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Financial, Exchange Rate, and Wage Policies in Singapore, 1979-86

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Abstract

This paper discusses the unique aspects of Singapore's financial, exchange rate, and wage policies during the period 1979-86, and attempts to quantify the impact of alternative policies on major macroeconomic variables. For this purpose, a simple short-term model is formulated and estimated, and various policy simulations conducted. It is found that the wage policy pursued by the authorities in the early 1980s played a significant role in influencing output and prices and that an appropriate wage policy is complementary to exchange rate policy in maintaining external competitiveness in Singapore.

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Contents

Summary

The paper discusses the unique aspects of Singapore's financial, exchange rate, and wage policies in recent years and attempts to quantify the importance of these policies in influencing macroeconomic variables, including output, prices, exchange rate, and foreign reserves. For this purpose, a simple short-term macroeconomic model was formulated. This model features, inter alia, reserve movements, as suggested by the monetary approach to the balance of payments, the authorities' reaction function that forms a basis for exchange rate policy, an output function that takes into account both supply and demand factors, and a price equation that is essentially derived from stock disequilibrium in the money market. The model was estimated by the two-stage least squares method, using quarterly data during the 1979-86 period, and various dynamic simulations were conducted.

The behaviorial relationships were generally well specified, and the estimated model as a whole captured the essential features of the Singapore economy. The major findings of this study are the following:

First, Singapore's exchange rate policy has been largely influenced by the liquidity implications of the authorities' contractionary financial operations and by the external competitiveness of the economy. As a result, the authorities have to strike an appropriate balance between the exchange rate and foreign reserve levels.

Second, the authorities' high-wage policy pursued in the early 1980s to promote a structural shift in favor of capital-intensive industries contributed to a significant loss of external competitiveness and a severe recession in 1985. By extension, moderate wage policies pursued since 1986, together with the sharp depreciation of the exchange rate, are expected to have a significant impact on external competitiveness and on sustaining the growth momentum.

1. Introduction

Singapore's recent experience with the conduct of financial and exchange rate policies suggests that the authorities' ability to implement an independent monetary policy has been constrained. With the economy being small and highly integrated with international markets, movements in the money supply have been influenced significantly by developments in the external sector, and domestic interest rates have been determined largely by foreign rates. 1/ At the same time, the authorities' exchange rate policy has been geared toward the often conflicting objectives of mitigating external inflationary pressures and sustaining economic activity by enhancing external competitiveness.

The cornerstone of financial policies in Singapore has been budgetary discipline, evidenced by the Government's budget surpluses that have been recorded every year since the late 1960s. These surpluses have been substantially augmented by savings generated by the social security scheme (Central Provident Fund) and government controlled financial institutions (e.g., Post Office Savings Banks), which have been deposited in government accounts with the Monetary Authority of Singapore (MAS). Consequently, government financial operations have drained liquidity from the banking system, creating persistently tight liquidity conditions.

Since the banking sector has an easy access to international capital markets, the tight domestic liquidity conditions have been eased by the inflow of funds from abroad. In the process, the authorities have provided domestic liquidity to the banking system by purchasing foreign exchange from, or arranging swap transactions with, the commercial banks. 2/ As a result, the short-run increases in the net foreign assets of the MAS have been closely associated with increases in government deposits with the MAS. Reflecting these financial policies, monetary aggregates have exhibited significant short-term fluctuations, but over the longer run the upward trend in foreign assets has sustained the underlying growth of domestic liquidity.

Exchange rate movements have reflected the authorities' reserve management policies. During 1979-84, increases in foreign reserves were rather moderate and the effective exchange rate of the Singapore

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1/ Edwards and Khan (1985) found that over 90 percent of movements in domestic interest rates in Singapore were explained by changes in foreign rates.

2/ Under these swap arrangements, the MAS typically purchases foreign exchange from commercial banks at the prevailing spot exchange rate with the provision to unwind the swap on a future date at a rate determined at the time of the arrangement.

dollar appreciated substantially. 1/ Since early 1985, however, the level of reserves has risen sharply and the effective exchange rate depreciated markedly, reversing most of the appreciation that had taken place earlier.

To benefit from the emerging pattern of external demand, the authorities pursued a high wage policy during 1979-85 with a view to inducing a shift in production away from labor-intensive to capital-intensive and high-tech activities. During this period labor costs increased at an annual average rate of 15 percent as nominal wages increased rapidly and the employers' (as well as workers') contributions to the Central Provident Fund were raised significantly. This wage policy had important implications for Singapore's external competitiveness and thus for economic activity. During the first half of the 1980s, Singapore's external competitiveness, measured in terms of relative unit labor costs adjusted for the exchange rate, deteriorated by more than 60 percent, contributing to the slowdown in the economic activity and to the severe, but short-lived, recession in 1985--the first decline in more than two decades. In 1986, concerned with the loss of external competitiveness, the authorities implemented a number of measures to reduce labor costs, including limits on nominal wage increases and reductions in contributions to the Central Provident Fund. The reduction in unit labor costs, together with the depreciation of the Singapore dollar, helped to regain some of the lost external competitiveness and contributed to economic recovery.

While the causal linkages between key macroeconomic variables described above have been well identified, there has been little attempt to formalize such relationships. 2/ The present paper is an attempt to fill this gap. The major objectives of this paper are to analyze transmission processes and to quantify the importance of alternative policy instruments in influencing key macroeconomic variables, including output, prices, the exchange rate, and foreign reserves. For this purpose, a simple short-term model is formulated and estimated, and various policy simulations are conducted.

