THE NEW CAMBRIDGE AGGREGATE PRIVATE EXPENDITURE FUNCTION: POSSIBLE CASE OF THE BREAKDOWN

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1. INTRODUCTION

In the early 1970s, the Cambridge Economic Policy Group (CEPG),[1] popularly known as the New Cambridge (NC) school, observed that the British current account balance was rapidly deteriorating. Even a 20 percent devaluation of sterling in 1972 could not prevent current account balance from deterioration.

In order to explain this phenomenon, the CEPG gives a theory which suggests a direct link between the government budget deficit and the current account deficit.

The basis of such a link stems from the national income accounting identity that the sum of the deficits of the private,[2] public[3] and foreign[4] sectors taken together is nil. However, this identity does not automatically give rise to a direct link between the government budget deficit and the current account deficit. Rather it crucially depends on the deficit of the private sector in particular. More specifically, if and only if the private sector deficit is zero or constant, then the government budget deficit has to be directly reflected on the current account deficit and *vice versa*.

The implication of a zero private sector deficit is that the private sector fully adjusts its expenditures to disposable income with a short lag.

In testing this hypothesis, the CEPG constructed the following two equation macroeconomitric model:[5]

$$\text{Log } PX = \text{Log}[a + bPDI + dPDI_{-1} + gHP + gST] + U \quad \ldots\ldots (1.1)$$

$$PDI = nPX + XN \quad \ldots\ldots (1.2)$$

$a, b, d, g, q > 0$; and 'n' $= 0.42$;

Equation (1.1) is known as the aggregate private expenditure (PX) function where PX is expressed as a function of private sector current disposable income (PDI) and that of lagged disposable income (PDI_{-1}) and some other non-income variables such as change in hire purchase debt outstanding to the personal sector (HP) and stock building in the private sector including stock appreciation (ST).

Equation (1.2) has been added just to take care of the feedback effect of PX into income. This is also known as the feedback equation in the New Cambridge literature. In this equation, PDI is expressed as a function of PX and other exogenous determinants of income (XN).

They expressed all the variables in nominal terms[6] and estimated the PX function together with the PDI equation with the help of maximum likelihood (ML) method assuming 'n' $= 0.42$ and taking no observation on XN. This method is known as the feedback adjusted maximum likelihood (FAML) method in the literature. According to this method, the aggregate private expenditure function, estimated with annual British data for 1954–74 as reported by Cripps, Godley and Fetherston (1976) is as follows:

$$PX = \underset{(1.14)}{156.5} + \underset{(7.60)}{0.616}PDI + \underset{(4.09)}{0.360}PDI + \underset{(2.26)}{1.173}HP + \underset{(4.99)}{0.472}ST \quad \ldots\ldots (1.3)$$

In terms of the PX function, the NC hypothesis proposes, in a strict sense, that the sum of the co-efficients of PDI and PDI_{-1} is unity. According to equation (1.3) the sum of the co-efficients of PDI and PDI_{-1} is 0.972 which is less than but very close to unity, implying that over 97 percent of the private sector disposable income is spent within two years. This gives a strong empirical support in favour of the NC theory.

But since then, no other study could corroborate the NC hypothesis. Rather Chrystal[7] and later Chrystal and Darnell,[8] estimated the NC aggregate private expenditure function using other techniques such as the ordinary least squares (OLS) and the indirect least squares (ILS) with more recent British data. Their findings with annual data, both in real and in nominal terms, for the period 1962–80, contradicted the initial results obtained by the CEPG for 1954–74. Accordingly, they rejected the NC aggregate private expenditure function on empirical grounds. From theoretical point of view, they strongly criticised the nature and specification of the PDI equation and argued that the estimation method adopted by the CEPG was faulty. However, none has ever attempted to explain the cause of the empirical breakdown of the model, nor did any one try to correct the model.[9]

The purpose of the present paper is to critically examine the NC model in order to identify the possible causes of its empirical breakdown. Including this introduction, the paper has been divided into four sections. The second section discusses the macrotheoretic and econometric flaws associated with the model specification. Section three focuses on the econometric loopholes of the estimation technique adopted by the CEPG. The last section concludes the paper with some guidelines based on which further modifications can be made to the NC model and its method of estimation.

2. MACROTHEORETIC AND ECONOMETRIC PROBLEMS OF THE MODEL SPECIFICATION

As it has already been mentioned, the major focus of the NC model is on its aggregate private expenditure (PX) function. In order to avoid the problem of simultaneity bias from the parameter estimates of the PX function, the CEPG justified the formulation of an added equation for PDI. This subsection critically evaluates the specification of these two equations separately.

