, \tag{1}$$

where $i = 1, 2, \ldots, 8$, $p = 3, 4$. For each variable we cannot reject the null hypothesis of a unit root (see Table 1). We also used Johansen (1991) misspecification test to choose the lag period of our VAR model. Johansen misspecification test utilized Box-Pierce Q statistic to test

TABLE 2
MISSPECIFICATION TESTS

Variables	Skewness	Kurtosis	Normality	Box-Pierce Q (12)
EX	-0.293	0.128	1.563	9.131
G	0.296	1.683	13.794	24.367
R	0.371	1.065	7.299	25.271
E	-1.230	5.408	152.928	12.633
M2	-1.002	3.524	71.221	4.682
IM	0.544	2.038	23.309	8.866
Y	-0.004	0.162	0.113	15.165
P	0.473	1.874	19.107	4.753

Note: $\chi^2_{0.95}(12) = 21.026$; $\chi^2_{0.95}(12) = 5.99$.

the autocorrelation of each residual. We found that the optimal lag period is three. Moreover, we also used Jargue and Bera statistic to test normality of variables. As shown in Table 2, all variables are distributed normally.

In this study, we try to use Johansen (1988, 1991) maximum likelihood (ML) method to estimate a VAR model. Johansen's ML procedure provides a unified framework for estimation and testing of cointegrating relations in the context of VAR error correction models. The error correction representation of the VAR(k) model with Gaussian errors can be written as

$$\Delta X_t = \mu + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots + \Gamma_{k-1} \Delta X_{t-p+1} + \Pi X_{t-k} + \Phi D_t + \varepsilon_t, \tag{2}$$

where $k = 3$, X_t is an 8×1 vector of $I(1)$ variables, D_t is a 3×1 seasonal dumy vector of $I(0)$ variables, $\Gamma_1, \Gamma_2, \ldots, \Gamma_{k-1}, \Pi$ are 8×8 matrices of unknown parameters, Φ is 8×3 matrix, μ is a constnant vector and $\varepsilon_t \sim N(0, \Sigma)$. The Johansen ML procedure estimates (2) subject to the hypothesis that Π has a reduced rank, $r < 8$. This hypothesis can be written as

$$H(r): \Pi = \alpha\beta', \tag{3}$$

where α and β are $8 \times r$ matrices. Johansen (1991) shows that the reduced rank condition (3) implies ΔX_t and $\beta' X_t$ are stationary under certain conditions. $\beta' X_t$ are referred to as the cointegrating relations. β is thus called a cointegrating vector matrix, while α is an adjustment matrix. In fact, $\beta' X_t = 0$ are long-run equilibrium relations. By considering (3), our VAR model (2) can be rewritten as

TABLE 3
COINTEGRATION TEST RESULTS: TRACE TEST

H_0	H_1	Statistics	Critical value (5%)
$r = 0$	$r = 1$	209.931*	155.999
$r \leq 1$	$r = 2$	130.878*	124.243
$r \leq 2$	$r = 3$	92.323	94.155
$r \leq 3$	$r = 4$	62.000	68.524
$r \leq 4$	$r = 5$	37.172	47.210
$r \leq 5$	$r = 6$	22.805	29.680
$r \leq 6$	$r = 7$	10.576	15.410
$r \leq 7$	$r = 8$	1.788	3.762

Note: Critical values are taken from Johansen and Juselius (1990).

$$\Delta X_t = \mu + \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1} \Delta X_{t-k+1} + \alpha (\beta' X_{t-k}) + \Phi D_t + \varepsilon_t. \tag{4}$$

As long as $\beta' X_{t-k}$ is not equal to zero, (4) implies a dynamic adjustment process.

It should be noted that the Johansen maximum likelihood approach to testing for and estimating co-integrating vectors in the context of a VAR depends on the VAR model assumptions. However, the assumption of a Gaussian distribution is not so serious as pointed by Johansen (1991). Rather the choice of lag length is more important, although moderate departures do not affect the inference so much. Moreover, for VAR models that allow integration of higher order, the likelihood analysis is more complicated. Also, Gonzalo (1990) compared the Stock and Watson (1988) method with the Johanson method in a Monte Carlo simulation and supported the contention that the Johansen-type estimation would tend to be superior (see also Banerjee, Dolado, Galbraith and Hendry 1993). In fact, Johansen (1991) had already shown that two methods were very similar.