The remainder of the paper is organized as follows. Section II discusses the underpinings behind the specification of the model, taking into account the unique features of the Singapore economy. Section III presents the estimates of the behavioral equations, while Section IV

1/ This rate is defined as a weighted average of the bilateral exchange rates between the Singapore dollar and the currencies of Singapore's major trading partners and competitors.

2/ Different aspects of financial and exchange rate policies in Singapore have been reviewed by studies contained in the Monetary Authority of Singapore (1981).

analyzes the simulation results based on alternative policy scenarios. Finally, Section V contains concluding remarks and draws policy implications for macroeconomic management in Singapore.

II. Model Specification

In this section a simple macroeconomic model is formulated to describe the movements of foreign reserves, the exchange rate, prices, real output, and government revenue and expenditure.

1. Foreign reserves

Since financial operations have consistently resulted in a significant drainage of liquidity, as explained earlier, a familiar feature of financial operations in Singapore has been increases in net foreign assets to eliminate the domestic excess demand for money. In order to describe this aspect of adjustment, it is assumed that actual holdings of real money balances (M/P) adjust with a lag to the difference between the desired holdings $(M/P)^d$ in the current period and the actual holdings in the previous period. 1/ The rationale behind this equation is that, if the current demand exceeds the actual holdings in the previous period, the public adjust its holdings by adding to its balances, and vice-versa. This partial adjustment mechanism, expressed in terms of natural logarithms (ln), can be described as:

$$(1) \quad \Delta \ln (M/P)_t = k[\ln (M/P)^d_t - \ln (M/P)_{t-1}]$$

where k is the coefficient of adjustment and is expected to be positive and less than unity, and Δ is the first-difference operator.

The demand for real balances is specified as a function of real output (Y) and domestic interest rate (r_d), with the latter measuring the opportunity cost of holding money.

$$(2) \quad \ln (M/P)^d_t = \alpha_0 + \alpha_1 \ln Y_t + \alpha_2 \, r_{d,t}$$

where α_1 denotes the income elasticity and is expected to be positive, and α_2 is the semi-interest rate elasticity and is expected to be negative.

1/ In analyzing the money demand in Singapore, Khan (1981) found that the empirical results rendered considerable support to this type of dynamic specification.

From the money supply identity, changes in the stock of money are equal to the sum of changes in net foreign assets (R) and changes in net domestic assets (D).

$$(3) \quad \Delta M_t = \Delta R_t + \Delta D_t$$

This relation can be log-linearized about the sample means and expressed in terms of the rate of change of variables in real terms as:

$$(4) \quad \Delta \ln (M/P)_t = m_0 + m_1 \Delta \ln (R/P)_t + m_2 \Delta \ln (D/P)_t$$

where $m_1 = (\bar{R}/\bar{M})$ and $m_2 = (\bar{D}/\bar{M})$ are, respectively, ratios of the sample means of net foreign assets and net domestic assets to the money supply, lagged by one period.

Substituting equations (2) and (4) in equation (1) and rearranging terms result in an equation which expresses the rate of change of net foreign assets in real terms as a function of variables in the demand for money equation, the lagged level of real balances, and the rate of change of domestic assets in real terms.

$$(5) \quad \Delta \ln (R/P)_t = (m_0 + k\alpha_0)/m_1 + k\alpha_1/m_1 \ln Y_t$$
$$+ k\alpha_2/m_1 \, r_{d,t} - k/m_1 \ln (M/P)_{t-1} - m_2/m_1 \Delta \ln (D/P)_t$$

According to this equation, reserve accumulation occurs as long as the demand for money is left unsatisfied at the beginning of the period and not met by domestic credit creation during this period. 1/

2. Exchange rate

Exchange rate policy in Singapore should be viewed as an integral part of the authorities' financial management. By providing domestic liquidity to the commercial banks through swap arrangements or outright purchases of foreign exchange, the authorities have accumulated foreign

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1/ This formulation is consistent with the monetary approach to the balance of payments, as highlighted by Frenkel and Johnson (1976) and International Monetary Fund (1977), and applied to small open economies by Otani and Park (1976) and Sassanpour and Sheen (1984).

assets in order to relieve the upward pressure on the exchange rate. At the same time, however, the authorities have had to consider the implications of the intervention policy for monetary stability and thus face a trade-off between the exchange rate and monetary objectives. 1/

It may be argued that the change in the exchange rate is a function of the gap between the authorities' desired level of the exchange rate (E^d) and the actual rate prevailing in the preceeding period (E_{t-1}), as shown in equation (6) below.

$$(6) \quad \Delta \ln E_t = \phi \, [\ln E_t^d - \ln E_{t-1}]$$

where ϕ is the adjustment coefficient and is expected to be positive and less than unity. E is defined as the value of the domestic currency in terms of the foreign currency, such that an increase in E denotes an appreciation of the Singapore dollar.

The desired level of the exchange rate in a given period is assumed to be set by the authorities, taking into consideration the ratio of foreign assets to total assets at the end of the preceeding period. As the level of foreign assets increases relative to domestic assets, reflecting the sales of domestic currency to the banking system, the desired level of the exchange rate would be, _ceteris paribus_, be lowered. In addition, the desired level of the exchange rate is assumed to respond to the discrepancy between the foreign inflation rate (Π_f) and the domestic rate (Π) with the lagged exchange rate as an anchor. This inflation rate differential can be interpreted as an indicator representing the premium/discount on the Singapore dollar or the _expected_ rate of change in the exchange rate. 2/

$$(7) \quad \ln E_t^d = \beta_0 + \beta_1 \ln (R/D)_{t-1} + \beta_2 \, [(\Pi_f - \Pi)_t + \ln E_{t-1}]$$

where β_1 is expected to be negative and β_2 to be positive. In this equation, if the role of foreign reserves becomes negligible in the

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1/ Branson (1981) emphasized the importance of this type of trade-off facing the policymakers in a small open economy like Singapore.

