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# NOTES TOWARD CONSTRUCTING MACROECONOMIC PLANNING MODELS FOR THE PHILIPPINES

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# Notes Toward Constructing Macroeconomic Planning Models for the Philippines

1. The National Economic Council has recently provided support to a research project to construct macroeconomic models of the Philippine economy that would be operationally useful for planning and policy-making purposes. The output of the project would be a series or collection of quantitative models containing empirically estimated parameters and coefficients of economic relationships - some models would be more specific in regard to particular areas of economic policy and would involve possible optimizing features. The model to use operationally at any given time would depend on what would seem appropriate at the time; for instance, one could be interested in investment allocation, and one should have a model that treats this problem specifically. If one is interested in using the instruments of monetary policy, another model that treats the monetary sector in some detail would be appropriate. In effect, we would have partial or sub-models grafted to a basic aggregative model, for it would seem more economical to approach our research objective this way rather than try to have one grand model that would answer all questions that may be put. The following notes are very preliminary.

2. We can start with a simple aggregative model that may suggest more detailed treatments at later stages of the study. Consider the following equations:

$$(1) \qquad Y = A(1+m)^t K^a N^{1-a}$$

$$(2) \qquad C = a_o + a_1 Y + a_2 H$$

$$(3) \qquad M = b_o + b_1 Y + b_2 X$$

$$(4) \qquad p = c_o + c_1 \dot{Z}/Y + c_2(G-T)$$

(5) $N = (1-a)\, p\, Y/w$

Real output Y is a function of capital K and employment N . Productivity change would be reflected by m; t stands for time in years. The other variables measured in real terms are consumption C, imports M, exports X, government expenditures G, and government revenues T. Z stands for the money supply, p for the general price level and w for the money wage rate. Population is represented by H. By "real" we mean "at constant prices". Throughout, all variables are dated at t unless otherwise stated.

3. The rationale for eq. (1) is simply that it is often used. Consumption C in (2) is the sum of private consumption and government consumption expenditures, both of which depend on population H. Presumably, basic consumption needs are met and provision of public services (such as education and health services) depend on population size. In (3), X is used as an explanatory variable for imports on the ground that the level of foreign exchange earnings can constrain M. This must have been especially so during the period of exchange controls. The price level p in (4) is made to depend (positively, we expect) on the ratio of the money supply to real output, and also on the government deficit. The rationale here is that p would be higher if there were more money relative to the goods that money can buy. Conversely, the higher is output Y, the lower p would be. In this regard, however, the role of government expenditures G is somewhat different, as most of G would be in the form of wages of government workers whose services are not purchased in the market. To take account of this fact, even if partially, we use the government deficit as another explanatory variable.

4. Equation (5) derives from profit-maximizing assumptions, given (1). The marginal productivity of labor is (1-a) Y/N, so that if this is equated to the real wage w/p, we get (5). It could then be considered a demand-for-labor function. We do not need a labor-supply function, as this has not been effective in the aggregate.

5. We have the following two relationship which are identities ex post: realized

(6) $I = Y - C - X + M$ (domestic investment)

(7) $K(t) = K(t-1) + I(t-1)$

$I = Y - C - (X - M)$

and also, possibly,

(8) $X = d_o + d_1 M^*$

where $M^*$ is world imports. Inclusion of (8) makes X endogenous but adds $M^*$ as an exogenous variable. There would not seem to be any particular advantage in this, unless we could get better prognosis of $M^*$ than of X.

6. At any rate, in the system (1) - (8) we have the following set-up: 5 exogenous variables H, $M^*$, Z, G and T, of which the last 3 are also possible instrument variables; and 9 other variables Y, K, N, C, M, X, p, w, I. We thus need one more equation to determine, in particular, the money wage w; alternatively, we could take w as exogenous, in which case the remaining 8 (endogenous) variables can be determined by the system of 8 equations. One possible justification for taking the latter course is that we have had two pieces of minimum-wage legislation since 1964. However, the question of a wage-determining relationship calls for some examination later. (See para. 21 below.)

7. We expect that all the regression coefficients in the model will turn out positive, and one can trace effects of the exogenous variables, say H for example

on the endogenous variables. A greater $H$ reduces $I$ through increasing $C_0$, thus reducing $K$ and hence $N$ in later periods. The model seems, on the whole, to reflect the main features of the economy.

