

Buenafe, Sheila W.; Reyes, Celia M.

Working Paper

Alternative Estimation Methodologies for Macro Model: ECM vs. OLS

PIDS Discussion Paper Series, No. 2001-22

Provided in Cooperation with:

Philippine Institute for Development Studies (PIDS), Philippines

Suggested Citation: Buenafe, Sheila W.; Reyes, Celia M. (2001) : Alternative Estimation Methodologies for Macro Model: ECM vs. OLS, PIDS Discussion Paper Series, No. 2001-22, Philippine Institute for Development Studies (PIDS), Makati City

This Version is available at:

<https://hdl.handle.net/10419/127770>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



Philippine Institute for Development Studies
Surian sa mga Pag-aaral Pangkaunlaran ng Pilipinas

Alternative Estimation Methodologies for Macro Model: ECM vs. OLS

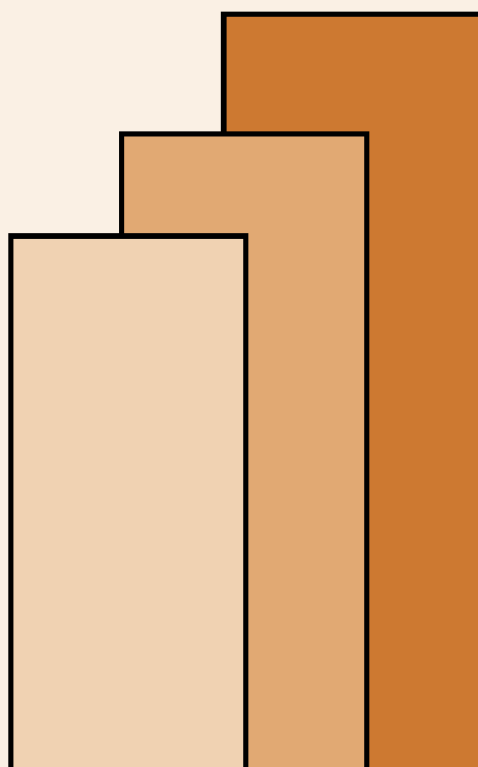
Celia M. Reyes and Sheila W. Buenafe

DISCUSSION PAPER SERIES NO. 2001-22

The *PIDS Discussion Paper Series* constitutes studies that are preliminary and subject to further revisions. They are being circulated in a limited number of copies only for purposes of soliciting comments and suggestions for further refinements. The studies under the *Series* are unedited and unreviewed.

The views and opinions expressed are those of the author(s) and do not necessarily reflect those of the Institute.

Not for quotation without permission from the author(s) and the Institute.



December 2001

For comments, suggestions or further inquiries please contact:

The Research Information Staff, Philippine Institute for Development Studies
3rd Floor, NEDA sa Makati Building, 106 Amorsolo Street, Legaspi Village, Makati City, Philippines
Tel Nos: 8924059 and 8935705; Fax No: 8939589; E-mail: publications@pidsnet.pids.gov.ph
Or visit our website at <http://www.pids.gov.ph>

Abstract

Macro-econometric models have proven to be a useful tool in analyzing the economy-wide or sector-specific effects of policy measures. Simulations using these models have enabled planners and policymakers to trace through the effects of proposed policy changes or external shocks as well as quantify their impacts. Their importance as an aid to planning is well recognized.

The NEDA Annual Macro Social Model employed the Error Correction Model representation of the dynamic model. Two-stage estimation is used. The first stage determines the long-run relationship among the variables. The second stage illustrates the short-run dynamics influenced by the deviation from the long run relationship.

The PIDS Annual Macro Social Model had followed the model structure and specifications of the equations used for NEDA AMSM making use of the Ordinary Least Squares estimation.

The tracking performances of the two models were evaluated after the dynamic simulation over the period 1992 – 1998. The criterion for good performance is that Mean Absolute Percentage Error (MAPE) should be as small as possible. In general, the results showed that the Error Correction Model method performs better than the OLS estimation method. In addition, the ECM captures better the volatile behavior of the data. However, the procedure for doing the ECM method is not as simple as in employing the OLS method since it is quite complicated and tedious. Moreover, a set of cointegrating variables is necessary.

In contrast, employing the OLS estimation is simpler. For each variable, a single equation is estimated incorporating both long-run and short-run dynamics. Adequacy of the equations is determined through adjusted R^2 , Durbin Watson and stationarity of the residuals.

Keywords

Cointegration, Error Correction Model, Ordinary Least Square, macroeconometric model, Mean Absolute Percentage Error, two-stage estimation, long-run dynamics, short-run dynamics

ALTERNATIVE ESTIMATION METHODOLOGIES FOR MACRO MODEL: ECM VS. OLS

by

CELIA M. REYES and SHEILA W. BUENAFE*

December 19, 2001

I. INTRODUCTION

Macroeconometric models have proven to be a useful tool in analyzing the economy-wide or sector-specific effects of policy measures. Simulations using these models have enabled planners and policymakers to trace through the effects of proposed policy changes or external shocks as well as quantify their impacts. These can also be used for forecasting within a reasonable margin of error based on specific assumptions regarding exogenous conditions and macro policies. Their importance as an aid to planning is therefore well recognized.

In the Philippines, macro-econometric models have been developed in the past. Among these are the UP expanded macro-econometric model by Encarnacion et al (1972), the Villanueva model (1977), the Central Bank model developed by Zialcita and Alfiler (1977), the macro model by Zialcita et al (1983), the macro model of Dowling et al, and the various PIDS-NEDA macroeconometric models (1985, 1987, 1989). Another set of macroeconometric modeling efforts in the country focused on the development of economic-demographic models which include those of Ruprecht (1967), Encarnacion et al (1974), the Bachue-Philippines (1978), and the Population and Development Planning (PDP) model (latest version, 1998).

At the NEDA, an annual macroeconometric model developed by Celia Reyes and Josef Yap of the Philippine Institute of Development Studies in 1993 used to be maintained. In 1997, a new macro model with a social sector developed by Dr. Joseph Lim of the University of the Philippines School of Economics superseded the PIDS-developed model. The new model was made necessary by the significant structural changes that have occurred resulting from the policy reforms and measures implemented by the previous administrations. However, refinements were still needed to maximize the usefulness of the model.

In addition to the annual macroeconometric models, other models have also been recently developed for use by NEDA for various purposes: the Quarterly Macroeconometric Model which was intended for making short-term forecasts and policy analysis; the updated Population and Development Planning (PDP) model which integrates demographic variables into the macroeconomic model and which was intended to be used for long-term planning;

* Senior Research Fellow and Information Systems Researcher of Philippine Institute for Development Studies, respectively.

and the PIDS model integrated with the Dagum model which has been utilized for assessing the income distribution impact of macro policies and trends and for setting quantitative poverty targets in the Medium-term Philippine Development Plan.

In line with the continuous desire of the NEDA to have a good analytical tool for evaluating the impact of macroeconomic policies and external shocks on the economy and for coming up with well-grounded forecasts, this annual macroeconomic and social model (AMSM) has been developed. In the model by Lim which has been used by NEDA, the treatment of the agriculture sector as an exogenous variable and the level of aggregation of industry and services output was deemed inadequate for policy analysis and forecasting. In general, further refinements were also needed to better capture the implications of macroeconomic policies and trends on specific production sectors, to firm up the linkages among sectors and economic blocks, and to incorporate social variables and capture the two-way relationships with macroeconomic variables.

Compared to the annual model developed by Lim, this annual macro-social model incorporates the following improvements:

- Endogenization of the agricultural sector
- Disaggregation of the industry and services sectors into their subsectors
- Strengthening of the linkage between sector blocks and the incorporation of the effect of specific policies (i.e. trade liberalization)
- Further refinement of other sector blocks and their linkages
- Modeling of the impact of macro variables on the social sector

As an added feature, the model that has been developed essentially captures the interaction and feedback among the macroeconomic and social variables over a medium-term time frame while maintaining its usefulness for annual forecasting and policy analysis. However, a large part of the interaction between the economic and social variables may become more evident over the longer-term and may not be sufficiently captured in this medium-term model.

The NEDA Annual Macro Social Model was developed using the Error Correction Model (ECM). Two-stage estimation is employed. The first stage is to determine the long-run relationship between the dependent variable and a set of explanatory variables denoted by X_i 's. The second stage is to incorporate short-run dynamics into the relationship.

If the model is
$$Y_t = \alpha + \phi_1 Y_{t-1} + \lambda_0 X_t + \lambda_1 X_{t-1} + \varepsilon_t$$
 then the first stage

$$Y_t = \beta_0 + \beta_1 X_t + \varepsilon_t$$

estimates the static part. The second stage,

$$Y_t = \gamma_0 + \gamma_1 \varepsilon_{t-1} + \delta_1 Y_{t-1} + \delta_2 Y_{t-2} + \lambda_1 X_t + \lambda_2 X_{t-1} + \dots$$

estimates the dynamic part.

The PIDS Annual Macro Social Model was patterned after the AMSM of NEDA employing the Ordinary Least Squares method. This is a technique for calculating the regression equation that minimizes the sum of the squares of the error terms.

The model is

$$Y_t = b_0 + b_1X_{1t} + b_2X_{2t} + \dots + e_t$$

II. Model Structure

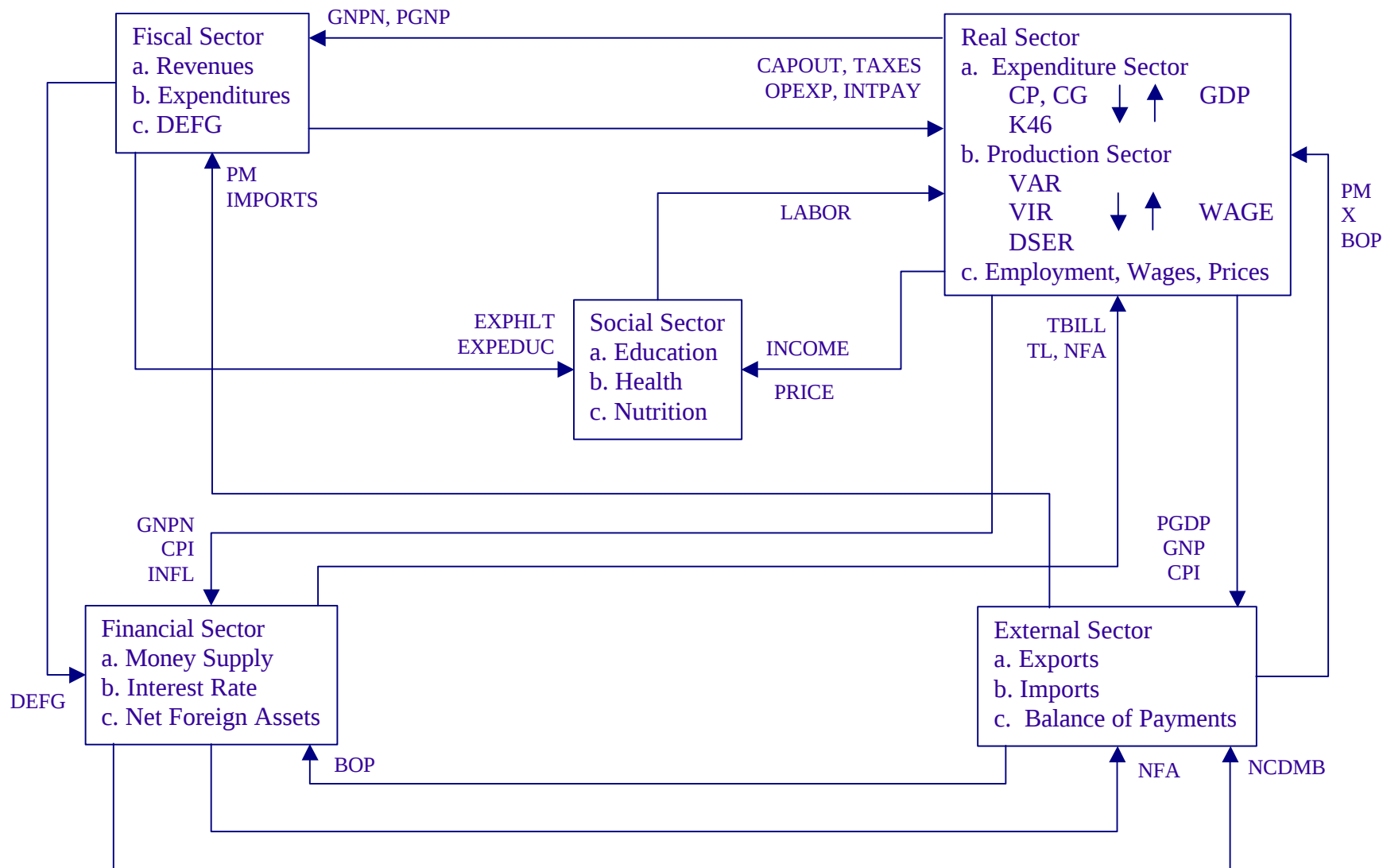
There are five major blocks in the model: namely: (1) the real sector, (2) the fiscal sector, (3) the financial sector, (4) the fiscal sector, and (5) the social sector. Aggregate output is determined as the sum of sectoral production (supply side), with demand variables entering the supply equations. Output determines the level of employment and prices. The real sector affects the fiscal sector, as the level of economic activity and general price level determines the revenues collected by the government.