2/ Had information been available on the premium/discount of the Singapore dollar vis-à-vis the currencies of Singapore's major trading partner and competitor countries, such information could have been used in place of the inflation rate differential. However, this information is available only for the exchange rate between the Singapore dollar and the U.S. dollar.

authorities' exchange rate policy, the desired level of exchange rate would be influenced more by the purchasing power parity, and thus the value of β_2 would be close to unity. In this case, the real exchange rate would be constant in the long run. On the other hand, if the role of foreign reserves becomes significant, β_2 would be close to zero, and the real exchange rate may not be constant in the long run.

Combining equations (6) and (7), the dynamic adjustment of the exchange rate can be expressed as:

$$(8) \quad \Delta \ln E_t = \phi\beta_0 + \phi\beta_1 \ln (R/D)_{t-1} + \phi\beta_2 (\Pi_f - \Pi)_t + (\beta_2 - \phi) \ln E_{t-1}$$

This functional specification is the authorities' reaction function and reflects their foreign reserve management policy as well as other factors influencing the exchange rate. 1/

3. Prices

The wholesale price index in Singapore, which is composed entirely of prices indices of traded goods, reflects price developments in the world markets as well as movements in the exchange rate. Therefore, variations of the wholesale price index (P_w) are specified as a function of changes in import prices (Pm) and export prices (Px), both denominated in terms of domestic currency.

$$(9) \quad \Delta \ln P_{w,t} = w_0 + w_1 \Delta \ln Pm_{,t} + w_2 \Delta \ln Px_{,t}$$

where w_1 and w_2, respectively, measure the contribution of import and export prices to changes in P_w. Both Pm and Px are exogenously-determined world market prices of Singapore's imports and exports, adjusted for the exchange rate. 2/

The rate of change in the consumer price index--$\Pi = \Delta \ln P$--has diverged from that in the wholesale price index, mainly reflecting changes

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1/ This equation could be only one of many plausible specifications to represent the authorities' reaction function. However, it is not the purpose of this paper to identify their true reaction function; such an attempt would require testing alternative reaction functions.

2/ That is, $P_m = P_m^*/E$ and $P_x = P_x^*/E$, where P_m^* and P_x^* are world market prices of imports and exports, respectively.

in prices of non-traded goods in response to domestic demand and supply conditions. Thus, the rate of change in the consumer price index is specified in equation (10) below as a function of the excess supply of domestic liquidity, which may serve as a counterpart to excess demand for goods. The domestic rate of inflation is also expected to respond positively to the excess of real output above its potential level. The potential output path, in logarithmic terms, is defined as $Y_0e^{\mu T}$, where Y_0 is the initial output level, μ is the potential (or steady state) growth rate, and T is the time trend term. In addition to demand and supply forces described above, the rate of change in the wholesale price index is included as an explanatory variable in order to capture the influence of traded goods prices on the consumer price index.

$$(10)\quad \Delta\ln P_t = \gamma_1[\ln (M/P)_{t-1} - \ln (M/P)^d_t] + \gamma_2 \ln (Y/Y_0e^{\mu T})_t + \gamma_3\ \Delta\ln P_{w,t}$$

where γ_1, γ_2, and γ_3 are expected to be positive. Combining equations (2) and (10) and rearranging terms result in:

$$(11)\quad \Delta\ln P_t = -(\gamma_1\alpha_0 + \gamma_2 \ln Y_0) + \gamma_1 \ln (M/P)_{t-1} + (\gamma_2 - \gamma_1\alpha_1) \ln Y_t - \gamma_1\alpha_2 r_{d,t}$$
$$+ \gamma_3\ \Delta\ln P_{w,t} - \gamma_2\mu T.$$

4. Real output

Given the openness of the economy and the limited size of the domestic market, 1/ overall economic activity in Singapore is dominated by the activity in the external sector, which in turn, is influenced largely by both external demand conditions for Singapore's output and domestic supply factors. As a result, the behavioral equation for real output needs to be derived from the demand and supply functions.

The world demand for Singapore's output could be posited as a function of the world real income (Y*) and the real exchange rate, representing the ratio of Singapore's output price relative to that of its competitors in the world market (E•P/P*). 2/

1/ The value of Singapore's exports has averaged about 140 percent of GDP in recent years.

2/ The domestic consumer price index was used as a proxy for the GDP deflator; while the latter would have been more appropriate in this equation, the former was chosen to limit the number of endogenous variables and provide a link with the rest of the model.

$$(12) \quad \ln Y_t^d = \lambda_1 + \lambda_2 \ln Y^*_t + \lambda_3 \ln (E \cdot/P^*)_t$$

where λ_2 is assumed to be positive and λ_3 negative.