2.1 The Aggregate Private Expenditure Function

The New Cambridge PX function integrates consumption and investment into a single equation, rather than specifying them separately as is done in the Keynesian tradition. Cuthberston[10] rationalized this integration by saying that:

> ..... the interaction between the personal sector and the company sector in determining their expenditure decisions is a complex one and therefore, a better prediction of consumption plus investment expenditure may be obtained using a single expenditure equation for the whole of the private sector (i.e. companies plus persons) rather than two separate equations. (pp. 57-58).

The CEPG's aggregated private expenditure function is quite uncommon and new in macroeconomic literature. Although initially critics objected in principle to the aggregation of personal consumption and corporate investment, during the recent past, applied economists have been increasingly accepting it for the purpose of forecasting and public policy analysis of government deficit and balance of payments deficit.[11]

In the Keynesian macroeconomic literature, it is an established hypothesis that investment is volatile, while consumption is stable. Since consumption constitutes a larger segment of the private expenditure, therefore, a PX function is expected to be more stable than an investment function separately. However, this proposition is subject to empirical testing.

In response to the model presented by Fetherson and Godley[12] at the Carnegie-Rochester conference in 1978, Blinder[13] said that since the aggregate private expenditure function was so central to the NC theory, it would need a more careful examination. In doing so, Blinder (1978) expressed the NC aggregate private expenditure function in a more Keynesian fashion as follows:[14]

$$(C+I)=u_1 (PRDI+UCP)+u_2A_{-1}, \ldots \quad (2.11)$$

$0 > u_1, u_2 > 1;$

where:

PRDI is personal disposable income;

UCP is undistributed corporation profits

A_{-1} is real net worth at the close of the previous period.

u_1 and u_2 are constants;

C and I are defined as before.

If an equation (2.11) is considered to be equivalent to a truncated version of the NC aggregate private expenditure function, then according to Blinder, this can be conceptualised as the sum of an Ando-Modigliani[15] type of consumption function:

$$C = v_1 PRDI + v_2 A_{-1}, 0< v_1 < v_2 < 1 \quad \ldots \quad (2.12)$$

and an investment function that depends only on retained earnings. But still Blinder does not understand how co-efficients of PRDI and UCP are equal in (2.11).

Another characteristic of the CEPG aggregate private expenditure function is its *ad hoc* modelling.

Russell and Wakeman,[16] in their comment pointed out that although Fetherston and Godley formulated their hypothesis as:

$$H_1: DSFA = (1-w)DPDI \quad \ldots\ldots \quad (2.13)$$

where:

D is for change;

SFA is the stock of financial assets held by the private sector;

PDI is private sector disposable income;

w is a constant;

they instead tested:

$$H_2: PX = wPDI + (1-w)\ PDI_{-1} \quad \ldots\ldots\ldots\ldots \quad (2.14)$$

where:

PX, PDI, and PDI_{-1} are defined as before.

Given the unsatisfactory empirical performance of their PX function, they added some non-income variables and finally tested:

$$H_3: PX = wPDI + (1-w)\ PDI_{-1} + gHP + hBAP + qST \quad \ldots\ldots \quad (2.15)$$

where:

all the variables in this function are defined as before; Equation (2.15) also did not survive empirical testing (Bispham: 1975, Chrystal: 1981-a, 1981-b, and Chrystal and Darnell: n.d.).

From the very beginning, the CEPG manipulates variables to get a better fit. The CEPG school confessed that they replaced BAP by regressing it on HP to get a better fit in their first attempt to estimate the model for 1954-72. This might have caused a systematic bias in the estimates of the parameter co-efficients. Over and above, they dropped the same variable from the revised model (Cripps, Godley and Fetherston: 1976), with a plea that it was not consistent with the data. Thus both the inclusion and exclusion of this variable were done on an *ad hoc* basis, just to get a better fit rather than on any theoretical grounds.

ST is another *ad hoc* variable. About its inclusion as an explanatory variable, Cripps, Godley and Fetherston (1974) have argued that " ..... firms treat stocks as liquid liabilities and tend automatically to borrow additional sums from banks to finance them." Thus, basically they have used it as a proxy variable for change in bank advances to the company sector (BAB).

But the problem of using ST as a proxy variable for BAB is three-fold: first, since the data on the original variable BAB are available, there is no valid reason to use a proxy variable for it; second, if the changes in stockbuilding are planned then it can be considered liquid liabilities as claimed by the CEPG. But if they are unplanned, then the CEPG assumption would not be valid; third, and more important, a part of ST [i.e., the value of physical change in stocks (inventories)] is a component part of the dependent variable (PX), making PX a linear combination of ST. Therefore, the presence of ST as an explanatory variable is not econometrically justifiable.