The fiscal sector affects the financial sector, specifically the monetary base and interest rate through the method of financing the deficit. It also influences the real sector through government expenditures on capital and operating expenses which partly determine output from the demand side. It also affects private consumption through taxes.

The financial sector influences the real sector through the interest rate, the amount of net foreign assets and the liquidity variable. The external sector affects the real sector, the financial sector and the fiscal sector through the linkages of the various current account components with output and expenditures and deficit financing, as well as its contributions to net foreign assets with the BOP accounts.

The social sector block is affected by the fiscal block through government expenditures on the social sector and the real sector, through per capita consumption and prices. The broad linkages among the sectors are shown in Figure 1.

Figure 1. Annual Macro Social Model



III. Model Estimates

A. NEDA-AMSM

The NEDA Annual Macro Social Model employed the ECM representation of the dynamic model. Two-stage estimation is used. The first stage determines the long-run relationship among the variables. The second stage illustrates the short-run dynamics influenced by the deviation from the long run relationship. The complete model can be found in Appendix A.

To estimate the equation for a particular variable (Y), this variable and a set of explanatory variables are tested if a cointegrating relationship exists. The choice of explanatory variables to be included is dictated by economic theory. If the variables are found to be cointegrating, then the variable is regressed on the explanatory variables using ordinary least squares. The resulting residual of the equation is then tested for stationarity. The augmented Dickey-Fuller Test is used to test for unit root. If it is not stationary, then additional explanatory variables are included until the residual becomes stationary. The adequacy of the equation is assessed as well in terms of the adjusted R^2 and the Durbin Watson.

Since the variables are cointegrated, the residuals from the first stage can be used to estimate the error correction model. In the second stage, the change in Y is regressed on the first difference of the Xs and their lags and lags of change in Y and the residual from the first stage. The resulting residuals from the second stage are then tested for stationarity.

B. Ordinary Least Squares Estimation

The PIDS Annual Macro Social Model had followed the model structure and specifications of the equations used for NEDA AMSM making use of the Ordinary Least Squares estimation. However, there are some equations where specifications were modified to improve the fit. The complete model which includes the behavioral equations and identities are shown in Appendix B.

The adequacy of the equation is measured using the adjusted R^2 . Serial correlation among variables was examined using the Durbin Watson test. Then, the stationarity of the residuals is analyzed using the Augmented Dickey-Fuller.

IV. Comparison of Performance of the Two Models using MAPE

The two models were simulated for the period 1992 – 1998. The Mean Absolute Percentage Errors (MAPE) are used to assess the performances of the two models. MAPE measures the percentage deviation of the predicted from the actual values. The smaller the MAPE the better the fit of the model to the actual data. MAPE is computed as follows:

$$\text{MAPE} = \frac{1}{T} \sum \frac{|y_t^s - y_t^a|}{y_t^a}$$

Using the ECM, more than two-thirds (about 65%) of the MAPEs fall below 10%. These include key variables in the real sector like agricultural output, services and industry output, private consumption, price deflators, employment, minimum wage, and WPI. For example, Real GDP and GNP have MAPEs of 2.41% and 2.6% respectively. Meanwhile, CPI and WPI have MAPEs of 4.94% and 2.61%. In the external sector, both total exports and imports (in dollars) have MAPEs of 9.04% and 6% respectively. There are about 22% of the variables that have MAPEs falling between 10% and 20%. In the financial sector, 91-day treasury bill rate has a MAPE of 12.07%. Most of the key financial variables have MAPEs higher than 20%.

In the OLS estimation, around 61% of the total MAPEs fall below 10%. Majority of the key variables in the real sector have MAPEs much lower than 10%. Real GDP and GNP have MAPEs of 1.93% and 2.02% respectively. Components in the expenditure share have MAPEs averaging to 7%. The GDPEXP (GDP by expenditure share) has a MAPE of 4.64%. Around 23% of the MAPEs fall between 10% and 20%. Most of the key variables in the external sector have MAPEs between 10% and 20%. Total imports (MGDS\$) has a MAPE of 10.12%. Exports of agro-based products (XAGRI\$) and exports of electronic parts and equipments (XSEM\$) have MAPEs of 13.28% and 17.23%, respectively.

	MAPE	
	OLS	ECM
Real Sector		
Production		
DLIVPO_PE	3.95	4.18
PLIVPO_PE	24.37	19.29
DCROPS_PE	2.73	2.73
PCROPS_PE	19.82	9.01
DFISH_PE	2.50	4.39
PINFI_PE	30.39	19.78
VAR_PE	1.88	1.94
DMQ_PE	9.81	6.37
PMQ_PE	5.78	5.48
DMFG_PE	3.60	3.32
PMFG_PE	3.68	1.63
DCONS_PE	11.41	7.03
PCONS_PE	2.42	6.43
DEGW_PE	3.89	4.29
PEGW_PE	10.32	5.82
DSER_PE	1.71	2.23
PSER_PE	1.13	4.88
VIR_PE	3.78	3.27
VISR_PE	2.37	2.69
GDP_PE	1.93	2.41
NFIAN_PE	11.79	14.92
PNFIA_PE	4.63	2.92
NFIA_PE	11.94	13.37
GNP_PE	2.02	2.60

	MAPE	
	OLS	ECM
Real Sector		
Expenditure		
CPPC_PE	1.17	2.09
CP_PE	1.17	1.94
CPFOOD_PE	1.49	1.79
CGN_PE	4.32	4.82
PCG_PE	3.67	9.44
CG_PE	5.48	10.18
CONSGON_PE	9.19	9.09
PCGOV_PE	8.81	5.22
CONSGO_PE	10.69	12.36
CONSPR_PE	13.28	11.95
IDER_PE	9.85	6.31
BREEDR_PE	2.10	4.26
GDCF_PE	7.06	8.08
XGDS_PE	13.04	11.01
PXGDS_PE	15.48	10.22
PXNFSV_PE	7.05	12.02
XNFSV_PE	12.14	8.72
PMGDS_PE	4.70	10.43
MGDS_PE	7.02	7.02
MNFSV_PE	7.39	10.26
PMNFSV_PE	9.63	12.61
GDPEXP_PE	4.64	4.59
STATD_PE	262.53	884.43

	MAPE	
	OLS	ECM
Real Sector		
Prices, Wage and Employment		
PAGRI_PE	19.24	10.18
PIND_PE	3.68	2.38
PGDP_PE	4.30	3.83
GDPN_PE	5.35	3.72
GNPN_PE	5.18	4.00
PGNP_PE	4.31	3.78
CPI_PE	4.86	4.94
CPISV_PE	6.30	5.77
EXPINFL_PE	133.13	73.84
AGEMP_PE	2.86	4.84
IEMP_PE	3.38	2.94
SEMP_PE	1.77	3.01
TEMP_PE	1.37	2.33
LF_PE	0.67	0.63
MINWAGE_PE	5.31	5.88
KCAR_PE	12.79	6.69
K46_PE	1.11	0.65
VISRLF_PE	0.11	0.12
TFPHAT_PE	2.65	242.90
POTVISRLF_PE	0.28	0.11
CAPUT_PE	4.81	2.75
WPI_PE	2.76	2.61
Fiscal Sector		
INCTAX_PE	9.16	9.13
CORPTAX_PE	5.75	9.59
EXCISE_PE	11.08	6.28
SALESTAX_PE	10.21	8.59
IMPDTAX_PE	13.67	16.47
TAXREV_PE	6.18	7.09
REV_PE	6.72	6.22
DEFG_PE	686.64	718.01

	MAPE	
	OLS	ECM
Financial Sector		
CHNCNG_PE	53.97	56.74
MSMM_PE	1.18	1.18
TLMM_PE	1.93	1.76
CHNFA_PE	85.94	111.93
NCNG_PE	18.57	21.42
NFA_PE	24.21	44.39
NDA_PE	100.57	105.78
TBILL_PE	25.67	12.07
TBILL364_PE	33.23	13.94
BM_PE	9.82	20.33
MS_PE	10.94	19.72
TL_PE	10.78	19.21
External Sector		
XSEM\$_PE	17.23	24.24
XMO\$_PE	22.31	10.39
XAGRI\$_PE	13.28	4.86
XAGRRL_PE	9.05	8.87
XO\$_PE	14.55	6.13
XGDS\$_PE	8.86	9.04
MFUEL\$_PE	5.33	6.12
MNFUEL\$_PE	10.84	6.62
MGDS\$_PE	10.12	6.00
XSV\$_PE	8.77	8.93
XNFSV\$_PE	13.49	14.13
MNFSV\$_PE	17.34	18.02
MSV\$_PE	11.48	13.19
TRABAL_PE	91.99	20.37
CURBAL_PE	92.90	22.80
BOP_PE	293.16	68.22
GIR_PE	51.43	12.10
ER_PE	5.01	8.11
ERR_PE	5.01	8.11
PM\$_PE	2.86	2.75
Social Sector		
MALN_PE	83.80	26.37
PRTOT_PE	2.79	1.37

Below is the summary of the number of variables with MAPEs from OLS less than MAPEs from ECM and MAPEs from ECM less than MAPEs from OLS.

Sector	Number of Variables		
	Total	OLS < ECM	ECM<OLS
Real Sector	69	33	36
Production	24	12	12
Expenditures	23	14	9
Prices	10	1	9
Wages	1	1	0
Employment	11	5	6
Fiscal Sector	8	4	4
Financial Sector	12	8	4
External Sector	20	9	11
Social Sector	2	0	2
Total	111	54	57

V. Findings

The tracking performances of the two models were evaluated using the results of the dynamic simulation over the period 1992 – 1998. Goodness of fit of the model was based mainly on MAPE.

The results showed that cointegration is generally more useful for data showing more volatility. This technique provides better estimates for data in the external sectors. The unpredictable behavior of those series is better captured by cointegration than using the OLS estimation. The MAPEs incurred by ECM for the external sector data are generally much lower than the MAPEs produced using OLS. For instance, MAPE for balance of payments (BOP_PE) is much smaller in ECM (68.22%) than in OLS (293.16). In addition, the error for the current account balance (CURBAL) produced using ECM is 23% while the MAPE using OLS is more than four times at almost 93%. The performance of the ECM on the average is more than twice better than the performance shown by the model using OLS. The average of the MAPEs incurred using OLS is 35% which is more than double the average of the MAPEs using ECM at 14%.

Most MAPEs using OLS for the financial sector are lower than the MAPEs produced using ECM. However, the performance of the ECM method on the average does not vary much from the performance of the OLS estimation method. The average MAPE using OLS method is 31.4% while the average MAPE using ECM is 35.7%.

For real sector data, the OLS estimation provides better estimates than ECM in terms of the expenditure share. The MAPEs under OLS are generally smaller than the MAPEs under ECM. For instance, errors for CP and CG employing the OLS estimation are 1.17% and 5.48%. These are relatively smaller than the errors incurred using the

ECM estimation at 1.94% and 10.18% respectively. However, the average performance shown by ECM does not deviate much from the average performance of OLS method. The average of the MAPEs under OLS method is 7.2%, a little less than the average of the MAPEs under ECM estimation that is, 7.9%.