The supply of output in the short run is assumed to depend on the inverse of real wages (P/W) and the utilized capital stock (UK).

$$(13) \quad \ln Y_t^s = \delta_1 + \delta_2 \ln (P/W)_t + \delta_3 \ln (UK)_t$$

where and δ_2 and δ_3 are expected to be positive. Solving equation (13) for P, substituting the solution in equation (12), and assuming that the actual output equals the demand, the output equation can be derived as: 1/

$$(14) \quad \ln Y_t = \psi_0 + \psi_1 \ln Y_t^* + \psi_2 \ln (E \cdot W/P^*)_t + \psi_3 \ln (UK)_t$$

where $\Psi_0 = \frac{\lambda_1 \delta_3 - \lambda_3 \delta_1}{\delta_2 - \lambda_3}$, $\Psi_1 = \frac{\lambda_2 \delta_2}{\delta_2 - \lambda_3}$, $\Psi_2 = \frac{\lambda_3 \delta_2}{\delta_2 - \lambda_3}$, and $\Psi_3 = \frac{-\lambda_3 \delta_3}{\delta_2 - \lambda_3}$.

Given the sign conditions in equations (12) and (13), ψ_1 and ψ_3 are expected to be positive, and ψ_2 negative. The term $E \cdot W/P^*$ is an indicator of external competitiveness and, for estimation purposes, is proxied by the relative unit labor costs adjusted for the exchange rate (E•RULC), where RULC is the ratio of Singapore's unit labor costs to that of its major trading partners. 2/ The utilized capital stock is proxied by the real value of bank credit extended to the private sector (C_{ps}/P). 3/ The first difference of equation (14), together with the proxy variables discussed above, yields the following equation:

$$(15) \quad \Delta \ln Y_t = \psi_1 \Delta \ln Y^* + \psi_2 \Delta \ln (E \cdot RULC)_t + \psi_3 \Delta \ln (C_{ps}/P)_t$$

1/ Branson and Love (1987) have used a similar approach for deriving the output equation for exportables.

2/ Branson and Love (1987) also use the index of unit labor costs adjusted for changes in the exchange rate to represent the external competitiveness.

3/ In many developing and newly-industrialized countries, the availability of bank credit plays an important role in influencing the rate of capacity utilization. The role of credit in output functions has been emphasized by Kapur (1976) and Keller (1980).

5. Government finances

Government revenue has been increasing in Singapore due to both high rates of economic growth and a buoyant tax structure. Public expenditure has also been rising in recent years, reflecting government efforts to meet the need for housing and infrastructure. However, owing to budgetary discipline, expenditures have been maintained successfully within available domestic resources; in fact, since 1968, the government fiscal operations have continuously resulted in surpluses.

Within this framework, the government expenditure (GE) function is formulated on the basis of the assumption that the Government attempts to adjust its expenditure with a lag to increases in revenue. In other words, the more government revenue (GR) exceeds expenditure, the faster the latter rises.

$$(16) \quad \Delta \ln GE_t = g\,(\ln GR_t - \ln GE_{t-1})$$

where g denotes the adjustment lag and is expected to be positive and less than unity. Rearranging terms in equation (16) leads to:

$$(17) \quad \ln GE_t = g \ln GR_t + (1-g) \ln GE_{t-1}$$

which formulates government expenditure as a weighted average of current government revenue and the lagged level of expenditure. 1/

Government revenue is specified simply as a log-linear function of nominal income.

$$(18) \quad \ln GR_t = q_0 + q_1 \ln (PY)_t$$

where q_1 measures the elasticity of total revenue with respect to nominal income. 2/

1/ In the estimation process, a constant term was added to this equation to capture the budgetary surpluses that have been recorded.

2/ In this formulation, the actual and desired levels of revenues are assumed to be the same. Aghevli and Khan (1977) assumed that revenue adjusts with a lag to its desired level. This formulation was suggested for high inflation countries, as the authorities attempt to adjust revenue in the face of its declining value in real terms.

6. Domestic assets

Having defined the money supply identity in equation (3), the monetary sector is completed by defining the net domestic assets (D) of the banking system. The change in net domestic assets is equal to changes in stock of credit to the private sector and changes in net credit to the Government (GC), including other items (net). 1/

$$(19) \quad \Delta D_t = \Delta C_{ps,t} + \Delta GC_t$$

The change in net credit to the Government (GC) is defined as:

$$(20) \quad \Delta GC_t = (GE_t - GR_t) - GNBB_t$$

where the first term represents budgetary operations and the second term indicates changes in net government borrowing from banking system that arises from nonbudgetary operations (GNBB). Reflecting budgetary surpluses and funds generated by the social security scheme and other operations, the Government has been a net depositor of funds with the banking system.

7. Working of the model 2/

The essence of the model, which conforms with a variety of formulations suggested by the monetary approach to the balance of payments, is that reserve accumulation occurs as long as the demand for money is not satisfied by increases in net domestic assets (equation (5)). In this model, the excess demand for money arises from the Government's contractionary financial operations, reflecting traditional budget surpluses and sizable build-ups of deposits by the Government with the monetary authorities (equations (19) and (20)).

Since reserve accumulation reflects the monetary authorities' foreign exchange purchases from (or swaps with) the commercial banks, a significant reserve accumulation would prevent the exchange rate from appreciating

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1/ The private sector credit is treated as an exogenous variable in this model. It could be assumed that the stock of credit to the private sector is, in principle, demand-determined, and this demand is always met by the supply of credit from the banking system.

2/ The process described below is presented in a static framework, but the actual process should be viewed in a dynamic setting where interactions among variables occur simultaneously. This is done in Section IV.

(equation (8)). This would reinforce the direct influence of rising foreign prices on the traded-goods prices (equation (9)), which would in turn increase domestic consumer prices at a faster pace if they were rising, or decrease them at a slower pace if falling (equation (11)).