The revised model inserted a constant term on the right hand side of the equation without any theoretical explanation. Inclusion of a constant term implies that the average and marginal propensities to spend out of disposable income are different. According to Chrystal and Darnell:[17]

> On the question of constant term, it is better included than excluded in such an equation, for not only does it aid the linear approximation, but its erroneous exclusion could seriously bias the estimates.

The CEPG used the logarithmic transformation of their private expenditure function on the assumption that the error term displays heteroscedasticity. They are not known to have performed any statistical test for the presence of heteroscedasticity. However, prior to the application of the NC model to the Canadian economy, this thesis will conduct a test for heteroscedasticity and the logarithmic formulation will be adopted or abandoned depending on the conclusion of the test.

2.2 Feedback Equation

The feedback equation in the NC model can be considered as an auxiliary equation for the purpose of facilitating the estimation process of the function.

In the feedback equation, the variable private sector disposable income (PDI), is expressed as a function of PX and XN where PX represents aggregate private expenditure and XN represents all exogenous determinants of income other

than PX. In estimating the model, the CEPG replaced 'n' by its crude estimate (0.42) which was obtained through an iterative process discussed earlier. The selection of the value for 'n' was not done on any standard statistical basis. They also did not take any observation on the variable XN, hence it is clearly vague and undefined and does not add any new information to the model.[18]

2.3 Common Characteristics of the Revised PX and PDI Equations

The New Cambridge school, in their revised model, expressed both the aggregate private expenditure function and the feedback equation in nominal rather than in real variables. In favour of this alteration, Cripps, Godley and Fetherston (1976) attempted to provide a theoretical explanation. According to them:

> A constant price expenditure function implies, since the equation involves lags, that a given level of money disposable income in the current period will generate the same amount of real expenditure in the following period, regardless of the rate of inflation between the two periods. However, since this period's expenditure is being financed by the money disposable income of the current and preceding periods, the real expenditure of the current period is more likely to be financed by current and lagged money income, both deflated by the prices prevailing in the current period. But this is the same as denominating the whole thing in money terms.

This is the only rationale, Cripps, Godley and Fetherston (1976), presented in favour of expressing the variables in nominal instead of real terms. It is however, hard to follow the argument contained in this quotation.

Chrystal and Darnell are not convinced with the CEPG – justification for current price formulation of the model. They counter-argued that the current and lagged PDI expressed in nominal terms are likely to be very highly correlated giving rise to multicollinearity in the model. The present research, in verifying the validity of the NC model for Canada will use both current and constant price data for two reasons: first, best linear unbiased estimates can be obtained even in the presence of multicollinearity; and second, it cannot be ruled out that a high correlation does not exist between the same variables in real terms.[19]

But the main issue here is whether or not expenditure behaviour of the private sector is based on real or nominal values. The CEPG did not make any direct comment on this question; they first estimated the PX function with real variables, and then on the wake of its empirical breakdown, they reformulated it in nominal terms without any apparent theoretical reason. However, the present study would rely more on the function expressed in real variables because in nominal terms, the price variable not only causes spurious correlation but is also likely to distort the relationship. The possibility of a distortion is especially high in the case of accelerated rate of inflation during the mid 1970s on the wake of the international oil crisis.

3. METHOD OF ESTIMATION

The only source that explains the CEPG method of estimation to a considerable detail is Fetherston's mimeograph[20] of 1975. He termed this technique as a feedback adjusted maximum likelihood (FAML) method.

The primary objective of this method was to endogenise current disposable income, in order to take care of the simultaneity between PX and PDI. In doing so, the CEPG specified an extra equation representing the feedback effect of expenditure into income. The two equations are then jointly estimated with the help of a maximum likelihood method. Chrystal[21] raised a question as to the status of the feedback equation because according to him, PDI is neither a behavioural equation nor a reduced form. He argued that if the feedback equation were considered as an equation and 'n' were set to zero, then the CEPG technique being correctly applied could produce the same parameter estimates as 2SLS. But in reality, the NC school used the feedback equation as an identity rather than an equation. The NC method of estimation has been criticised on two major points: the undefined nature of the variable XN and the use of the crude estimate of 'n'. They are discussed separately as follows.