In the production side, the performances of the two methods do not vary considerably. The number of variables with MAPEs under OLS lower than MAPEs under ECM is the same as the number of variables with MAPEs under ECM lower than OLS. However, the average performance of the model using ECM is 6.3% (average of MAPEs under ECM), slightly lower than the average performance of OLS method at 7.4% (average of MAPEs under OLS).

The MAPEs incurred using the ECM method in prices of the real sector are relatively smaller than the MAPEs obtained using the OLS estimation method. Furthermore, estimates in the employment sector are generally better using the ECM than OLS method except for TFPHAT. ECM produced a very large MAPE for TFPHAT at 243% while OLS method has a MAPE of merely 2.65%. On the other hand, OLS performed better in estimating MINWAGE than ECM. MINWAGE has a MAPE of 5% using the OLS method while 6% using the ECM method. On the average, the performance of OLS estimation for prices, wage and employment is relatively better than the performance of ECM estimation. The average of MAPEs under OLS method is 11.14% while the average of MAPEs under ECM is 18.16%.

In general, the results showed that the Error Correction Model method performs better than the OLS estimation method. A little more than one half of the total equations have MAPEs under ECM lower than the MAPEs under OLS. In addition, the ECM captures better the volatile behavior of the data. However, the procedure for doing the ECM method is not as simple as in employing the OLS method. Performing the ECM estimation is quite complicated and tedious. In ECM, assumptions are followed more strictly. ECM requires a set of cointegrating variables. Otherwise, the result would be a classic spurious regression. In order to establish that the variables do cointegrate, residual series of the long run equilibrium is then checked for stationarity. In the same manner, stationarity of the residual series of the short run dynamics is ensured.

In contrast, estimating a macroeconometric model using Ordinary Least Squares is simpler. For each variable, a single equation is estimated incorporating both long-run and short-run dynamics. Adequacy of the equation is determined through adjusted R^2 , Durbin Watson and stationarity of the residuals.

Appendix A

NEDA Annual Macro Social Model using Error Correction Model

$PDLIVPOL = -2.731465726 - 0.0002107400152 * (((PLIVPO/PLIVPO(-1)) - 1) / (((PINFI/PINFI(-1)) - 1) + 0.9751599434 * LOG(CP) - 0.135469733 * D7580 + 0.1973805442 * D8998$
 $DDLIVPOL = -0.02424681897 + 1.839153367 * D(LOG(CP)) - 0.2823583536 * (DLIVPOL(-1) - PDLIVPOL(-1))$
 $DLIVPOL = DLIVPOL(-1) + DDLIVPOL$
 $DLIVPO = EXP(DLIVPOL)$

$PLIVPOL = -1.24454501 + 0.5663914089 * LOG(DLIVPO) - 0.08501474437 * LOG(RBLOAN) - 0.001654494385 * LOG(MCEREALR) + LOG(PFEEDS * (ERR/100))$
 $PLIVPO = EXP(PLIVPOL)$

$DFISHL = 3.290195538 - 0.002086876804 * (((PINFI/PINFI(-1)) - 1) * 100 / (((CPI/CPI(-1)) - 1) * 100)) + 0.537115331 * LOG(CP) + 0.08969156663 * DUM87 + 0.929540654 * (3.290195538 - 0.002086876804 * (((PINFI(-1)/PINFI(-2)) - 1) * 100 / (((CPI(-1)/CPI(-2)) - 1) * 100)) + 0.537115331 * LOG(CP(-1)) + 0.08969156663 * DUM87(-1) - DFISHL(-1))$
 $DFISH = EXP(DFISHL)$

$PINFIL = -6.846836894 + 0.789780706 * LOG(DFISH) + LOG(PCROPS) - 0.165237118 * LOG(RBLOAN) + 0.2343763407 * D7081$
 $PINFI = EXP(PINFIL)$

$PDCROPSL = 4.417608986 - 0.4295975528 * LOG(PCROPS/CPI) + 0.52797242 * LOG(CP + XAGRRL - MCEREALR)$
 $DDCROPSL = 0.02678267905 - 0.2477579935 * (DCROPSL(-1) - PDCROPSL(-1)) - 0.3131175049 * D(LOG(PCROPS/CPI)) - 0.1659523327 * DUM98 + 0.1659523327 * (1 + 0.2477579935) * DUM98(-1)$
 $DCROPSL = DCROPSL(-1) + DDCROPSL$
 $DCROPS = EXP(DCROPSL)$

$PCROPSL = 5.89127405 - 0.8294738274 * LOG(HCTRG) + 0.006997465085 * LOG(RBLOAN) + 0.1690552707 * LOG(DCROPS) + LOG(PAGRI)$
 $PCROPS = EXP(PCROPSL)$

$VAR = DCROPS + DLIVPO + AGSERR + DFISH + FORES$

$DMQL = 4.519278009 - 0.1372067955 * LOG(PMQ/CPI) + 0.4062807378 * LOG(CONSGO + CONSPR) - 0.2581848102 * D7578 + 0.3456243647 * D8693 - 0.428752753 * D6769 + 0.4585910498 * DUM85$
 $DMQ = EXP(DMQL)$

$PPMQL = 0.9867776789 + 0.8070970475 * LOG(WPI) - 0.1742119204 * D9398$
 $DPMQL = 0.01566153165 + 1.182951288 * D(LOG(WPI)) - 0.4644615877 * D(LOG(WPI(-1))) - 0.5937280078 * (PMQL(-1) - PPMQL(-1))$
 $PMQL = PMQL(-1) + DPMQL$
 $PMQ = EXP(PMQL)$

$PDMFGL = 2.068992126 - 0.4352954779 * LOG(PMFG/CPI) + 0.7341419459 * LOG(CP + CG + GDCF + XGDS) - 0.1068812707 * D9398$
 $DDMFGL = -0.008083410023 + 0.72673224 * D(LOG(CP + CG + GDCF + XGDS)) + 0.221965513 * D(LOG(DMFGL(-1))) - 0.3681578177 * (DMFGL(-1) - PDMFGL(-1))$

DMFGL = DMFGL(-1) + DDMFGL
DMFG = EXP(DMFGL)

PPMFGL = 0.4558835528 + 0.9025308937*LOG(WPI) + 0.1589426382*D9398
DPMFGL = 0.03366522843 + 0.6567781691*DLOG(WPI) - 0.2561067379*(PMFGL(-1)-
PPMFGL(-1))
PMFGL = PMFGL(-1) + DPMFGL
PMFG = EXP(PMFGL)

PDCONSL = -0.6423587858 - 0.7905095478*LOG(PCONS/CPI) +
1.013343452*LOG(CONSGO+CONSPR)
DDCONSL = 0.004997269383 + 0.9635164758*D(LOG(CONSGO+CONSPR)) -
0.442972553*(DCONSL(-1)-PDCONSL(-1))
DCONSL = DCONSL(-1) + DDCONSL
DCONS = EXP(DCONSL)

PPCONSL = 0.5492194738 + 0.8929047505*LOG(WPI) + 0.2260987141*D9398
DPCONSL = 0.03231123738 + 0.6844435371*DLOG(WPI) - 0.1081129877*(PCONSL(-1)-
PPCONSL(-1))
PCONSL = PCONSL(-1) + DPCONSL
PCONS = EXP(PCONSL)

PDEGWL = -13.53281293 - 0.72427932*LOG(PEGW/WPI) +
1.704302475*LOG(CP+CG+GDCF+XGDS)
DDEGWL = 0.07450343033 - 0.5772465184*D(LOG(PEGW/WPI)) - 0.3723837293*(DEGWL(-1)-
PDEGWL(-1))
DEGWL = DEGWL(-1) + DDEGWL
DEGW = EXP(DEGWL)

PPEGWL = 0.2521913227 + 0.9155024163*LOG(WPI) + 0.2127748026*D9398
DPEGWL = 0.03781577794 + 0.6103172037*D(LOG(WPI)) - 0.3343611813*(PEGWL(-1)-
PPEGWL(-1))
PEGWL = PEGWL(-1) + DPEGWL
PEGW = EXP(PEGWL)

PDSERL = -0.3059620166 - 0.008480347201*LOG(PSER/CPI) +
0.955922502*LOG(CP+CG+XGDS) - 0.01917213529*DUM6783 - 0.06075694005*D9498
DDSERL = 0.01246741426 + 0.6509064698*DLOG(CP+CG+XGDS) - 0.5337913274*(DSERL(-
1)-PDSERL(-1))
DSERL = DSERL(-1) + DDSERL
DSER = EXP(DSERL)

PPSERL = 0.5945237266 + 0.881983926*LOG(WPI) + 0.3109550136*D9398
DPSERL = 0.03585637444 + 0.506881606*DLOG(WPI) + 0.1693290693*DLOG(PSER(-1)) -
0.05585375517*(PSERL(-1)-PPSERL(-1))
PSERL = PSERL(-1) + DPSERL
PSER = EXP(PSERL)

VIR = DMQ + DMFG + DCONS + DEGW
VISR = VIR + DSER
GDP = VAR + VISR

NFIAN = 2390.091485 + 0.8335672417*((INVINC+INCREM-INVEXP-INCOU)*ER)

PPNFIAL = -0.01817831875 + 1.003773403*LOG(PGDP)

$DPNFIAL = 0.006681285216 + 0.9326468147 * D(\text{LOG}(\text{PGDP})) - 0.3539985516 * (\text{PNFIAL}(-1) - \text{PPNFIAL}(-1))$
 $\text{PNFIAL} = \text{PNFIAL}(-1) + \text{DPNFIAL}$
 $\text{PNFIA} = \text{EXP}(\text{PNFIAL})$

$\text{NFIA} = \text{NFIA} / (\text{PNFIA} / 100)$
 $\text{GNP} = \text{GDP} + \text{NFIA}$

$\text{PINCTAXL} = -5.366495332 + 1.044404054 * \text{LOG}(\text{INCTAXRATE} * \text{GNPN})$
 $\text{DINCTAXL} = 0.178385263 - 0.6047581964 * (\text{INCTAXL}(-1) - \text{PINCTAXL}(-1))$
 $\text{INCTAXL} = \text{INCTAXL}(-1) + \text{DINCTAXL}$
 $\text{INCTAX} = \text{EXP}(\text{INCTAXL})$

$\text{PCORPTAXL} = -15.85885962 + 1.579774658 * \text{LOG}(\text{CPTAXRATE} * (\text{VIR} * (\text{PIND} / 100)))$
 $\text{DCORPTAXL} = 0.08026199202 + 0.8183407809 * D(\text{LOG}(\text{CPTAXRATE} * (\text{VIR} * (\text{PIND} / 100)))) - 0.6229169237 * (\text{CORPTAXL}(-1) - \text{PCORPTAXL}(-1))$
 $\text{CORPTAXL} = \text{CORPTAXL}(-1) + \text{DCORPTAXL}$
 $\text{CORPTAX} = \text{EXP}(\text{CORPTAXL})$

$\text{PEXCISEL} = -4.628941804 + 1.060503961 * \text{LOG}(\text{GNPN})$
 $\text{DEXCISEL} = 0.02538993254 + 0.9191320506 * D(\text{LOG}(\text{GNPN})) - 0.4076039394 * (\text{EXCISEL}(-1) - \text{PEXCISEL}(-1))$
 $\text{EXCISEL} = \text{EXCISEL}(-1) + \text{DEXCISEL}$
 $\text{EXCISE} = \text{EXP}(\text{EXCISEL})$

$\text{PSALESTAXL} = -6.483081859 + 1.183844973 * \text{LOG}(\text{GNPN})$
 $\text{DSALESTAXL} = 0.06009570894 + 0.7858538974 * D(\text{LOG}(\text{GNPN})) - 0.3709907177 * (\text{SALESTAXL}(-1) - \text{PSALESTAXL}(-1))$
 $\text{SALESTAXL} = \text{SALESTAXL}(-1) + \text{DSALESTAXL}$
 $\text{SALESTAX} = \text{EXP}(\text{SALESTAXL})$