III. Empirical Analysis

Table 3 and 4 report the results of the cointegration test. Two test statistics are reported to determine the number of cointegrating vectors. The trace test allows us to evaluate the null hypothesis that there are r or fewer cointegrating vectors against a general alternative. The maximum eigenvalue test evaluates the null hypothesis $r = 0$

TABLE 4
COINTEGRATION TEST RESULTS: MAXIMUM EIGENVALUE TEST

H_0	H_1	Statistics	Critical value (5%)
$r = 0$	$r = 1$	79.053*	51.420
$r = 1$	$r = 2$	38.549	45.277
$r = 2$	$r = 3$	30.328	39.372
$r = 3$	$r = 4$	24.828	33.461
$r = 4$	$r = 5$	14.367	27.061
$r = 5$	$r = 6$	12.229	20.967
$r = 6$	$r = 7$	8.788	14.069
$r = 7$	$r = 8$	1.788	3.762

Note: Critical values are taken from Johansen and Juselius (1990).

against the alternative r = 1, etc. The trace test outcomes in Table 1 show that the null hypothesis of $r = 0$ and $r \leq 1$ are rejected at 5% level. There are at least two cointegrating vectors. The maximun eigenvalue test provides an alternative check for the number of cointegrating variables. In Table 3 the results of the maximum eigenvalue test do not accord well with those of the trace test. It shows that at least there is one cointegrating vector.

Table 5 reports estimates of the unconstrained cointegrating vectors as well as the speeds of adjustment. We normalize on output. This is done by setting the estimated coefficient on Y equal to -1 and dividing each cointegrating vector by the negative of the reported Y coefficient. The long-run relation can be written as

$$Y = 0.303EX + 0.578G - 0.155R + 0.012E + 0.18M2 - 0.287IM - 0.131P. \quad (5)$$

As can be seen from Table 5, the estimated adjustment speed for money balances is quite low, i.e. α_{15} is near zero, while the real variables adjust more quickly. Equation (5) shows that the long-run elasticity of government expenditure, export, and import are relatively high in comparison with those of nominal or financial variables. The long-run relation described in (5) indicates an existence of common trends among these variables shown in this equation. Only one of the cointegrating equation is reported here, i.e. $\hat{\beta}'_1 X_t = 0$. We chose cointegrating vector β_1 instead of β_2 according to the economic relation among variables. For example, the relation between GNP and export (or import) for β_2 is difficult to be justified. The cointegrating vector following the maximum eigenvalue test is not reported here. These results are available

TABLE 5

COINTEGRATING VECTOR AND SPEEDS OF ADJUSTMENT

Variables	Cointegrating Vector		Speeds of Adjustment	
	β_1	β_2	α_1	α_2
EX	-0.303	1.611	-0.143	-0.157
G	-0.578	-1.362	0.331	0.116
R	0.155	1.161	-0.277	-0.071
E	-0.012	-1.210	0.049	0.010
M2	-0.180	1.000	-0.008	-0.023
IM	0.287	-1.319	-1.090	0.198
Y	1.000	-1.181	-0.489	-0.014
P	0.131	-0.778	0.020	0.011

on request.

The error correction model can be written as

$$\Delta X_t - \hat{\alpha}\hat{\beta}'_1 X_{t-k} = \mu + \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1}\Delta X_{t-k+1} + \Phi D_t + \varepsilon_t. \quad (6)$$

where $\hat{\alpha}$ and $\hat{\beta}_1$ are the estimated adjustment speed and cointegrating vectors. Using OLS estimation method to estimate the coefficiente of (6), we have the short-run dynamics of these eight variables. Only DY_t, DP_t and $DM2_t$ are reported (see Tables 6, 7 and 8). The economic hypothesis that we try to test is to see whether government policy variables such as public expenditure, money supply, rediscount rate and exchange rate have strongly affected economic growth. Moreover, we also want to see if the trade sector has strong effects on income growth.