3.1 Undefined Nature of XN

Fetherston tried to justify this point in the following manner. In his own words:

> The procedure to be described here, which will be denoted FAML (feedback adjusted maximum likelihood) attempts to allow for this feedback effect in a way which, unlike 2SLS, does not require specifications of any additional predetermined variables, but merely requires an *a priori* value for the magnitude of the feedback effect (i.e., a value for n). This eliminates the danger of misspecifying predetermined variables of the system, but of course, introduces the possibility of misspecifying the value of n. However, as long as the feedback parameters are correctly specified, then the estimates obtained will be valid and so compatible with a great number of possible alternative specifications of other equations. (Fetherston: 1975).

Since no observation has been taken on XN, therefore, the feedback equation does not represent a complete behavioural relationship; hence its inclusion is in fact not making care of simultaneity between PX and PDI as was originally intended. Chrystal (1981-a) criticised the addition of this equation as making the parameter co-efficients of PDIs biased downward.

3.2 The Crude Estimate of 'n'

The NC school estimated the private expenditure function given the value of 'n'. Through an interative method, the NC school found that if 'n' takes the value 0.42, the aggregate private expenditure function yields the best fit. Thus, they take 'n' to be 0.42, in the application of their FAML estimation method. Thus, the NC school considered 0.42 to be a crude estimate of 'n'.

Imputation of 0.42 to the parameter 'n', as done by the NC school was quite an *ad hoc* phenomenon, not found in any established statistical procedure. Apart from this, the parameter estimates of the PX function are found to be quite sensitive to the value of 'n'. Putting the value of 'n' from 0.0 to 1.0, Mowl (1974) found that the estimated co-efficients of PDI, PDI_{-1}, HP, BAP and ST varies from 0.562 to 0.445, 0.388 to 0.505, 0.869 to 1.045, 0.737 to 0.936 and 0.944 to 0.014 respectively.

Chrystal (1981-a) was most critical about the crude estimate of 'n'. He accused the NC school of simply trying various values, and settling on the value they liked the best. In their estimation method, as Fetherston (1975) has explained after trying different values for 'n' they have settled down at 0.42, which produces the best fit. But Chrystal did not accept this trial and error method. He claimed that the results obtained by

the CEPG were manipulative and hence not reliable. The NC school never responded to this fundamental criticism of their model.

4. SUMMARY AND CONCLUSION

The new Cambridge aggregated private expenditure function is quite uncommon and new in macroeconomic literature. Although, initially critics objected in principle to the aggregation of personal consumption and corporate investment, during the recent past, applied economists have been increasingly accepting it for the purpose of forecasting and public policy towards government deficit and balance of payments deficit.[22]

In the Keynesian macroeconomic literature, it is an established fact that investment is volatile, while consumption is stable. Since consumption constitutes a larger segment of the private expenditure, therefore, PX function is expected to be more stable than investment function separately. However, this proposition is subject to empirical testing.

The critical analysis of the New Cambridge aggregate private expenditure function makes the following points clear. The specification of the model and the estimation method adopted by the CEPG are very much *ad hoc* in nature. The variable such as BAP has been included and excluded just to get good fit and not for any theoretical reason. The explanatory variable ST in the PX function is a proxy variable for bank loans to the business sector. The availability of data on BAB makes the use of ST unwarranted. More importantly, since the dependent variable PX is a linear combination of ST, therefore, its use as an explanatory variable is econometrically unjustifiable.

Logarithmic transformation has been taken to the New Cambridge PX function on the presumption that the disturbance term does display heteroscedasticity, having no tests performed for it. Appropriate tests for heteroscedasticity is again necessary prior to the logarithmic transformation of the function.

In their model, the CEPG has expressed variables, first, in real and then in nominal terms, again without any apparent theoretical reason.

The estimation method adopted by the NC school is also *ad hoc*. In the name of taking care of the simultaneity between PX and PDI, the feedback equation has been introduced which is wrongly specified. In this equation, first, the CEPG imputed a fixed value to the co-efficient of a variable; and second, the CEPG did not take any observation on the other variable.

Apart from the specification error with the PX function, if it is estimated as a single equation then the parameter estimates will be biased and if they are estimated simultaneously in the CEPG manner then the estimates will be biased as well, caused by the restriction imposed on the co-efficient of PX.

Thus it is needless to emphasise that the model needs a thorough modification before any further empirical testing. This modification can be undertaken according to the following set of principles:

(i) the variable(s) which do(es) not have a sound theoretical basis should be dropped;
(ii) the excluded variables which have a theoretical importance should be re-instead;
(iii) the endogeneity of the private sector disposable income should properly be maintained;
(iv) unnecessary imputation of a-priori values to any parameter should be avoided.