A more depreciated exchange rate would safeguard the external competitiveness and improve growth performance, provided that wage costs remain unchanged (equation (15)). A higher real output level, in turn, would increase the demand for money and reduce the pressure on domestic prices. Thus, the direct impact of exchange rate changes on these prices would be counteracted by the influence of the output, and the net impact would depend on the relative size of the relevant coefficients.

Developments in domestic prices and real output have implications for the level of government revenue (equation (18)). However, to the extent that expenditure grows in line with revenue (equation (17)), the net monetary impact of budgetary operations should be minimal.

The upshot of the discussion is that a tight financial policy could trigger foreign exchange intervention that may induce a depreciation of the domestic currency and eventually an expansion of output. This possibility, however, depends on the values of the parameters of the behavioral equations and is thus an empirical question.

III. Empirical Results

Table 1 summarizes the estimates of the complete model, comprising seven behavioral equations and three identities. The model is estimated by the two-stage least squares method for the period 1979-86, using quarterly data. 1/ The behavioral relationships are generally well estimated, and the model as a whole appears to capture the essential features of the Singapore economy.

The estimated equation for foreign reserve movements suggests that the extent of these changes is indeed systematically related to the excess demand for money that is not met by changes in domestic credit. From this equation, the long-run income and interest rate elasticities of the demand for money are calculated to be about 1.2 and -0.1, respectively. Furthermore, using the average sample value of $m_1 = 0.7$, the adjustment coefficient, k, is estimated to be about 0.6, which implies that about 60 percent of

1/ The beginning of the observation period corresponds to the first full year following the total liberalization of exchange controls in June 1978. Thus, the structural equations specified in this model may not be suitable for the period prior to mid-1978.

Table 1. Singapore: Estimated Model
(Q1 1979 - Q4 1986)1/

Behavioral equations:

Foreign reserves 2/

$$\Delta \ln (R/P)_t = \underset{(3.4)^{**}}{-4.55} + \underset{(4.5)^{**}}{1.01} \ln (Y)_t - \underset{(2.2)^{*}}{1.1}\, r_{d,t} - \underset{(5.5)^{**}}{0.81} \ln (M/P)_{t-1} - \underset{(5.5)^{**}}{0.39} \Delta \ln (D/P)_t$$

$\bar{R}^2 = 0.73$ S.E.E. = 0.04 D.W. = 1.86

Exchange rate 2/

$$\Delta \ln (E)_t = \underset{(5.4)^{**}}{0.07} - \underset{(5.2)^{**}}{0.04} \ln (R/D)_{t-1} + \underset{(6.7)^{**}}{0.37} (\Pi_f - \Pi)_t - \underset{(3.4)^{**}}{0.28} \ln (E)_{t-1}$$

$\bar{R}^2 = 0.76$ S.E.E. = 0.01 D.W. = 1.70

Wholesale prices

$$\Delta \ln (Pw)_t = \underset{(0.1)}{0.001} + \underset{(2.4)^{*}}{0.20} \Delta \ln (Px)_t + \underset{(8.2)^{**}}{0.90} \Delta \ln (Pm)_t$$

$\bar{R}^2 = 0.96$ S.E.E. = 0.01 D.W. = 1.92

Consumer prices 2/

$$\Delta \ln (P)_t = \underset{(1.6)}{0.45} + \underset{(1.9)}{0.07} \ln (M/P)_{t-1} - \underset{(2.2)^{*}}{0.09} \ln (Y)_t + \underset{(1.0)}{0.10}\, r_{d,t} + \underset{(1.3)}{0.07} \Delta \ln (Pw)_t - \underset{(1.1)}{0.001}\, T$$

$\bar{R}^2 = 0.65$ S.E.E. = 0.01 D.W. = 1.97

Output 2/

$$\Delta \ln (Y)_t = \underset{(3.2)^{**}}{-0.01} + \underset{(4.4)^{**}}{0.35} \Delta \ln (Y^*)_t - \underset{(3.1)^{**}}{0.14} \Delta \ln (E \cdot RULC)_t + \underset{(7.5)^{**}}{0.82} \Delta \ln (C_{ps}/P)_t$$

$\bar{R}^2 = 0.78$ S.E.E. = 0.02 D.W. = 2.10

Government revenue 2/

$$\ln (GR)_t = \underset{(5.5)^{**}}{-11.90} + \underset{(9.1)^{**}}{1.47} \ln (Y \cdot P)_t + \underset{(3.0)^{**}}{0.50}\, \text{Dummy } 3/$$

$\bar{R}^2 = 0.78$ S.E.E. = 0.18 D.W. = 1.51

Government expenditure

$$\ln (GE)_t = \underset{(1.4)}{1.15} + \underset{(4.8)^{**}}{0.57} \ln (GR)_t + \underset{(2.5)^{*}}{0.28} \ln (GE)_{t-1} + \underset{(2.1)^{*}}{0.50}\, \text{Dummy } 3/$$

$\bar{R}^2 = 0.76$ S.E.E. = 0.19 D.W. = 2.28

Identities:

Money supply

$$\Delta M_t = \Delta R_t + \Delta D_t$$

Domestic credit

$$\Delta D_t = \Delta C_{ps,t} + \Delta CG_t$$

Credit to the government

$$\Delta CG_t = GE_t - GR_t - GNBB_t$$

1/ ** and * indicate that the estimated coefficient is significantly different from zero at a critical level of 1 percent and 5 percent, respectively.