$\text{IMPDTAXL} = -2.86647418 + 1.222285721 * \text{LOG}(\text{MGDS} * \text{ER} * (\text{TARIFF} / 100)) - 0.237727326 * D9798$
 $\text{IMPDTAX} = \text{EXP}(\text{IMPDTAXL})$

$\text{TAXREV} = \text{INCTAX} + \text{CORPTAX} + \text{EXCISE} + \text{SALESTAX} + \text{IMPDTAX} + \text{OTHER TAXES}$
 $\text{REV} = \text{TAXREV} + \text{NTAXRE}$
 $\text{EXPN} = \text{OPEXP} + \text{CAPOUT} + \text{CAPTRANS} + \text{NETLEN}$
 $\text{DEFG} = -(\text{REV} - \text{EXPN})$

$\text{PCPPCL} = 4.419630809 + 0.5019411207 * \text{LOG}((\text{GNP} - (\text{INCTAX} / (\text{PGNP} / 100))) / \text{POP}) + 0.0691306104 * \text{LOG}(\text{TL} / \text{GNP})$
 $\text{DCPPCL} = 0.0120550542 + 0.3115753025 * D(\text{LOG}((\text{GNP} - (\text{INCTAX} / (\text{PGNP} / 100))) / \text{POP})) - 0.8869871584 * (\text{CPPCL}(-1) - \text{PCPPCL}(-1))$
 $\text{CPPCL} = \text{CPPCL}(-1) + \text{DCPPCL}$
 $\text{CPPC} = \text{EXP}(\text{CPPCL})$

$\text{CP} = \text{CPPC} * \text{POP}$

$\text{PCPFOODL} = -0.8358238535 + 1.01708532 * \text{LOG}(\text{CP})$
 $\text{DCPFOODL} = 0.0007778577502 + 0.9733995115 * D\text{LOG}(\text{CP}) - 0.29702876 * (\text{CPFOODL}(-1) - \text{PCPFOODL}(-1))$
 $\text{CPFOODL} = \text{CPFOODL}(-1) + \text{DCPFOODL}$
 $\text{CPFOOD} = \text{EXP}(\text{CPFOODL})$

$\text{PCGNL} = 0.9701275414 + 0.8954861365 * \text{LOG}(\text{OPEXPO}) - 0.1899355901 * D8893$

$DCGNL = 0.1097776768 + 0.3058776089 \cdot D(\text{LOG}(\text{OPEXPO})) - 0.01881774027 \cdot (\text{CGNL}(-1) - \text{PCGNL}(-1))$
 $\text{CGNL} = \text{CGNL}(-1) + \text{DCGNL}$
 $\text{CGN} = \text{EXP}(\text{CGNL})$

$\text{PPCGL} = 0.1902661262 + 0.9957998925 \cdot \text{LOG}(\text{PGDP}) + 0.3038694308 \cdot \text{D9698}$
 $\text{DPCGL} = 0.03062565927 - 0.09503230147 \cdot (\text{PCGL}(-1) - \text{PPCGL}(-1)) + 0.5198536205 \cdot D(\text{LOG}(\text{PGDP})) + 0.2589002749 \cdot D(\text{LOG}(\text{PCG}(-1)))$
 $\text{PCGL} = \text{PCGL}(-1) + \text{DPCGL}$
 $\text{PCG} = \text{EXP}(\text{PCGL})$

$\text{CG} = \text{CGN}/(\text{PCG}/100)$

$\text{CONSGON} = 396.2820037 + 1.181457044 \cdot \text{CAPOUTO} - 26146.00355 \cdot \text{DUM86}$

$\text{PPCGOVL} = -0.1481678183 + 1.040145315 \cdot \text{LOG}(\text{PGDP}) - 0.1517604178 \cdot \text{DUM97} - 0.2078406904 \cdot \text{DUM98}$
 $\text{DPCGOVL} = -0.0325246229 + 1.271588612 \cdot \text{DLOG}(\text{PGDP}) - 0.2933395681 \cdot (\text{PCGOVL}(-1) - \text{PPCGOVL}(-1))$
 $\text{PCGOVL} = \text{PCGOVL}(-1) + \text{DPCGOVL}$
 $\text{PCGOV} = \text{EXP}(\text{PCGOVL})$

$\text{CONSGO} = \text{CONSGON}/(\text{PCGOV}/100)$

$\text{PCONSPRL} = -0.4748234223 + 0.597252234 \cdot \text{LOG}(\text{GDP}) - 0.005136152766 \cdot (\text{TBILL364} - \text{EXPINFL}) + 0.3069698691 \cdot \text{LOG}(\text{CONSGO})$
 $\text{DCONSPRL} = -0.05250048766 - 0.4550787712 \cdot (\text{CONSPRL}(-1) - \text{PCONSPRL}(-1)) + 2.256567889 \cdot \text{DLOG}(\text{GDP}) - 0.002528013748 \cdot D(\text{TBILL364} - \text{EXPINFL}) + 0.1509830291 \cdot \text{DLOG}(\text{CONSGO})$
 $\text{CONSPRL} = \text{CONSPRL}(-1) + \text{DCONSPRL}$
 $\text{CONSPR} = \text{EXP}(\text{CONSPRL})$

$\text{PIDERL} = -2.233009533 + 0.6088339722 \cdot \text{LOG}(\text{GDP}) + 0.4236867899 \cdot \text{LOG}(\text{MGDS}) - 0.005664379165 \cdot (\text{TBILL364} - \text{EXPINFL})$
 $\text{DIDERL} = -0.03403659316 + 2.511866586 \cdot D(\text{LOG}(\text{GDP})) - 0.001604375022 \cdot D(\text{TBILL364} - \text{EXPINFL}) - 0.4117363384 \cdot (\text{IDERL}(-1) - \text{PIDERL}(-1)) - 0.1424716954 \cdot \text{DUM98} - 0.1424716954 \cdot (1 + 0.4117363384) \cdot \text{DUM98}(-1)$
 $\text{IDERL} = \text{IDERL}(-1) + \text{DIDERL}$
 $\text{IDER} = \text{EXP}(\text{IDERL})$

$\text{BREEDRL} = 1.07283272 + 0.7971019362 \cdot \text{LOG}(\text{DLIVPO}) + 0.3745705819 \cdot \text{D8083} + 0.1636571976 \cdot \text{D8489}$
 $\text{BREEDR} = \text{EXP}(\text{BREEDRL})$

$\text{GDCF} = \text{CONSGO} + \text{CONSPR} + \text{IDER} + \text{BREEDR} + \text{IINV}$

$\text{PXGDS} = -13.65096681 + 1.327878703 \cdot ((\text{PX\$ERR})/100) - 25.81724529 \cdot \text{D8591}$

$\text{XGDS} = 1707.972275 + 0.9892991961 \cdot ((\text{XGDS\$ER})/(\text{PXGDS}/100)) - 37566.98504 \cdot \text{DUM98} + 0.761232668 \cdot (1707.972275 + 0.9892991961 \cdot ((\text{XGDS\$}(-1) \cdot \text{ER}(-1))/(\text{PXGDS}(-1)/100)) - 37566.98504 \cdot \text{DUM98}(-1) - \text{XGDS}(-1))$

$\text{PXNFSV} = -21.09597779 + 1.446795815 \cdot ((\text{PX\$ERR})/100) - 34.09705571 \cdot \text{D8591} - 142.128719 \cdot \text{DUM98}$

$\text{XNFSV} = 7724.00859 + 0.9623110984 \cdot ((\text{XNFSV\$ER})/(\text{PXNFSV}/100)) + 9860.45697 \cdot \text{D8794}$

PMGDS = -26.35703444 +
 1.282925174*(((MFUEL\$/MGDS\$)*MPIF*(1+(FTARIFF/100)))+((MNFUEL\$/MGDS\$)*MPINF*(1+(NFTARIFF/100))))*(ERR/100)) - 35.78380077*D8492

MGDSL = 4.297263499 + 0.8446839596*LOG(MFUELQ+(MNFUEL\$/(MPINF/100))) +
 0.8166212392*(4.297263499 + 0.8446839596*LOG(MFUELQ(-1)+(MNFUEL\$(-1)/(MPINF(-1)/100)))-MGDSL(-1))
 MGDS = EXP(MGDSL)

PMNFSV = -43.15092399 +
 2.044078084*(((MFUEL\$/MGDS\$)*MPIF)+((MNFUEL\$/MGDS\$)*MPINF))*(ERR/100)) -
 62.34176681*D8485 + 75.6888406*D9497

PMNFSVR = 5904.214753 + 0.6435564821*(MNFVSV\$*ER/(PMNFSV/100)) -
 6558.308307*D7079 + 6931.408104*D8493
 DMNFSVR = 580.2874944 - 0.4190861562*(MNFVSV(-1)-PMNFSVR(-1)) +
 0.6326619274*D(MNFVSV\$*ER/(PMNFSV/100))
 MNFSV = MNFSV(-1) + DMNFSVR

GDPEXP = CG + CP + GDCF + XGDS + XNFSV - MGDS - MNFSV
 STATD = GDP - GDPEXP

PAGRI = PLIVPO*(DLIVPO/VAR) + PINFI*(DFISH/VAR) + PCROPS*(DCROPS/VAR) +
 PAGSER*(AGSERR/VAR) + PFORES*(FORES/VAR)

PIND = PMQ*(DMQ/VIR) + PMFG*(DMFG/VIR) + PCONS*(DCONS/VIR) + PEGW*(DEGW/VIR)

PGDP = PAGRI*(VAR/GDP) + PIND*(VIR/GDP) + PSER*(DSER/GDP)
 GDPN = GDP*(PGDP/100)
 GNPN = GDPN + NFIAN
 PGNP = (GNPN/GNP)*100

PCPIL = -0.04405922505 + 1.005145893*LOG(PGDP)
 DCPIL = -0.02006391749 + 1.057721704*D(LOG(PGDP)) + 0.5410058789*D(LOG(CPI(-1))) -
 0.4121498693*D(LOG(PGDP(-1))) - 0.4797808914*(CPIL(-1)-PCPIL(-1))
 CPIL = CPIL(-1) + DCPIL
 CPI = EXP(CPIL)

PCPISVL = -0.2798031335 + 1.046169638*LOG(CPI)
 DCPISVL=0.02281515835+0.8111241889*DLOG(CPI)-0.2435575832*(CPISVL(-1)-PCPISVL(-1))+0.06254513999*D9798+0.04748221656*DUM91-
 0.04748221656*(1+0.2435575832)*DUM91(-1)
 CPISVL = CPISVL(-1)+DCPISVL
 CPISV = EXP(CPISVL)

INFL = (CPI/CPI(-1)-1)*100

PEXPINFL = 3.31644573 + 0.3539067038*((ER/ER(-1)-1)*100) + 0.3828808046*((MS/MS(-1)-1)*100) + 0.1568240909*(((PM\$(1+TARIFF))/(PM\$(-1)*(1+TARIFF(-1)))-1)*100)
 DEXPINFL = 0.8879219296+0.5550405162*D((ER/ER(-1)-1)*100)+0.2317359262*D(((PM\$(1+TARIFF))/(PM\$(-1)*(1+TARIFF(-1)))-1)*100)-
 0.8593425185*(EXPINFL(-1)-PEXPINFL(-1))+15.5876241*DUM83-
 15.5876241*(1+0.8593425185)*DUM83(-1)-
 23.41252828*DUM98+23.41252828*(1+0.8593425185)*DUM98(-1)
 EXPINFL = EXPINFL(-1) + DEXPINFL

$PAGEMPL = -9.002668431 + 1.508113949 * \log(VAR) - 0.3074145523 * \log(MINWAGE / PGDP)$
 $DAGEMPL = 0.02696420598 - 0.2886180077 * D(\log(MINWAGE / PGDP)) -$
 $0.5967769097 * (AGEMPL(-1) - PAGEMPL(-1)) - 0.08277141776 * DUM98 +$
 $0.08277141776 * (1 + 0.5967769097) * DUM98(-1)$
 $AGEMPL = AGEMPL(-1) + DAGEMPL$
 $AGEMP = \exp(AGEMPL)$