Foot Notes

1. The CEPG is a group of economic forecasters in the Department of Applied Economics at the University of Cambridge, England. Nicholas Kaldor was a senior sympathizer of this group until his death. Among the members of the group, Wynne Godley, Fransis Cripps, Martin Fetherston, Robert Neild and Christopher Taylor are most noteworthy.
2. Private sector is comprised of the personal sector and the company sector.
3. Public sector includes federal, state/provincial and local governments, nationalized industries and public corporations.
4. This includes foreign nationals, companies and governments at all levels.
5. Through a process of evolution, this turned out to be the final form of the New Cambridge model.
6. Earlier, they used constant price data to estimate the model. The implications have been discussed in detail under 'common characteristics' of the model.
7. K. A. Chrystal (1981-a), "The New Cambridge Aggregate Expenditure Function: The Emperor's Old Clothes?", *Journal of Monetary Economics*, Vol. 7, No. 3, pp. 395-402.
   K. A. Chrystal (1981-b), "The New Cambridge Aggregate Expenditure Function: Correction and Confirmation", *University of Essex Discussion Papers*, No. 189.
8. K. A. Chrystal and A. C. Darnell (date not available), "The Aggregate Private Expenditure Function Again", *Working Paper*, University of Essex and University of Durham, unpublished.
9. Anyadike-Danes reformulated it in a non-linear form and found a very good prediction results with less than one percent error for the data period of 1965-80. But the problem with the Anyadike-Danes formulation is that it imputed fixed values to each of the parameters on *a priori* basis. Therefore, whatever be the predictability of the model, it serves hardly any purpose in policy matters. For details, see M. Ayadike-Danes (1982), "The New Cambridge Hypothesis and Fiscal Planning", *Cambridge Economic Policy Review*, Vol. 8, No. 1, April, pp. 33-38.
10. K. Cuthberston (1979), *Macroeconomic Policy: The New Cambridge, Keynesian and Monetarist Controversies*, London, Macmillan Press Ltd., Chapter 3, pp. 53-89.
11. M. Anyadike-Danes (1982) "The New Cambridge Hypothesis and Fiscal Planning", *Cambridge Economic Policy Review*, April, Vol. 8, No. 1, pp. 33-38.
12. M. J. Fetherston and W. A. H. Godley (1978), "New Cambridge Macroeconomics and Global Monetarism: Some Issues in the Conduct of U.K. Economic Policy", in K. Brunner and A Meltzer (et.al.), *Carnegie-Rochester Conference Series on Public Policy: A Supplementary Series to the Journal of Monetary Economics, Public Policies in Open Economics*, North Holland, Vol. 9, pp. 33-65.
13. A S. Blinder (1978), "What's New and What's Keynesian in the New Cambridge Keynesianism?", in K. Brunner and A. Meltzer (et. al.) *Carnegie-Rochester Conference Series on Public Policy: A Supplementary Series to the Journal of Monetary Economics, Public Policies in Open Economies*, North Holland, Vol. 9, pp. 67-85.
14. This equation is not directly available in the Fetherston-Godley Paper (1978), but it definitionally follows from two equations that can be found there.
15. A. Ando and F. Modigliani (1963), "The Life Cycle Hypothesis of Savings: Aggregate Implications and Tests", *American Economic Review*, Vol. 53, pp. 55-84.
16. R. Russell and L. M. Wakeman (1978), "New Cambridge Economics Without Markets: A Comment", in K. Brunner and A. Meltzer (et. al) *Carnegie-Rochester Conference Series on Public Policy: A Supplementary Series to the Journal of Monetary Economics, Public Policies in Open Economies*, North Holland, Vol. 9, pp. 95-101.
17. K. A. Chrystal and A. C. Darnell (n.d.), "The Aggregate Private Expenditure Function Again", *Working Paper*, University of Essex and University of Durham, U.K., unpublished.
18. The econometric flaws pertaining to this equation are critically evaluated later in this chapter under the method of estimation.
19. In fact Chrystal (1981-b) found the correlation coefficient between PDI and PDI in real terms for 1962-80 to be as high as 0.970; in nominal terms, for the same period, it was even higher i.e. 0.999.
20. M. J. Fetherston (1975), "Estimation of Simultaneous Relationships: A U.K. Private Expenditure Function", Department of Applied Economics, University of Cambridge, England, Unpublished.
21. K. A. Chrystal (1981-a), "The New Cambridge Aggregate Expenditure Function: The Emperor's Old Clothes?", *Journal of Monetary Economics*, Vol. 8, No. 3, pp. 395-402.
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