2/ Corrected for autocorrelation in residuals by the Cochrane-Orcutt method.

3/ Dummy variable takes a value of 1 for the first quarter of 1986 and 0 otherwise in order to capture the once and for all change in the accounting entries that resulted from the transaction of land ownership.

the excess demand for money would be satisfied by reserve accumulation within one quarter and over 80 percent of this excess would be met within two quarters. The estimated speed of adjustment of the money market is therefore rather fast, which is consistent with the observation that Singapore's financial markets are highly integrated with the foreign markets.

While movements in foreign reserves are found to be the principal mechanism for meeting changes in the excess demand for money, the level of these reserves relative to domestic assets is a significant factor influencing the level of exchange rate. The estimated coefficient of this explanatory variable suggests that, as the level of foreign assets increases relative to the domestic assets, the upward pressure on the exchange rate is relieved. At the same time, the estimated coefficient of the inflation rate differential term is found to be statistically significant, indicating that the authorities have implicitly taken into account changes in relative prices in managing the exchange rate. The coefficient of the lagged endogenous variable, together with the coefficient of the inflation rate differential term, suggests that about 76 percent of the gap between the desired level and the actual level of the exchange rate is adjusted within a given quarter, indicating a reasonably rapid exchange rate adjustment. 1/

The rate of change in wholesale prices, as expected, is explained almost entirely by changes in import and export prices denominated in the domestic currency, indicating the openness of the economy and the role of the exchange rate in the transmission of inflationary pressures from abroad. 2/ However, the rate of change of consumer prices is influenced more by overall domestic conditions, which suggests that the demand and supply conditions for the non-traded goods are important determinants of consumer prices.

The coefficients of the estimated output function have the expected signs and are statistically significant. It is noteworthy that the availability of credit to the private sector, as observed in many developing and newly industrialized countries, is a significant factor for influencing short-term fluctuations in output. Moreover, it is found that the

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1/ The estimates of ϕ and β_2 involve a second degree polynominal in β_2. The roots of the polynominal are -0.76 and 0.49. Since β_2 is assumed to be positive and less than unity, only the latter root is the meaningful solution. Given $\beta_2 = 0.49$, ϕ is calculated to be 0.76.

2/ While the sum of the point estimates of w_1 and w_2 exceeds unity, the variance-covariance matrix for these estimates suggests that, with a 95 percent probability, one cannot reject the hypothesis that the sum of w_1 and w_2 equals unity.

relative unit labor costs adjusted for the exchange rate play an important role in growth performance, as expected for a highly-open economy such as Singapore.

The estimated equations for the government revenue and expenditure capture the essential characteristics of the budgetary operations. The large and statistically significant elasticity of revenue with respect to nominal income reflects the progressive income tax structure. The sum of two estimated coefficients in the expenditure equation is not significantly different from unity. 1/ This finding indicates that attempts have been made to keep the level of expenditure in line with total revenue. The coefficient of adjustment is estimated to be in the order of 0.7, implying that about 90 percent of adjustment occurs within two quarters.

IV. Simulation Exercises

This section analyzes the results of various simulation exercises. The major objectives are, first, to examine the overall explanatory power of the model and, second, to explore the impact of alternative policy scenarios on key macroeconomic variables.

For the purpose of investigating the overall performance of the model, the system of the estimated behavioral and the definitional equations are simulated dynamically during the observation period, 1979-86. The simulation results for the key variables are depicted in Chart 1. The comparison between the actual and the simulated values of real output, consumer prices, the exchange rate, and foreign reserves all suggest that the model as a whole tracks the recent developments rather well, capturing even major turning points, i.e., the decline of output in 1985, the decline in consumer prices from mid-1985, and the sharp turn-around in the exchange rate in late-1984. The gaps between the actual and the simulated values for the consumer prices and the exchange rate are serially correlated for certain periods, but they do not seem to be excessive, given the tendency that the errors in a dynamic simulation are accumulated over time and hence are more magnified than in a static simulation.

In order to examine the effects of policy actions and changes in exogenous factors on key macroeconomic variables, a number of simulation exercises are conducted. 2/ One of the compelling issues facing the