As we can see from Table 6, the growth rate of GNP is significantly affected by the growth rate of the real variables, while the nominal variables are not shown to be the significant factors of the income growth during the last three decades (from 1966 to 1992). This seems to confirm the real-business-cycle hypothesis that only the real shocks matter. The money supply only affects the general price level (see Table 7). Among the real variables, the government expenditure which includes public investment is one of the key factor of the economic growth of Taiwan, R.O.C.. Both the government expenditure and export have positive effects on the growth, while import has negative effect on the GNP growth rate. The effect of rediscount rate on GNP is ambiguous. Lagged one-period rediscount rate positively affects GNP, while lagged two-period one has negative impact on GNP. Rediscount rate policy is the main monetary policy. As mentioned by Plosser (1990) rediscount rate policy has real effect. In fact, it has direct effect on the costs of banks. Before 1992, almost all banks in Taiwan are owned by the gov-

TABLE 6
ERROR-CORRECTION REGRESSION OF *DY*

variable	coefficients	*t*-statistics
constant	1.942*	227.120
DEX (–1)	0.032	1.234
DG (–1)	0.173*	6.619
DR (–1)	0.104*	2.899
DE (–1)	–0.167	–1.341
DM2 (–1)	0.082	0.683
DIM (–1)	–0.088*	–4.317
DP (–1)	–0.022	–0.251
DY (–1)	–0.831*	–10.667
DEX (–2)	0.051*	2.171
DG (–2)	0.336*	15.258
DR (–2)	–0.104*	–3.047
DE (–2)	0.224	1.708
DM2 (–2)	–0.007	–0.059
DIM (–2)	–0.108*	–5.048
DP (–2)	0.086	0.973
DY (–2)	–0.504*	–5.534
D1	–0.013	–1.125
D2	–0.024	–2.542
D3	–0.035*	–3.001

$\bar{R}^2 = 0.941$, $DW = 1.801$

Note: * represents that coefficients are significant at 5% significance level.

ernment. As long as the Central Bank announced to lower the rediscount rate, all large banks would cut down its loan interest rate. Through lower interest on bank credits, private investment was induced.

As shown in Table 6, export expansion has been the engine of economic growth in Taiwan. The exports-GNP ratio was 0.219 in 1966. However, since 1972 this ratio was above 0.4 (export the year of 1975). More importantly, the government adoped export-promotion policies directed at all industries without special favor to any particularly selected industries and enterpreneurs. These included regulations for the rebate of taxes on export products, tariffs reduction of importing materials and equipments to be used in the production of exports, special low interest loans, and government-financed export-promotion facilities and market research. Besides, the government also created tax and duty-free export processing zones.

Both fiscal and monetary policies were also adopted by the Taiwan

TABLE 7
ERROR-CORRECTION REGRESSION OF *DP*

variable	coefficients	*t*-statistics
constant	0.094*	8.607
DEX (-1)	0.068*	2.057
DG (-1)	-0.082*	-2.461
DR (-1)	0.088	1.916
DE (-1)	0.090	0.562
DM2 (-1)	-0.170	-1.104
DIM (-1)	-0.035	-1.314
DP (-1)	0.221*	1.995
DY (-1)	-0.193	-1.929
DEX (-2)	0.041	1.385
DG (-2)	-0.066*	-2.331
DR (-2)	0.023	0.530
DE (-2)	-0.011	-0.066
DM2 (-2)	0.550*	3.707
DIM (-2)	-0.027	-0.995
DP (-2)	0.118	1.047
DY (-2)	0.171	1.465
D1	0.042*	2.786
D2	-0.004	-0.362
D3	0.028	1.872

$\bar{R}^2 = 0.555$, $DW = 1.778$
Note: * represents that coefficients are significant at 5% significance level.

government to promote economic growth. Aside from emphasizing on the Confucian virtue of thriftiness, the government utilized tax-incentive policies to raise savings. Before 1981, tax exemptions on interest income earned from deposits longer than two years were allowed. After 1981, each person interest income up to about ten thousand US dollars is exempt from income tax. Low loan interest rate, investment credit, tax reductions, five-year tax exemption and accelerated depreciation policies were also designed to encourage investment. Moreover, the government adopted strong education policy to improve the quality of labor force. Public expenditure on education was maintained 16% of total government expenditure since 1973, while the public expenditure on infrastructure and public enterprise investment remained at more than 26% most of the years. In fact, the share of the government and public enterprise investment kept over 40% since 1968 (except the year of 1973 and 1988).