$PIEMPL = -6.812516357 + 0.1676066448 * \log(VIR) + 0.8680424662 * \log(K46) -$
 $0.04327284256 * \log(MINWAGE / PIND)$
 $DIEMPL = 0.02373220917 + 0.5051015667 * D(\log(VIR)) - 0.5529445468 * (IEMPL(-1) - PIEMPL(-1)) +$
 $0.01555533761 * DUM92 - 0.01555533761 * (1 + 0.5529445468) * DUM92(-1)$
 $IEMPL = IEMPL(-1) + DIEMPL$
 $IEMP = \exp(IEMPL)$

$SEEMPL = -9.256456174 + 0.5983713886 * \log(DSER) - 0.3995340278 * \log(MINWAGE / PSER)$
 $+ 0.7132889615 * \log(K46)$
 $SEMP = \exp(SEEMPL)$

$TEMP = AGEMP + IEMP + SEMP$

$PLF = -3261.036604 + 0.7279440818 * POP15N$
 $DLF = 749.2649208 - 0.771035593 * (LF(-1) - PLF(-1))$
 $LF = LF(-1) + DLF$

$UNEMP = LF - TEMP$
 $UERA = UNEMP / LF$

$PMINWAGE = -4.084848762 + 0.6607493911 * CPI$
 $DMINWAGE = -0.3835985514 + 0.6993666071 * D(CPI) - 0.5076252656 * (MINWAGE(-1) -$
 $PMINWAGE(-1))$
 $MINWAGE = MINWAGE(-1) + DMINWAGE$

$PKCARL = -9.523117492 + 1.398947023 * \log(K46) - 0.2564964019 * D8995 -$
 $0.228693861 * D9698$
 $DKCARL = -0.02297998589 + 1.132558194 * D(\log(K46)) + 0.4644397856 * D(\log(KCAR(-1))) -$
 $0.227262502 * (KCARL(-1) - PKCARL(-1))$
 $KCARL = KCARL(-1) + DKCARL$
 $KCAR = \exp(KCARL)$

$K46 = K46(-1) + GDCF - KCAR$

$VISRLF = 2.846577103 + 0.3749189863 * \log(K46) + 0.5100821348 * \log(IEMP + SEMP) +$
 $0.22060905 * DUM6783$

$PTFPAT = -0.3952031709 - 0.001943735516 * MALN + 0.004901977954 * PRTOT$
 $DTFPAT = 0.001113212812 - 0.9546852236 * (TFPAT(-1) - PTFPAT(-1))$
 $TFPAT = TFPAT(-1) + DTFPAT$

$POTVISRLF = 2.846577103 + 0.3749189863 * \log(K46) + 0.5100821348 * \log(LF - AGEMP) +$
 $0.22060905 * DUM6783$

$CAPUT = \exp(VISRLF) / \exp(POTVISRLF + TFPAT)$

$WPI = 12.826157 +$
 $0.0570503471 * (((MFUEL\$ / MGDS\$) * MPIF * (1 + (FTARIFF / 100))) + ((MNFUEL\$ / MGDS\$) * MPINF * (1$

$+(NFTARIFF/100)))*(ERR/100)) + 54.36789764*CAPUT + 8.759432409*(TL/GNP) + 33.23788184*(MINWAGE/(VISR/(IEMP+SEMP)))$

$PCHNCNG = 3250.559593 + 0.2221449099*(CGOVN+CGN-REV) - 1.533381251*EXTFIN + 29793.92496*D9798$

$DCHNCNG = 1809.110302 + 0.5259380586*D((CGOVN)+CGN-REV) - 3.522484866*D(EXTFIN) + 0.287543889*D(CHNCNG(-1)) - 1.720920316*(CHNCNG(-1)-PCHNCNG(-1))$

$CHNCNG = CHNCNG(-1) + DCHNCNG$

$RATIO = (1+CUTD)/(CUTD+REQRATIO)$

$MSMML = 1.445866737 + 0.2867572553*LOG(RATIO) - 0.2996282834*LOG(TIME) + 0.08214848884*DUM97$

$MSMM = EXP(MSMML)$

$PTLMML = 2.458621036 + 0.5641285135*LOG(RATIO) - 0.09651158314*DUM97 - 0.1897617521*DUM98$

$DTLMML = 0.001671192697 + 0.623608562*D(LOG(RATIO)) - 0.7900949277*(TLMMML(-1)-PTLMML(-1)) - 0.10482562*DUM97 + 0.10482562*(1+0.7900949277)*DUM97(-1) - 0.2958282311*DUM98 + 0.2958282311*(1+0.7900949277)*DUM98(-1)$

$TLMMML = TLMMML(-1) + DTLMMML$

$TLMM = EXP(TLMMML)$

$PCHNFA = -1982.018699 + 0.6782055083*(BOP*ER) + 53259.79326*D9293$

$DCHNFA = -365.5175554 + 0.8391985604*D(BOP*ER) - 0.5347304849*(CHNFA(-1)-PCHNFA(-1)) + 0.4601058048*D(CHNFA(-1))$

$CHNFA = CHNFA(-1) + DCHNFA$

$NCNG = CHNCNG + NCNG(-1)$

$NFA = CHNFA + NFA(-1)$

$NDA = NCNG + OTHNDA$

$PTBILL = 2.966029443 + 21.47497334*((DEFG-EXTFIN-CHNCNG)/TL) + 0.4700582159*INFL + 8.276345521e-06*GNP$

$DTBILL = 0.1374107502 + 0.3765354926*D(INFL) + 0.3113438059*D(TBILL(-1)) - 0.4153356402*(TBILL(-1)-PTBILL(-1))$

$TBILL = TBILL(-1) + DTBILL$

$TBILL364 = -3.729162662 + 1.322577043*TBILL + 0.06533721072*INFL - 4.386188505*DUM86$

$BM = NDA + NFA + OTHERBM$

$MS = MSMM*BM$

$TL = TLMM*BM$

$PXSEM\$ = -16.34204721 - 0.7324989922*LOG(((PXSEM/(ERR/100))/WPXDMFG)) + 1.815333547*LOG(INDJAP) + 1.702831869*LOG(MGDS\$)$

$DXSEM\$ = 0.09894266918 + 1.325451321*D(LOG(INDJAP)) + 0.4623837939*D(LOG(XSEM$(-1))) - 0.1340438898*(XSEM$(-1)-PXSEM$(-1))$

$XSEM\$ = XSEM$(-1) + DXSEM\$$

$XSEM\$ = EXP(XSEM\$)$

$PXMO\$ = -40.13084854 - 0.02880447589*LOG((PXMO/(ERR/100))/WPXDMFG) + 3.682275696*LOG(DMFG) + 0.0006619987295*GDPU\$ - 0.7465718921*D9798$

$DXMO\$ = 0.1272413625 + 2.063082298*DLOG(DMFG) - 0.4418509747*(XMO$(-1)-PXMO$(-1)) - 0.2187709432*DUM96 - 0.2187709432*(1+0.4418509747)*DUM96(-1)$

XMO\$ = XMO\$(-1) + DXMO\$
XMO\$ = EXP(XMO\$)

PXAGRI\$ = -5.212340963 - 0.5931735168*LOG((PXAGRL(-1)/(ERR(-1)/100))/WPXDAGRI(-1))
+ 1.619800908*LOG(DCROPS) - 0.4605481364*LOG(CPFOOD) +
0.290661891*((GDPUS/GDPUS(-1))-1)
DXAGRI\$ = -0.003038427842 - 0.6356863906*(XAGRI\$(-1)-PXAGRI\$(-1))
XAGRI\$ = XAGRI\$(-1) + DXAGRI\$
XAGRI\$ = EXP(XAGRI\$)

PXAGRRL = 6.432216054 + 0.6086648825*LOG((XAGRI\$*ER)/PXAGRL)
DXAGRRL = 0.005545913727 + 0.6472689382*DLOG((XAGRI\$*ER)/PXAGRL) -
0.7240205889*(XAGRRL(-1)-PXAGRRL(-1))
XAGRRL = XAGRRL(-1)+DXAGRRL
XAGRRL = EXP(XAGRRL)

PXO\$ = -10.35259506 - 0.1803153708*LOG((PXO/(ERR/100))/WPXDMFG) +
2.004858269*LOG(GDPUS)
DXO\$ = 0.05824451529 - 0.4798171173*(XO\$(-1)-PXO\$(-1)) + 0.2852319432*D(LOG(XO\$(-
1)))
XO\$ = XO\$(-1) + DXO\$
XO\$ = EXP(XO\$)

XGDS\$ = XSEM\$ + XMO\$ + XAGRI\$ + XO\$

MFUELQL = -3.66946274 - 0.2161553798*((MPIF*(1+(FTARIFF/100)))/(PGDP/(ERR/100))) +
0.871761873*LOG(GDP) + 3.745542183e-05*(NFA/ER)
MFUELQ = EXP(MFUELQL)

MFUEL\$ = MFUELQ * (MPIF/100)

PMNFUEL\$ = -22.86605009 -
12.8033469*(LOG(MPINF*(1+(NFTARIFF/100)))/((PGDP/ERR)*100)) + 2.423442798*LOG(GDP)
+ 5.568750043e-05*(NFA/ER) + 0.2883686229*DUM90
DMNFUEL\$ = 0.04197365986+2.555153178*DLOG(GDP)+2.829309634e-05*D(NFA/ER)-
0.1036176251*(MNFUEL\$(-1)-PMNFUEL\$(-1))-0.1735052662*DUM98-
0.1735052662*(1+0.1036176251)*DUM98(-1)
MNFUEL\$ = MNFUEL\$(-1) + DMNFUEL\$
MNFUEL\$ = EXP(MNFUEL\$)

MGDS\$ = MFUEL\$ + MNFUEL\$

PM\$ = -1.130185335 +
1.241157804*LOG((MPIF*(MFUEL\$/MGDS\$))+ (MPINF*(MNFUEL\$/MGDS\$))) +
0.7753016959*(-1.130185335 + 1.241157804*LOG((MPIF(-1)*(MFUEL\$(-1)/MGDS\$(-
1)))+(MPINF(-1)*(MNFUEL\$(-1)/MGDS\$(-1)))) - PM\$(-1))
PM\$ = EXP(PM\$)

XNFSV\$ = -4.691167046 + 1.290723667*LOG(XGDS\$+MGDS\$) + 0.4310026383*D7273 +
0.6628502284*D8586 - 0.568660801*DUM98
XNFSV\$ = EXP(XNFSV\$)

XSV\$ = XNFSV\$ + INVINC + INCREM

PMNFSV\$ = -2.529778528 + 1.04200298*LOG(MGDS\$+XGDS\$) + 3.931098991e-
05*(NFA/ER) + 0.3112634976*DUM97 - 0.2656636944*D9293

$DMNFSV\$L = -0.01174506293 + 1.143854355 * DLOG(MGDS\$ + XGDS\$) -$
 $0.7309084956 * (MNFSV\$L(-1) - PMNFSV\$L(-1)) + 0.1613745831 * DUM82 + 0.1613745831 * (1 + 0.7309084956) * DUM82(-1) -$
 $0.2741358851 * DUM98 - 0.2741358851 * (1 + 0.7309084956) * DUM98(-1)$
 $MNFSV\$L = MNFSV\$L(-1) + DMNFSV\$L$
 $MNFSV\$ = EXP(MNFSV\$L)$

$MSV\$ = MNFSV\$ + INVEXP + INCOU$

$TRABAL = XGDS\$ - MGDS\$ + XSV\$ - MSV\$$
 $CURBAL = TRABAL + ITRANS - OTRANS$
 $CAPBAL = ILTLON - OLTLO + NINDF + NSHTRM + COLLATERAL + TRBONDS + CHKNFA$
 $BOP = CURBAL + CAPBAL + MNGOLD + ALLSDR + UNREM + REVADJ + ERROR$

$PCHGIR = 160.1321268 + 0.749294767 * BOP$
 $DCHGIR = -16.2250816 + 0.7154157417 * D(BOP) - 0.9545340696 * (CHGIR(-1) - PCHGIR(-1)) -$
 $0.191311599 * D(CHGIR(-1))$
 $CHGIR = CHGIR(-1) + DCHGIR$