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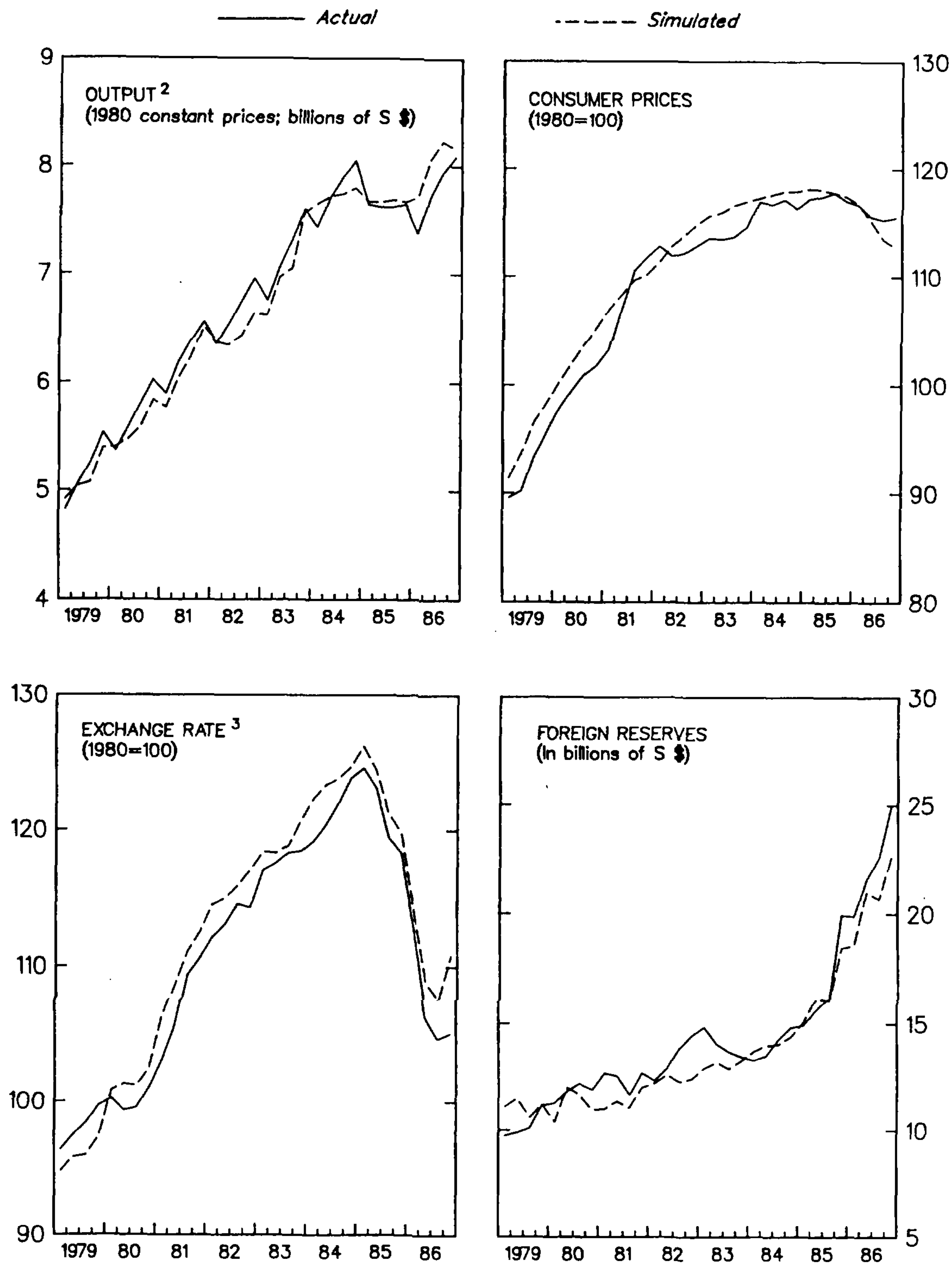
1/ The variance-covariance matrix for the two coefficients in the government expenditure equation indicates that, with a 95 percent confidence, one cannot reject the hypothesis that the sum of the coefficient of ln (GR) and that of ln $(GE)_{t-1}$ equals unity.

2/ However, as suggested by Lucas (1973), the parameters of the behavioral relationships could change as the authorities pursue alternative policies. Thus, the results should only be interpreted as indicative of the direction of changes and the rough magnitudes of the effects.

CHART 1
SINGAPORE
SELECTED MACROECONOMIC VARIABLES (ACTUAL AND SIMULATED), 1979–1986[1]



1 Simulated values represent the results of dynamic simulation, taking as given, the actual values of exogenous variables.
2 Output measured in terms of real GDP.
3 An increase indicates an appreciation of the Singapore dollar.

Singapore authorities in the recent years has been the impact of the high-wage policy pursued in the first half of the 1980s on the performance of the economy in terms of output and employment. While this is a complex issue, a partial answer could be provided by analyzing the result of a simulation exercise based on the assumption that the authorities' wage policy was rather conservative, such that the growth rate of nominal wages adjusted for changes in labor productivity was kept at the same rate as the weighted average of those in Singapore's major competitor countries. In order to capture this hypothetical case, it is assumed that the relative unit labor costs (unadjusted for exchange rate) were fixed at the level of 1980 for the period 1981-86. This means that the assumed level of relative unit labor costs were, on average, about 16 percent below the actual level; all other exogenous variables take the actual values.

The results of this scenario (Case I) and that of the base run (dynamic simulation) are contained in Table 2. According to this simulation, the level of output would have been about 3 percent higher than the base run outcome, mainly because this wage policy would have contributed directly to the improvement in Singapore's external competitiveness. A higher output level would have enlarged the excess demand for money and increased the need to supply domestic liquidity by purchasing foreign exchange. This would have led to an increase in foreign reserves and a decline in the exchange rate, leading to a further improvement in external competitiveness. This is illustrated by Table 2, indicating that, compared with the base run, the level of foreign reserves would have been higher by about 7 percent and the nominal exchange rate would have been lower by about 1 percent. Reflecting primarily the output effect, the consumer prices would have been slightly below the result suggested by the base run simulation.

Another important issue facing the authorities has been the effectiveness of financial and exchange rate policies. In order to analyze this issue, consider Case II, representing the hypothetical situation whereby the public sector financial institutions' deposits in the Government's accounts with the MAS had been reduced by $0.2 billion in each quarter. In other words, the equivalent of about 1 percent of the total liquidity had been injected in the banking system in each quarter. In this situation, with the excess demand for liquidity being partially alleviated, the need for the monetary authorities to acquire foreign exchange would have been reduced, leading to a reduction in foreign reserves to a level about 8 percent below the base run result. In the process, the domestic currency would have been allowed to appreciate by nearly 2 percent compared with the base run outcome. This, in turn, would have contributed to stabilizing prices, but at the same time would have deteriorated the external competitiveness and thus the output performance. This scenario exemplifies the severe constraint that the authorities have been experiencing with the conduct of the financial and exchange rate policies.