Table 8 shows that money supply is an endogenous variable as em-

TABLE 8
ERROR-CORRECTION REGRESSION OF *DM2*

variable	coefficients	*t*-statistics
constant	0.348*	43.508
DEX (–1)	–0.065*	–2.697
DG (–1)	–0.007	–0.287
DR (–1)	–0.076*	–2.257
DE (–1)	–0.030	0.257
DM2 (–1)	0.511*	4.555
DIM (–1)	–0.039*	–2.031
DP (–1)	0.070	0.869
DY (–1)	0.172*	2.360
DEX (–2)	–0.021	–0.958
DG (–2)	0.013	0.649
DR (–2)	–0.006	–0.193
DE (–2)	–0.018	–0.147
DM2 (–2)	–0.086	–0.792
DIM (–2)	0.002	0.008
DP (–2)	0.080	0.978
DY (–2)	0.118	1.382
D1	–0.004	–0.405
D2	–0.019*	–2.197
D3	0.011	1.006

$\bar{R}^2 = 0.404$, $DW = 2.026$

Note: * represents that coefficients are significant at 5% significance level.

phasized by real business cycle theorists. It was negatively affected by lagged-one-period rediscount rate. Thus, when the Central Bank sought to ease money supply, it lowered the rediscount rate. Open market operations were seldom utilized in this period under study. Moreover, both the growth rate of lagged export and output have significant effects on the growth rate of *M2*.

IV. Conclusion

In this paper, we have tried to use a vector autoregression (VAR) model to describe the economic growth and fluctuations of the Taiwan economy. Using a unit root test, we found that all variables under study were nonstationary. After taking differences, we also found that the optimal lag was three. The Johanson cointegration test procedure allowed us to find the long-run relation of these variables. After cor-

recting the errors, we can estimate the dynamic equation of each variable.

The cointegration test result shows that common trend do exist among these variables. The estimated results indicate that both fiscal policy and rediscount rate policy had strong effects on output growth during the last three decades. However, money supply did not play an important role in the economic growth. It did affect price stability. Moreover, the real variables such as export and import had effects on the output growth. Money supply was endogenous during this period. All these results seem to confirm the conjecture of the real business cycle theory. Our results also point out that macroeconomic policy have played an important role in the log-run economic growth of the Taiwan economy. This seems to support De Long and Summers' (1992) and Fischer's (1991) arguments. It is also true for the common view that export oriented policy also matters to the economic growth.

References

Banerjee, Anindya, Dolado, Juan, Galbraith, John W., and Hendry, David F. *Co-Integration, Error Correction, and the Econometric Analysis of Non-Stationary Data.* New York: Oxford Univ. Press, 1993.

Barro, Robert J. "Neoclassical Approach to Fiscal Policy." in R. Barro (ed.), *Modern Business Cycle Theory.* Mass.: Harvard Univ. Press, 1989.

De Long, Bradford J., and Summers, Lawrence H. "Macroeconomic Policy and Long-Run Growth." in *Policies for Long-Run Growth,* A Symposium sponsored by The Federal Reserve Bank of Kansas City, August 1992: 93-128.

Fischer, Stanley. "Growth, Macroeconomics, and Development." in *NBER Macroeconomics Annual* 1991: 329-64.

Gonzalo, J. "Comparison of Five Alternative Methods of Estimating Long-Run Equilibrium Relationships." Discussion Paper, San Diego: University of California, 1990.

Hsu, Chen-Min. "Debt Financing, Public Investment and Economic Growth in Taiwan." forthcoming in *Lessons from East Asian Growth, NBER-East Asia Seminar on Economics* 4, 1994.