$GIR = GIR(-1) + CHGIR$

$PERDEP = 33.17356632 - 0.08558219083 * (TBILL - INFL) + 2.416975457 * (LIBOR - USINFL) -$
 $4.009203166 * LOG(GIR)$
 $DERDEP = -1.744754772 - 0.3478224311 * D(TBILL - INFL) - 8.634398671 * D(LOG(GIR)) -$
 $0.9580708397 * (ERDEP(-1) - PERDEP(-1)) + 36.98189148 * DUM98 -$
 $36.98189148 * (1 + 0.9580708397) * DUM98(-1)$
 $ERDEP = ERDEP(-1) + DERDEP$

$ER = (ERDEP / 100 + 1) * ER(-1)$

$ERR = (ER / 18.6073) * 100$

$PMALN = 2.97881838 - 0.006372743845 * CPPC + 69.03240438 * (PAGRI / PGDP) -$
 $7.95905881 * DUM84 + 7.926662291 * DUM98$
 $DMALN = -0.05513589584 - 0.2114151398 * (MALN(-1) - PMALN(-1)) -$
 $0.004202557952 * D(CPPC) + 0.5885103405 * D(MALN(-2)) + 3.731320281 * DUM98 -$
 $3.731320281 * (1 + 0.2114151398) * DUM98(-1)$
 $MALN = MALN(-1) + DMALN$

$PRTOT = 119.9946789 + 2.010210311e-05 * ((NGEXPED / POP) / (PGDP / 100)) -$
 $53.65914069 * (CPISV / CPI) + 0.001249779183 * CPPC + 3.617110229 * DUM97$

Appendix B

PIDS Annual Macro Social Model using OLS

DLIVPOL = -9.333755144 - 0.08204422184*LOG(PLIVPO/PCROPS) + 1.48300499*LOG(CP) -
 0.08076221263*DUM85 - 0.07473152995*DUM75 + 0.832489472*(-9.333755144 -
 0.08204422184*LOG(PLIVPO(-1)/PCROPS(-1)) + 1.48300499*LOG(CP(-1)) -
 0.08076221263*DUM85(-1) - 0.07473152995*DUM75(-1) - DLIVPOL(-1))
 DLIVPO = EXP(DLIVPOL)

PLIVPOL = -(14.5876082140 - 0.1326685628*LOG(PFEEDS*(ERR/100)) +
 0.2103191850*LOG(RBLOAN) + 0.2919018293*LOG(MCEREALR) - 1.4830049900*LOG(CP) -
 0.0820442218*LOG(PCROPS) + 0.3021931511*DUM80 + 0.2748158054*DUM70 +
 0.0807622126*DUM85 + 0.0747315300*DUM75 + 0.1850768644*DUM97 - 0.8324894720*(-
 9.333755144 - 0.08204422184*LOG(PLIVPO(-1)/PCROPS(-1)) + 1.48300499*LOG(CP(-1)) -
 0.08076221263*DUM85(-1) - 0.07473152995*DUM75(-1) - DLIVPOL(-1)))/0.21471278464
 PLIVPO = EXP(PLIVPOL)

DFISHL = 3.027387993 - 0.1382069059*LOG(PINFI/CPI) + 0.5512024033*LOG(CP) +
 0.07494742461*DUM83 + 0.8165461853*(3.027387993 - 0.1382069059*LOG(PINFI(-1)/CPI(-1))
 + 0.5512024033*LOG(CP(-1)) + 0.07494742461*DUM83(-1) - DFISHL(-1))
 DFISH = EXP(DFISHL)

PINFIL = -(5.776000777 + 0.179267733*LOG(RBLOAN) - 0.551202403*LOG(CP) -
 0.138206906*LOG(CPI) - 0.164243809*LOG(PCROPS) - 0.302936326*D7081 - 0.074947425
 DUM83 - 0.816546185(3.027387993 - 0.138206906*LOG(PINFI(-1)/CPI(-1)) +
 0.551202403*LOG(CP(-1)) + 0.074947425*DUM83(-1) - DFISHL(-1)))/0.302450715
 PINFI = EXP(PINFIL)

DCROPSL = 6.107928972 - 0.2439702769*LOG(PCROPS/CPI) +
 0.4013351933*LOG(CP+XAGRRL-MCEREALR) - 0.151368156*DUM98 +
 0.8118263241*(6.107928972 - 0.2439702769*LOG(PCROPS(-1)/CPI(-1)) +
 0.4013351933*LOG(CP(-1)+XAGRRL(-1)-MCEREALR(-1)) - 0.151368156*DUM98(-1) -
 DCROPSL(-1))
 DCROPS = EXP(DCROPSL)

PCROPSL = -(-6.611837112 + 1.149665617*LOG(HCTRG) + 0.112929653*LOG(RBLOAN) -
 0.401335193*LOG(CP+XAGRRL-MCEREALR) - 0.22495553*LOG(PAGRI) -
 0.22495553*LOG(CPI) + 0.070773109*DUM72 + 0.078776435*DUM80 + 0.094475731*DUM97
 + 0.151368156*DUM98 - 0.811826324*(6.107928972 - 0.2439702769*LOG(PCROPS(-1)/CPI(-
 1)) + 0.4013351933*LOG(CP(-1)+XAGRRL(-1)-MCEREALR(-1)) - 0.151368156*DUM98(-1) -
 DCROPSL(-1)))/0.44991107
 PCROPS = EXP(PCROPSL)

VAR = DCROPS + DLIVPO + AGSERR + DFISH + FORES

DMQL = 3.916858386 - 0.2377662773*LOG(PMQ/PGDP) +
 0.4575934499*LOG(CONSGO+CONSPR) - 0.3718600588*D6775 + 0.4178340516*D8591
 DMQ = EXP(DMQL)

PMQL = 1.165641787 + 0.7550997744*LOG(WPI) + 0.2368108315*DUM73 +
 0.4529717017*(1.165641787 + 0.7550997744*LOG(WPI(-1)) + 0.2368108315*DUM73(-1) -
 PMQL(-1))
 PMQ = EXP(PMQL)

$DMFGL = 2.691032327 - 0.3154743156 * \log(PMFG/CPI) +$
 $0.6884404971 * \log(CP+CG+GDCF+XGDS) - 0.07354488805 * D9298 +$
 $0.5228585088 * (2.691032327 - 0.3154743156 * \log(PMFG(-1)/CPI(-1))) +$
 $0.6884404971 * \log(CP(-1)+CG(-1)+GDCF(-1)+XGDS(-1)) - 0.07354488805 * D9298(-1) -$
 $DMFGL(-1))$
 $DMFG = \exp(DMFGL)$

$PMFGL = 0.1897018464 + 0.3717634628 * \log(WPI) + 0.6044056091 * \log(PMFG(-1)) +$
 $0.1930199862 * DUM84 + 0.09360578399 * D7071$
 $PMFG = \exp(PMFGL)$

$DCONSL = 0.9186364643 - 0.1835382392 * \log(PCONS/CPI) +$
 $0.8730414188 * \log(CONSGO+CONSPR) - 0.1487798977 * DUM85 +$
 $0.826135735 * (0.9186364643 - 0.1835382392 * \log(PCONS(-1)/CPI(-1))) +$
 $0.8730414188 * \log(CONSGO(-1)+CONSPR(-1)) - 0.1487798977 * DUM85(-1) - DCONSL(-1))$
 $DCONS = \exp(DCONSL)$

$PCONSL = 0.1540281476 + 0.1825887702 * \log(WPI) + 0.8062079075 * \log(PCONS(-1)) +$
 $0.2188972723 * DUM74 + 0.2379342553 * DUM84$
 $PCONS = \exp(PCONSL)$

$DEGWL = -5.933133676 - 0.2233797955 * \log(PEGW/WPI) +$
 $0.7564995526 * \log(CP+CG+GDCF+XGDS) + 0.3011782665 * DUM74 + 0.1579610744 * DUM82$
 $+ 0.1704604065 * D8486 + 0.5501176646 * \log(DEGW(-1))$
 $DEGW = \exp(DEGWL)$

$PEGWL = -3.457739808e-05 + 0.9856400282 * \log(WPI) + 0.6680027653 * (-3.457739808e-05 +$
 $0.9856400282 * \log(WPI(-1))) - PEGWL(-1))$
 $PEGW = \exp(PEGWL)$

$DSERL = -0.08501793991 - 0.1577544045 * \log(PSER/PGDP) +$
 $0.2924604392 * \log(CP+CG+XGDS) - 0.02200547247 * D8081 - 0.06560301102 * D8485 +$
 $0.6958794309 * \log(DSER(-1))$
 $DSER = \exp(DSERL)$
 $DSER = \exp(DSERL)$

$PSERL = 0.06450529423 + 0.420967925 * \log(WPI) - 0.3344963419 * \log(WPI(-1)) +$
 $0.9174756523 * \log(PSER(-1)) + 0.104084819 * DUM84 - 0.04867374635 * DUM87$
 $PSER = \exp(PSERL)$

$VIR = DMQ + DMFG + DCONS + DEGWL$
 $VISR = VIR + DSER$
 $GDP = VAR + VISR$

$NFIAN = 1768.319433 + 0.9400457998 * ((INVINC+INCREM-INVEXP-INCOUT)*ER) -$
 $29871.84352 * DUM97 + 8465.773928 * D8991$

$PNFIAL = -0.02294114986 + 1.004118378 * \log(PGDP) + 0.5535368896 * (-0.02294114986 +$
 $1.004118378 * \log(PGDP(-1))) - PNFIAL(-1))$
 $PNFIA = \exp(PNFIAL)$

$NFIA = NFIAN / (PNFIA/100)$
 $GNP = GDP + NFIA$

$INCTAXL = -8.064581161 + 1.223159089 * \log(INCTAXRATE*GNPN) + 0.5991236549 * (-$
 $8.064581161 + 1.223159089 * \log(INCTAXRATE(-1)*GNPN(-1))) - INCTAXL(-1))$

INCTAX = EXP(INCTAXL)

CORPTAXL = -6.810938852 + 0.6758203639*LOG(CPTAXRATE*(VIR*(PIND/100))) +
0.5877364595*LOG(CORPTAX(-1)) - 0.132569854*DUM88 - 0.1644016926*DUM86 -
0.2171860366*DUM98

CORPTAX = EXP(CORPTAXL)

EXCISEL = -3.97746196 + 1.013524948*LOG(GNP) + 0.5998813836*(-3.97746196 +
1.013524948*LOG(GNP(-1)) - EXCISEL(-1))

EXCISE = EXP(EXCISEL)

SALESTAXL = -6.231189009 + 1.166030451*LOG(GNP) + 0.6303628817*(-6.231189009 +
1.166030451*LOG(GNP(-1)) - SALESTAXL(-1))

SALESTAX = EXP(SALESTAXL)

IMPDTAXL = -2.866473106 + 1.222285619*LOG(MGDS\$*ER*(TARIFF/100)) -
0.2376808693*D9798

IMPDTAX = EXP(IMPDTAXL)

TAXREV = INCTAX + CORPTAX + EXCISE + SALESTAX + IMPDTAX + OTHERTAXES

REV = TAXREV + NTAXRE

EXPN = OPEXP + CAPOUT + CAPTRANS + NETLEN

DEFG = -(REV-EXPN)

CPPCL = 3.435323476 + 0.6062548633*LOG((GNP-(INCTAX/(PGNP/100)))/POP) +
0.04579861011*LOG(TL/GNP) + 0.02055411699*D9293 + 0.01778071663*DUM98

CPPC = EXP(CPPCL)

CP = CPPC*POP

CPFOODL = -0.9607201155 + 1.026540482*LOG(CP) - 0.008758151656*D8789 +
0.5857433447*(-0.9607201155 + 1.026540482*LOG(CP(-1)) - 0.008758151656*D8789(-1) -
CPFOODL(-1))

CPFOOD = EXP(CPFOODL)

CGNL = 0.2684941487 + 0.1622304925*LOG(OPEXPO) + 0.8215103806*LOG(CGN(-1)) +
0.2200067656*DUM74 - 0.1199123802*DUM92

CGN = EXP(CGNL)

PCGL = 0.02404582143 + 0.14438039*LOG(PGDP) + 0.8798066107*LOG(PCG(-1)) +
0.1429687742*DUM84 + 0.1016253196*DUM74 - 0.06975980761*DUM92