Table 2. Singapore: Simulation Results, 1981-1986 1/

	Simulation Period	Foreign Reserves (billions of Singapore dollars)	Exchange Rate (1980=100)	Consumer Prices (1980=100)	Output (1980 constant prices; billions of Singapore dollars)
		(Period average)			
Base Run	1981-86	14.7	116.7	114.7	7.2
	1984-86	17.1	118.9	116.7	7.8
Case I	1981-86	15.6 (6.8)	115.5 (-1.0)	114.2 (-0.4)	7.4 (2.8)
Case II	1984-86	15.7 (-8.2)	120.8 (1.6)	116.8 (0.1)	7.8 (-0.3)
Case III	1984-86	16.2 (-5.3)	119.4 (0.4)	117.2 (0.4)	7.6 (-2.6)

1/ Figures in parentheses represent percentage differences from the base-run results.

Case I: Relative unit labor cost is fixed at the level of end-1980 for the period 1981-1986.

Case II: The Government deposits with the MAS are reduced by S $0.2 billion in each quarter during 1984-86.

Case III: The quarterly growth rate of world income in real terms is reduced by 1 percentage point.

In order to highlight the impact of external demand conditions, Case III examines the hypothetical situation whereby the growth rate of world income in real terms had been 1 percentage point less than the actual growth rate, or, the average level of that income had been about 6.5 percent lower than the actual. In this case, Singapore's output would have been about 3 percent lower than the base run, indicating that approximately about one half of the variation in the world economic activity would have been transmitted to Singapore. Since a lower output level would have reduced the demand for liquidity, the level of international reserves would have been about 5 percent below the level suggested by the base run simulation. This, in turn, would have contributed to an appreciation of the Singapore dollar, compared with the base run result. Despite this appreciation, the consumer prices would have risen, mainly as a result of a lower level of output relative to the liquidity position of the economy.

V. Concluding Remarks

The purpose of this paper has been to examine the impact of financial, exchange rate, and wage policies in Singapore on key macroeconomic variables such as output, prices, and foreign reserves. Toward this end, a simple short-term model was formulated and estimated. This model was used to conduct a number of policy simulations. Several conclusions could be drawn from this analysis.

First, the exchange rate policy in Singapore has been largely influenced by the liquidity implications of contractionary budgetary and other financial operations. As a result, there has been a trade-off that the authorities need to consider in their decision to adopt a particular mix of the exchange rate and reserve levels.

Second, the authorities' high wage policy pursued in the first half of the 1980s contributed to rapid increases in the domestic labor costs relative to those of Singapore's competitors. This, together with the sharp appreciation of the Singapore dollar, contributed to a significant loss of external competitiveness and a severe recession in 1985. Had the authorities adopted a more moderate wage policy, the output would have been significantly higher than the actual, and the 1985 recession probably would have been avoided, or at least its severity reduced. Now that the relative unit labor costs adjusted for the exchange rate have declined to a level prevailing in the early 1980s, reflecting both the depreciation of the domestic currency and the sharp decline in wages and other labor costs, growth prospects should improve noticeably over the medium term.

Third, considering the openness of the economy, the economic activity has been influenced by the external environment, particularly the level of world income in real terms. The model estimates suggest that financial and exchange rate policies had relatively limited influence in insulating the domestic economic activity from external shocks, mainly because price stability was also one of the major objectives of the authorities.

The experience of Singapore, while being unique in many respects, may offer some lessons for other countries with small and highly-open economies and no impediments to international capital movements. Singapore's experience suggests that flexibility in financial, exchange rate, and wage policies is crucial in achieving non-inflationary growth with external payments viability. Should exchange rate policy aimed at improving the external competitiveness jeopardize an inflation target, as is often the case in many open economies, other policy instruments merit consideration. As demonstrated by this paper, an appropriate wage policy may be an important complement to the exchange rate policy. Over the longer run, these policies could help to maintain external competitiveness and adapt the structure of production to the changing pattern of external demand and hence reduce the vulnerability of these economies to external developments.

Data Sources and Definitions

Data used for estimation were obtained from four primary sources:

A. International Monetary Fund, International Financial Statistics.

B. International Monetary Fund, Direction of Trade Statistics.

C. Department of Statistics, Singapore, Monthly Digest of Statistics.

D. The Monetary Authority of Singapore, Monthly Statistical Bulletin.

Definition of variables and sources were as follows:

R = net foreign assets of the banking system (source A).

M = broad money--currency plus demand deposits plus quasi-money (source A).

C_{ps} = outstanding credit to the private sector by the banking system (source A).

D = domestic credit (source A).

CG = net claims on the Government (source A).

GE = government expenditure including net lending (source A).

GR = government revenue (source A).

GNBB = government non-bank borrowing (source A).

E = nominal efffective exchange rate; calculated from data provided in sources A and B.

P = consumer price index (source A).

Pw = wholesale price index (source A).

Px = export price index (source A).

Pm = import price index (source A).

RULC = ratio of Singapore's unit labor costs to that of its major trading and competitor countries; calculated from data provided in sources A, B, and C.

r_d = three-month interbank deposit rate (source D).

Π = percentage change in P (Source A).

Π_f = percentage change in the arithematic average of export and import prices in foreign currency terms (Source A).

Y = real Gross Domestic Product (source C).

Y* = weighted average of real GDP or GNP in Singapore's major trading partner countries (source A).

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