Johansen, Soren, "Statistical Analysis of Cointegration Vectors." *Journal of Economic Dynamics and Control* 12, 1988: 321-54.

_____. "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models." *Econometrica* (November 1991): 1551-80.

_____ and Juselius, K. "Maximum Likelihood Estimation and Inference on Cointegration—with Applications to the Demand for Money." *Oxford Bulletin of Economics and Statistics* 52 (1990): 169-210.

King, Robert, Plosser, Charles, and Rebelo, Sergio. "Production, Growth and Business Cycles, I. The Neoclassical Model." *Journal of Monetary Economics*

21 (1988): 195-232.

Plosser, Charles I. "Money and Business Cycles: A Real Business Cycle Interpretation." NBER Working Paper 3221 (January 1990).

Stock, James H., and Watson, Mark W. "Testing for Common Trends." *Journal of the American Statistical Association* 83 (1988): 1097-107.

Comment

Sung-In Jun*

Professor Hsu's paper deals with the common theme of this symposium, i.e., the role of government policy in the development experience of Asian countries. The past two to three decades have witnessed a rapid economic development in Asian countries. It is usually the case that major structural changes accompanied the development experience and presumably the government's economic policy played an important role.

So the issues that this paper addresses are important ones. Unfortunately, analyzing economic relationship among key macro variables becomes challenging when the economic environment changes rapidly and drastically as you typically see in this area. This paper faces the similar challenge, though resolves it only partially.

Several comments are in order. Let me comment on major issues first and, if time constraint is not binding, go on to specific issues subsequently.

Application of Long-run Analysis to a Rapidly Developing Economy

Arguably the main contribution of this paper is the use of time series technique, specifically, cointegration analysis. Cointegration analysis deals with the low frequency properties of economic variables. Hence it finds its best application in an economy which enjoys stable long-run equilibrium and is disturbed only occasionally by external shocks. I feel very much uncomfortable when professor Hsu applied this technique to one of world's most rapidly growing economies like Taiwan. Of course there may be unchanging long-run relationship in such economies, but certainly I would not bet on it.

Now, assuming that cointegration analysis is acceptable, the next issue is how well the analysis is carried out. The range and the depth of statistical analysis, as they are in the paper, are at best insufficient. The presentation of test results is kept at minimum. For example, no test figures on the existence of unit roots are available. Also no dynam-

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ic analysis of the estimated system is performed even if the error-correction model is essentially a dynamic one. Besides the economic hypothesis the paper tries to test is not explicitly set up, and one can not find any formal testing of the hypothesis.

Specific Issues

First, The paper mixes real and nominal variables in a multivariate system. It is not clear to me what kind of macro model can justify this practice. Statistically there is another related issue. It is usually the case that the nominal variables like *M2* and GNP deflator are integrated of higher order, making their growth rates still nonstationary. Apparently the paper did not pay additional concern on the possibility.

Second, the paper reports mixed evidences on the number of cointegrating vectors without trying to resolve the problem through another estimation technique. For example, Stock and Watson (1988) also provided an estimation technique which can be applied to a multivariate system to determine the number of common trends. Without any justification, the paper adopts the case of two cointegrating vectors and later derives economic conclusion based only on one of them, β_1, that monetary variables have little influence on real output. However, if you look at the other cointegrating vector, β_2, the monetary variables are apparently as important as real ones. I wonder that the common β looks like when the case of only one cointegrating vector is adopted.

Third, after estimating the error-correction model, the paper looks at only individual coefficients of lagged variables and concludes that the monetary variables are insignificant. However, I think the correct way to test the hypothesis is to perform bloc *F* tests on the set of lagged nominal variables. This is because individual coefficients are subject to multicollinearity problem in a VAR system. Also the dynamic analysis like an impulse-response analysis is needed in order to see the propagation mechanism of the system.

As I have said in the beginning, the issue this paper addresses is an important one. This is why I look forward to seeing a full-blown version of this paper soon.

Reference

Stock, J.H. and Watson, Mark. "Testing for Common Trends," *Journal of the American Statistical Association* 83 (1988): 1097-107.