PCG = EXP(PCGL)

CG = CGN/(PCG/100)

CONSGON = 216.7908059 + 1.189108441*CAPOUTO - 26250.41894*DUM86

PCGOVL = -0.03224670433 + 1.00691806*LOG(PGDP) + 0.7806348272*(-0.03224670433 +
1.00691806*LOG(PGDP(-1)) - PCGOVL(-1))

PCGOV = EXP(PCGOVL)

CONSGO = CONSGON/(PCGOV/100)

CONSPRL = -2.842535042 + 0.7600151276*LOG(GDP) - 0.003543111261*(TBILL364-
EXPINFL) + 0.3236490377*LOG(CONSGO) + 0.5114086019*(-2.842535042 +

$0.7600151276 * \text{LOG}(\text{GDP}(-1)) - 0.003543111261 * (\text{TBILL364}(-1) - \text{EXPINFL}(-1)) +$
 $0.3236490377 * \text{LOG}(\text{CONSGO}(-1)) - \text{CONSPRL}(-1))$
 $\text{CONSPR} = \text{EXP}(\text{CONSPRL})$

$\text{IDERL} = -1.720244665 + 0.5461140612 * \text{LOG}(\text{GDP}) + 0.450648964 * \text{LOG}(\text{MGDS}) -$
 $0.005906153162 * (\text{TBILL364} - \text{EXPINFL}) + 0.2975630805 * \text{DUM82} - 0.3056893959 * \text{DUM87}$
 $\text{IDER} = \text{EXP}(\text{IDERL})$

$\text{BREEDRL} = 0.1272245081 + 0.1981815012 * \text{LOG}(\text{DLIVPO}) + 0.7700200981 * \text{LOG}(\text{BREEDR}(-1))$
 $+ 0.4194101026 * \text{DUM80} + 0.09055826573 * \text{DUM85}$
 $\text{BREEDR} = \text{EXP}(\text{BREEDRL})$

$\text{GDCF} = \text{CONSGO} + \text{CONSPR} + \text{IDER} + \text{BREEDR} + \text{IINV}$

$\text{PXGDS} = -29.81960004 + 1.449107968 * ((\text{PX} * \text{ERR}) / 100) + 0.847634333 * (-29.81960004 +$
 $1.449107968 * ((\text{PX}(-1) * \text{ERR}(-1)) / 100) - \text{PXGDS}(-1))$

$\text{XGDS} = 1707.972276 + 0.9892991961 * ((\text{XGDS} * \text{ER}) / (\text{PXGDS} / 100)) - 3185.39898 * \text{DUM98} +$
 $0.761232668 * (1707.972276 + 0.9892991961 * ((\text{XGDS}(-1) * \text{ER}(-1)) / (\text{PXGDS}(-1) / 100)) -$
 $3185.39898 * \text{DUM98}(-1) - \text{XGDS}(-1))$

$\text{PXNFSV} = -16.8107189 + 1.254844863 * ((\text{PX} * \text{ERR}) / 100) - 97.53893816 * \text{DUM98} -$
 $28.49500032 * \text{DUM88} + 39.66959598 * \text{D9496}$

$\text{XNFSV} = 7572.743909 + 0.9706278753 * ((\text{XNFSV} * \text{ER}) / (\text{PXNFSV} / 100)) + 9494.724647 * \text{D8794} -$
 $39909.93074 * \text{DUM98}$

$\text{PMGDS} = -4.663105717 +$
 $0.2691333388 * ((((\text{MFUEL} / \text{MGDS}) * \text{MPIF} * (1 + (\text{FTARIFF} / 100))) + ((\text{MNFUEL} / \text{MGDS}) * \text{MPINF} * (1$
 $+ (\text{NFTARIFF} / 100)))) * (\text{ERR} / 100)) + 0.8349026426 * \text{PMGDS}(-1) - 17.92557777 * \text{DUM86} +$
 $48.14782614 * \text{DUM98}$

$\text{MGDSL} = 4.297263477 + 0.8446839593 * \text{LOG}(\text{MFUELQ} + (\text{MNFUEL} / (\text{MPINF} / 100))) +$
 $0.8166212632 * (4.297263477 + 0.8446839593 * \text{LOG}(\text{MFUELQ}(-1) + (\text{MNFUEL}(-1) / (\text{MPINF}(-1) / 100))) -$
 $\text{MGDSL}(-1))$
 $\text{MGDS} = \text{EXP}(\text{MGDSL})$

$\text{PMNFSV} = -46.31032695 +$
 $2.121031681 * ((((\text{MFUEL} / \text{MGDS}) * \text{MPIF}) + ((\text{MNFUEL} / \text{MGDS}) * \text{MPINF})) * (\text{ERR} / 100)) -$
 $66.65880128 * \text{D8485} + 79.1052644 * \text{D9597}$

$\text{MNFSV} = -2033.584273 + 0.2043006417 * (\text{MNFSV} * \text{ER} / (\text{PMNFSV} / 100)) +$
 $0.9056847543 * \text{MNFSV}(-1) + 18476.96944 * \text{DUM97} - 15557.84225 * \text{DUM98}$

$\text{GDPEXP} = \text{CG} + \text{CP} + \text{GDCF} + \text{XGDS} + \text{XNFSV} - \text{MGDS} - \text{MNFSV}$
 $\text{STATD} = \text{GDP} - \text{GDPEXP}$

$\text{PAGRI} = \text{PLIVPO} * (\text{DLIVPO} / \text{VAR}) + \text{PINFI} * (\text{DFISH} / \text{VAR}) + \text{PCROPS} * (\text{DCROPS} / \text{VAR}) +$
 $\text{PAGSER} * (\text{AGSERR} / \text{VAR}) + \text{PFORES} * (\text{FORES} / \text{VAR})$

$\text{PIND} = \text{PMQ} * (\text{DMQ} / \text{VIR}) + \text{PMFG} * (\text{DMFG} / \text{VIR}) + \text{PCONS} * (\text{DCONS} / \text{VIR}) + \text{PEGW} * (\text{DEGW} / \text{VIR})$

$\text{PGDP} = \text{PAGRI} * (\text{VAR} / \text{GDP}) + \text{PIND} * (\text{VIR} / \text{GDP}) + \text{PSER} * (\text{DSER} / \text{GDP})$
 $\text{GDPN} = \text{GDP} * (\text{PGDP} / 100)$
 $\text{GNPN} = \text{GDPN} + \text{NFIAN}$
 $\text{PGNP} = (\text{GNPN} / \text{GNP}) * 100$

$$\text{CPIL} = -0.04494294432 + 1.004795998 \cdot \text{LOG}(\text{PGDP}) + 0.6842302472 \cdot (-0.04494294432 + 1.004795998 \cdot \text{LOG}(\text{PGDP}(-1)) - \text{CPIL}(-1))$$

$$\text{CPI} = \text{EXP}(\text{CPIL})$$

$$\text{CPISVL} = -0.4074796558 + 1.074363329 \cdot \text{LOG}(\text{CPI}) + 0.7035840361 \cdot (-0.4074796558 + 1.074363329 \cdot \text{LOG}(\text{CPI}(-1)) - \text{CPISVL}(-1))$$

$$\text{CPISV} = \text{EXP}(\text{CPISVL})$$

$$\text{INFL} = (\text{CPI}/\text{CPI}(-1) - 1) \cdot 100$$

$$\begin{aligned} \text{EXPINFL} = & 1.183232059 + 0.384946299 \cdot ((\text{ER}/\text{ER}(-1) - 1) \cdot 100) + 0.5353395537 \cdot ((\text{MS}/\text{MS}(-1) - 1) \cdot 100) \\ & + 0.2007725393 \cdot (((\text{PM}\$ \cdot (1 + \text{TARIFF})) / (\text{PM}\$(-1) \cdot (1 + \text{TARIFF}(-1))) - 1) \cdot 100) + \\ & 18.80651271 \cdot \text{DUM7374} - 9.081188832 \cdot \text{D9697} \end{aligned}$$

$$\begin{aligned} \text{AGEMPL} = & -3.538410733 + 0.6486646092 \cdot \text{LOG}(\text{VAR}) - 0.2717568173 \cdot \text{LOG}(\text{MINWAGE}/\text{PGDP}) \\ & + 0.5262954181 \cdot \text{LOG}(\text{AGEMP}(-1)) - 0.1320584705 \cdot \text{DUM77} + 0.08359046518 \cdot \text{DUM83} + \\ & 0.04580939573 \cdot \text{D9192} \\ \text{AGEMP} = & \text{EXP}(\text{AGEMPL}) \end{aligned}$$

$$\begin{aligned} \text{IEMPL} = & -7.360780759 + 0.1861758272 \cdot \text{LOG}(\text{VIR}) + 0.8863625332 \cdot \text{LOG}(\text{K46}) - \\ & 0.2063905141 \cdot \text{LOG}(\text{MINWAGE}/\text{PIND}) - 0.1454847803 \cdot \text{D8286} \\ \text{IEMP} = & \text{EXP}(\text{IEMPL}) \end{aligned}$$

$$\begin{aligned} \text{SEMP} = & -9.345054163 + 0.3616414504 \cdot \text{LOG}(\text{DSER}) - 0.2601557466 \cdot \text{LOG}(\text{MINWAGE}/\text{PSER}) \\ & + 0.9258888937 \cdot \text{LOG}(\text{K46}) + 0.4850665959 \cdot (-9.345054163 + 0.3616414504 \cdot \text{LOG}(\text{DSER}(-1)) - \\ & 0.2601557466 \cdot \text{LOG}(\text{MINWAGE}(-1)/\text{PSER}(-1)) + 0.9258888937 \cdot \text{LOG}(\text{K46}(-1)) - \text{SEMP}(-1)) \\ \text{SEMP} = & \text{EXP}(\text{SEMP}) \end{aligned}$$

$$\text{TEMP} = \text{AGEMP} + \text{IEMP} + \text{SEMP}$$

$$\text{LF} = -3317.852855 + 0.728544282 \cdot \text{POP15N} + 815.3700719 \cdot \text{DUM87}$$

$$\begin{aligned} \text{UNEMP} &= \text{LF} - \text{TEMP} \\ \text{UERA} &= \text{UNEMP}/\text{LF} \end{aligned}$$

$$\begin{aligned} \text{MINWAGE} = & -4.985645275 + 0.6686636807 \cdot \text{CPI} + 0.5003071546 \cdot (-4.985645275 + \\ & 0.6686636807 \cdot \text{CPI}(-1) - \text{MINWAGE}(-1)) \end{aligned}$$

$$\begin{aligned} \text{KCARL} = & -4.563169357 + 1.056234699 \cdot \text{LOG}(\text{K46}) + 0.8766772314 \cdot (-4.563169357 + \\ & 1.056234699 \cdot \text{LOG}(\text{K46}(-1)) - \text{KCARL}(-1)) \\ \text{KCAR} = & \text{EXP}(\text{KCARL}) \end{aligned}$$

$$\text{K46} = \text{K46}(-1) + \text{GDCF} - \text{KCAR}$$

$$\begin{aligned} \text{VISRLF} = & 3.196616497 + 0.2483492192 \cdot \text{LOG}(\text{K46}) + 0.6711773546 \cdot \text{LOG}(\text{IEMP} + \text{SEMP}) + \\ & 0.2525583273 \cdot \text{D6783} + 0.0999549656 \cdot \text{DUM84} \end{aligned}$$

$$\begin{aligned} \text{TFPF} = & -0.2846904028 - 0.003063624605 \cdot \text{MALN} + 0.003701975157 \cdot \text{PRTOT} + \\ & 0.03832064866 \cdot \text{D8991} \end{aligned}$$

$$\begin{aligned} \text{POTVISRLF} = & 3.196616497 + 0.2483492192 \cdot \text{LOG}(\text{K46}) + 0.6711773546 \cdot \text{LOG}(\text{LF} - \text{AGEMP}) + \\ & 0.2525583273 \cdot \text{D6783} + 0.0999549656 \cdot \text{DUM84} \end{aligned}$$

$$\text{CAPUT} = \text{EXP}(\text{VISRLF}) / \text{EXP}(\text{POTVISRLF} + \text{TFPF})$$