8. To use the model, we would have to have some idea of the social objective function. Suppose this is to maximize $Y$ subject to an upper constraint on $p$. Then we get a straightforward solution, for to increase $Y$ we need to increase $N$, which can be increased by increasing $p$ up to the point where the constraint becomes effective. The policy instruments $Z$, $G$, $T$ shruld then assume their appropriate values. The way eq. (4) is put, there are substitution possibilities between monetary and fiscal policies. The model is clearly very crude, however, for it does not show the different effects of higher $G$ through greater $T$ or through greater public borrowing. This defect should be corrected by a more detailed treatment of the public sector.

9. Unlike the Phillips relationship, the model says that $N$ and $p$ rise together (for any given year). It might be asked, therefore, why one should wish to impose a constraint on $p$ considering the unemployment situation. One important reason would be that there are more employed persons than unemployed, and the employed are capable of complaining more about higher prices. Presumably they would also have more political power. (Recent events surrounding the February 1970 *de facto* devaluation of the peso suggest that external balance is a higher priority objective relative to price "stability".)

10. Needless to say, other specifications of the economic relationships are possible, and these should be estimated provided of course that they are not unreasonable from a theoretical viewpoint. For instance in eq. (4), we could try time rates of change of the variables in place of the variables themselves. In place of eq. (2), we could try

(2.1) $C = C_p + C_g$

(2.2) $C_p = a_{01} + a_{11}(Y-T) + a_{21}H$

(2.3) $C_g = a_{02} + a_{12}T + a_{22}H$

where $C_p$ is private consumption and $C_g$ is government consumption. If the data permit, we should also try to disaggregate C into major components like food, clothing, etc. Another classification might be expenditures on agricultural commodities, manufactures, etc.

11. Output Y could be disaggregated into agriculture, manufacturing, services, etc. At some later stage of the research, the 1965 input-output data could be used for further disaggregation.

12. We would want to report (in an appendix) all these other estimated equations, whether or not they turn out nicely from a curve-fitting viewpoint, as a service to other prospective investigators.

13. As the main objective of the research project is to produce operationally useful macroeconomic models for the Philippines, we are constrained to including estimated equations (in our models) that appear more reliable statistically, even though from a theoretical viewpoint other equations might be more attractive. The reason is that we need relationships which are such that we can place more confidence in them as regards the effects of manipulating the instrument variables. Thus in general, between two possible relationships that are at least not unreasonable from the viewpoint of theory, we would choose to include in our models the one that gives a better fit to the data even if the other is theoretically

more attractive. But perhaps this matter could be decided on an ad hoc basis.

14. It will be observed that the model (1) - (8) is a supply model in the sense that it contains a production function for output, which is not determined - as it would be in a demand model - as the sum of consumption and investment demand. We cannot add an independent investment function that determines investment ex post, for this would overdetermine the system.

15. An alternative model would drop the production function and include an investment function, but this may not be too appropriate to the Philippine situation unless certain restrictions are imposed on the model. For it would appear sufficient to increase demand in order to increase output, and this would be true only within relatively narrow limits. The implications of such a model are thus likely to be misleading, if we accept the (broadly correct) viewpoint that the main constraint on output growth stems from the supply side rather than the demand side. This viewpoint is at least consistent with our experience of a secular rise in the price level.

16. Since $I = I_p + I_g$ where $I_p$ is private domestic investment and $I_g$ is government, it is possible to consider a model where I is residual. We shall refer to this model as Model B, a variant of the system (1) - (8) which we shall call Model A. Specifically, Model B consists of eqs. (1), (2.1) - (2.3), (3)-(8) and (9) $I = I_p + I_g$

with $I_g$ exogenous. One rationale for making $I_p$ residual is that to a large extent, ex ante private investment does not seem constrained by investment possibilities but rather by foreign exchange and credit availability. Rates of

return on investment appear relatively high, and it seems likely that in general, $I_p$ ex post has fallen short of ex ante magnitudes. Accordingly, the data on investment would not directly give us information that would help estimate investment demand functions. (One view that ex ante investment typically exceeds ex post is obviously not incompatible with the fact that the government has been encouraging investment along particular lines of activity.)

17. While Model B belongs to the same genre as Model A, a quite different one results from deleting eq. (2.2) and including an equation for $I_p$ in Model B. Such an equation for $I_p$ would not have to be necessarily a demand function but may simply be a relationship between $I_p$ (ex post, which is the only data we have) and other aggregative variables. One rationale for suppressing a private consumption demand function would be that in a supply model, quantities consumed would be constrained by current supply conditions (abstracting from unplanned inventory changes). It might also be mentioned - though this would be irrelevant to the point - that consumption has been estimated as a residual item in the national income accounts. In any event, we consider that the equation for $C_p$ can be omitted without much loss if we wish to take explicit account of the determination of $I_p$. The latter would be of greater interest from a policy viewpoint.