$$\text{WPI} = 13.45089722 + 0.05734303265 * ((((\text{MFUEL} / \text{MGDS}) * \text{MPIF} * (1 + (\text{FTARIFF} / 100)))) + ((\text{MNFUEL} / \text{MGDS}) * \text{MPINF} * (1 + (\text{NFTARIFF} / 100)))) * (\text{ERR} / 100) + 53.63662735 * \text{CAPUT} + 8.663838971 * (\text{TL} / \text{GNP}) + 33.26287394 * (\text{MINWAGE} / (\text{VISR} / (\text{IEMP} + \text{SEMP})))$$

$$\text{CHNCNG} = 2319.270942 + 0.3765448323 * (\text{CGOVN} + \text{CGN-REV}) - 1.309460476 * \text{EXTFIN} - 28366.39637 * \text{DUM92} + 50402.21925 * \text{D9394} + 33882.78658 * \text{D9798}$$

$$\text{RATIO} = (1 + \text{CUTD}) / (\text{CUTD} + \text{REQRATIO})$$

$$\text{MSMML} = 1.445866737 + 0.2867572553 * \text{LOG}(\text{RATIO}) - 0.2996282834 * \text{LOG}(\text{TIME}) + 0.08214848884 * \text{DUM97}$$

$$\text{MSMM} = \text{EXP}(\text{MSMML})$$

$$\text{TLMML} = 1.989099652 + 0.3888878159 * \text{LOG}(\text{RATIO}) + 0.09013738521 * \text{D9496}$$

$$\text{TLMM} = \text{EXP}(\text{TLMML})$$

$$\text{CHNFA} = -2129.441279 + 0.5211665333 * (\text{BOP} * \text{ER}) + 68832.52267 * \text{D9192} + 0.5978449331 * (-2129.441279 + 0.5211665333 * (\text{BOP}(-1) * \text{ER}(-1)) + 68832.52267 * \text{D9192}(-1) - \text{CHNFA}(-1))$$

$$\text{NCNG} = \text{CHNCNG} + \text{NCNG}(-1)$$

$$\text{NFA} = \text{CHNFA} + \text{NFA}(-1)$$

$$\text{NDA} = \text{NCNG} + \text{OTHNDA}$$

$$\text{TBILL} = 2.767796447 + 18.78329456 * ((\text{DEFG} - \text{EXTFIN} - \text{CHNCNG}) / \text{TL}) + 0.4122754181 * \text{INFL} + 8.895663653e-06 * \text{GNP} + 8.317951074 * \text{DUM85} + 6.293141473 * \text{DUM90}$$

$$\text{TBILL364} = -4.424486742 + 1.40125895 * \text{TBILL} + 0.04734279417 * \text{INFL} - 4.95684435 * \text{DUM86} - 2.771502712 * \text{D9091}$$

$$\text{BM} = \text{NDA} + \text{NFA} + \text{OTHERBM}$$

$$\text{MS} = \text{MSMM} * \text{BM}$$

$$\text{TL} = \text{TLMM} * \text{BM}$$

$$\text{XSEM\$} = -26.3068926 - 0.2617694129 * \text{LOG}((\text{PXSEM} / (\text{ERR} / 100)) / \text{WPXDMFG}) + 4.573305704 * \text{LOG}(\text{INDJAP}) + 1.415276073 * \text{LOG}(\text{MGDS\$}) + 1.095020837 * \text{D7586} - 0.5551166851 * \text{DUM90} + 0.5452155658 * \text{DUM98}$$

$$\text{XSEM\$} = \text{EXP}(\text{XSEM\$})$$

$$\text{XMO\$} = -61.62340412 - 0.0001510029759 * \text{LOG}((\text{PXMO} / (\text{ERR} / 100)) / \text{WPXDMFG}) + 2.965508385 * \text{LOG}(\text{DMFG}) + 3.931744937 * \text{LOG}(\text{GDPUS}) - 0.6165169424 * \text{DUM72} - 0.5574600988 * \text{D9698}$$

$$\text{XMO\$} = \text{EXP}(\text{XMO\$})$$

$$\text{XAGRI\$} = -15.0277885 - 0.266317517 * \text{LOG}((\text{PXAGRL} / (\text{ERR} / 100)) / \text{WPXDAGRI}) + 4.085973752 * \text{LOG}(\text{DCROPS}) - 1.917415248 * \text{LOG}(\text{CPFOOD}) + 3.130737114 * ((\text{GDPUS} / \text{GDPUS}(-1)) - 1) - 0.339489843 * \text{D8586} + 0.5393422341 * \text{DUM98} + 0.2480999487 * \text{DUM95}$$

$$\text{XAGRI\$} = \text{EXP}(\text{XAGRI\$})$$

$$\text{XAGRLL} = 6.801994375 + 0.5482961558 * \text{LOG}((\text{XAGRI\$} * \text{ER}) / \text{PXAGRL}) - 0.1347999631 * \text{D8285} + 0.2045093016 * \text{DUM98}$$

$$\text{XAGRLL} = \text{EXP}(\text{XAGRLL})$$

$$\text{XO\$} = -9.622231442 - 0.07286386656 * \text{LOG}((\text{PXO} / (\text{ERR} / 100)) / \text{WPXDMFG}) + 1.920408878 * \text{LOG}(\text{GDPUS}) + 0.3298993409 * \text{D7980} + 0.6079706022 * (-9.622231442 -$$

$0.07286386656 * \text{LOG}((\text{PXO}(-1)/(\text{ERR}(-1)/100))/\text{WPXDMFG}(-1)) + 1.920408878 * \text{LOG}(\text{GDPUS}(-1)) + 0.3298993409 * \text{D7980}(-1) - \text{XO\$L}(-1)$
 $\text{XO\$} = \text{EXP}(\text{XO\$L})$

$\text{XGDS\$} = \text{XSEM\$} + \text{XMO\$} + \text{XAGRI\$} + \text{XO\$}$

$\text{MFUELQL} = -3.836850867 - 0.2364177522 * ((\text{MPIF} * (1 + (\text{FTARIFF}/100))) / (\text{PGDP} / (\text{ERR}/100))) + 0.885813814 * \text{LOG}(\text{GDP}) + 3.389889785e-05 * (\text{NFA}/\text{ER}) - 0.1973594579 * \text{DUM86}$
 $\text{MFUELQ} = \text{EXP}(\text{MFUELQL})$

$\text{MFUEL\$} = \text{MFUELQ} * (\text{MPIF}/100)$

$\text{MNFUEL\$L} = -28.64201221 - 26.59305966 * (\text{LOG}(\text{MPINF} * (1 + (\text{NFTARIFF}/100))) / ((\text{PGDP}/\text{ERR}) * 100)) + 2.889454197 * \text{LOG}(\text{GDP}) + 1.141978997e-05 * (\text{NFA}/\text{ER}) + 0.8260507201 * (-28.64201221 - 26.59305966 * (\text{LOG}(\text{MPINF}(-1) * (1 + (\text{NFTARIFF}(-1)/100))) / ((\text{PGDP}(-1)/\text{ERR}(-1)) * 100)) + 2.889454197 * \text{LOG}(\text{GDP}(-1)) + 1.141978997e-05 * (\text{NFA}(-1)/\text{ER}(-1)) - \text{MNFUEL\$L}(-1))$
 $\text{MNFUEL\$} = \text{EXP}(\text{MNFUEL\$L})$

$\text{MGDS\$} = \text{MFUEL\$} + \text{MNFUEL\$}$

$\text{PM\$L} = -1.130185335 + 1.241157804 * \text{LOG}((\text{MPIF} * (\text{MFUEL\$}/\text{MGDS\$})) + (\text{MPINF} * (\text{MNFUEL\$}/\text{MGDS\$}))) + 0.7753016959 * (-1.130185335 + 1.241157804 * \text{LOG}((\text{MPIF}(-1) * (\text{MFUEL\$}(-1)/\text{MGDS\$}(-1))) + (\text{MPINF}(-1) * (\text{MNFUEL\$}(-1)/\text{MGDS\$}(-1)))) - \text{PM\$L}(-1))$
 $\text{PM\$} = \text{EXP}(\text{PM\$L})$

$\text{XNFSV\$L} = -4.09907999 + 1.23414188 * \text{LOG}(\text{XGDS\$} + \text{MGDS\$}) - 0.363819711 * \text{D7980} + 0.5908310244 * \text{D8586} - 0.5391611893 * \text{DUM98}$
 $\text{XNFSV\$} = \text{EXP}(\text{XNFSV\$L})$

$\text{XSV\$} = \text{XNFSV\$} + \text{INVINC} + \text{INCREM}$

$\text{MNFSV\$L} = -3.086544735 + 1.096914374 * \text{LOG}(\text{MGDS\$} + \text{XGDS\$}) + 2.502576792e-05 * (\text{NFA}/\text{ER}) + 0.2685524243 * \text{DUM97} + 0.6585240246 * (-3.086544735 + 1.096914374 * \text{LOG}(\text{MGDS\$}(-1) + \text{XGDS\$}(-1)) + 2.502576792e-05 * (\text{NFA}(-1)/\text{ER}(-1)) + 0.2685524243 * \text{DUM97}(-1) - \text{MNFSV\$L}(-1))$
 $\text{MNFSV\$} = \text{EXP}(\text{MNFSV\$L})$

$\text{MSV\$} = \text{MNFSV\$} + \text{INVEXP} + \text{INCOUT}$

$\text{TRABAL} = \text{XGDS\$} - \text{MGDS\$} + \text{XSV\$} - \text{MSV\$}$
 $\text{CURBAL} = \text{TRABAL} + \text{ITRANS} - \text{OTRANS}$
 $\text{CAPBAL} = \text{ILTLON} - \text{OLTLON} + \text{NINDF} + \text{NSHTRM} + \text{COLLATERAL} + \text{TRBONDS} + \text{CHKNFA}$
 $\text{BOP} = \text{CURBAL} + \text{CAPBAL} + \text{MNGOLD} + \text{ALLSDR} + \text{UNREM} + \text{REVADJ} + \text{ERROR}$

$\text{CHGIR} = 208.5702663 + 0.8204828536 * \text{BOP} - 1921.501312 * \text{DUM85}$

$\text{GIR} = \text{GIR}(-1) + \text{CHGIR}$

$\text{ERDEP} = 22.7111467 - 0.155509355 * (\text{TBILL} - \text{INFL}) + 2.151470899 * (\text{LIBOR} - \text{USINFL}) - 2.864922537 * \text{LOG}(\text{GIR}) + 40.47869213 * \text{DUM70} + 34.93576418 * \text{DUM98}$

$@\text{TRACE ERDEP GIR CHGIR BOP CURBAL TRABAL XGDS\$ XSV\$ MGDS\$ MSV\$}$

$\text{ER} = (\text{ERDEP}/100 + 1) * \text{ER}(-1)$

$$\text{ERR} = (\text{ER}/18.6073)*100$$

$$\text{MALN} = -8.73320644 - 0.005623758619*\text{CPPC} + 75.32253385*(\text{PAGRI}/\text{PGDP}) - 8.021027458*\text{DUM84} + 4.758561234*\text{DUM91} - 6.278935518*\text{DUM95} + 5.689796301*\text{DUM98}$$

$$\text{PRTOT} = 126.1987591 + 2.75496772\text{e-}05*((\text{NGEXPED}/\text{POP})/(\text{PGDP}/100)) - 64.06871231*(\text{CPISV}/\text{CPI}) + 0.001392768486*\text{CPPC} - 3.220662489*\text{DUM89} + 3.418750983*\text{DUM97}$$

APPENDIX C

List of Reference

- Enders, Walter. *Applied Econometric Time Series*, 1995. Canada: John Wiley and Sons, Inc.
- Greene, William H. *Econometric Analysis 3rd edition*, 1997. New Jersey: Prentice-Hall Inc.
- Pindyck, Robert S. and Daniel L. Rubinfeld. *Econometric Models and Economic Forecasts 4th edition*, 1998. Singapore: McGraw-Hill Companies, Inc.
- Reyes, Celia M. and Winnie M. Constantino. *An Annual Macro-Social Model for the Philippines*. September 2000.