18. Consider

$$(10) \qquad I_p = e_o + e_1 Y + e_2 (M-X)$$

which could be interpreted as a financing equation, the $Y$ term reflecting domestic saving and the $(M-X)$ term reflecting foreign saving. We should expect

$0 < e_1 < 1$ and $e_2 > 0$, but estimates from our data give $e_2 < 0$*. One possible explanation is that the data are inaccurate, for it seems that imports were overvalued and exports undervalued during the period of exchange controls. Such errors in data would not seem great enough to account for the "wrong" sign, however. Another possibility is that the interpretation of (10) is wrong. This can be written

$$(10.1) \qquad I_p = \frac{e_o}{1 - e_1} + \frac{e_1}{1 - e_1}(C + I_g) + \frac{e_1 - e_2}{1 - e_1}(X-M)$$

and in this form, it is not clear why $e_2$ should be positive. If negative, that would only mean that the dependence of $I_p$ on the trade surplus is greater than its dependence on $C + I_g$. There would seem to be rather little theoretical motivation for (10.1), however.

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*Cf. M. Mangahas, "Foreign Assistance in Models of the Philippine Economy", Philippine Economic Journal (forthcoming), who reviews the work of Y. Shibuya and S. Yamashita, "Foreign Aid and Economic Growth of Developing Asian Countries," Occasional Paper No. 2, The Institute of Asian Economic Affairs, Tokyo 1968. These papers have estimated (10) with I as the dependent variable.

19. It is also possible that a more correct specification is

$$(10.2) \qquad I_p = e_o + e_1 Y + e_2 (M-X) + e_3 K$$

where the $Y$ term now reflects profit levels; as before, we expect that $e_2 > o$ to show the influence of net capital inflows, while $e_3 < o$.* Let us call this Model C, obtained from Model B by dropping eq. (2.2) and including eq. (10.2). It will be interesting to find out whether or not the estimated $e_2$ here turns out positive.

20. In any event, a negative $e_2$ in eq. (10) still calls for an explanation. The underlying mechanism may be that as an import surplus reduces the money supply directly, the amount of bank credit available to finance investment is also reduced. Accordingly, as a first attempt we could try

$$(10.3) \qquad I_p = f_o + f_1 Y + f_2 B$$

$$(10.4) \qquad B = g_o + g_1 Y + g_2 (M-X)$$

where $B$ is new bank credit, defined as the net addition to total bank credit during the year. We shall refer to this as Model D, using (10.3) - (10.4) in place of (10.2) in Model C. The $Y$ term in (10.4) plays the role of a trend variable, and $B$ is endogenous. Explicit consideration of the money supply $Z$ is ignored here, as we are taking $Z$ as exogenous. We expect $f_2 > o$ and $g_2 < o$, which would imply $e_2 < o$ in eq. (10) since (10.3) - (10.4) give

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*Cf. Y.K. Song, "A Macroeconometric Model of the Korean Economy," paper presented at the Second World Congress of the Econometric Society, Cambridge, September 1970.

$$(10.5) \qquad I_p = (f_o + f_2 g_o) + (f_1 + f_2 g_1)Y + f_2 g_2 (M-X)$$

which has the same form as eq. (10).

21. To return to the question of the money wage rate w, we can try the following equation to make w endogenous rather than exogenous:

$$(11) \qquad \frac{\Delta w}{w} = h_o + h_1 \frac{\Delta p}{p} + h_2 \frac{\Delta Y}{Y}$$

where $\Delta u(t)) = u(t+1) - u(t)$. If statistically significant, this would be a frankly empirical relationship but supported by microeconomic considerations. For if price inflation is faster, there would be institutional pressures for wage increases (this also works the other way of course); and faster output growth may require employers to pay higher wages because of frictions in the labor market, despite a labor surplus in the economy as a whole. Writing eq. (11) for time (t-1) instead of t, we see that eqs. (1), (4), (5) and (11) will determine Y, N, p and w simultaneously, given the values of the predetermined variables.

22. The next stage of the work, after estimating the various models (and other versions), would be to formulate less aggregative sub-models which can be grafted to some basic model and which would elucidate the quantitative effects of sets of related policy decisions. If, for example, the policy problem is one of investment allocation, eq. (1) will have to be replaced by less aggregative production functions.

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