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A Review of Philippine Macroeconometric Models

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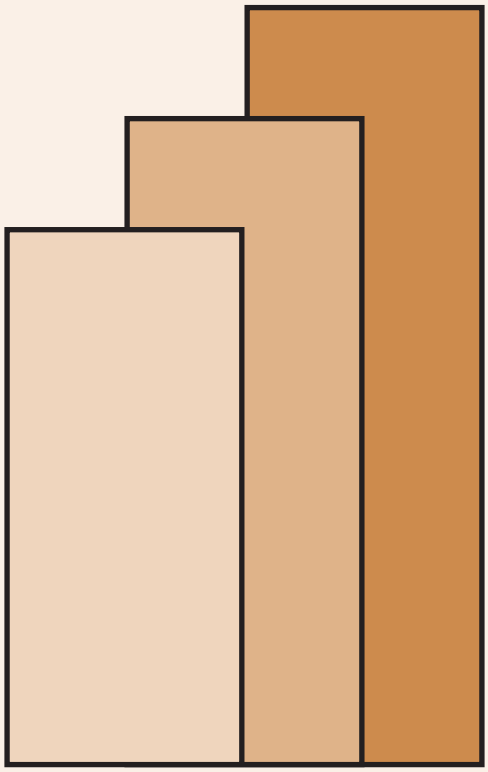

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Abstract. This scoping paper presents the current landscape of the Philippine macroeconometric models by first reviewing the inventory of earlier studies. It finds that there is a need for a new model for the Philippines considering only two models are actively being used for policy simulations.

Keywords: Macroeconometric model, Philippines, Error-Correction Model

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1. Introduction

The Philippine development plan 2016-2022 identified one of the strategies necessary to achieve the outcome of a responsible, strategic and supportive fiscal sector is the need for its macroeconomic policy-making bodies like the BSP or NEDA to pursue regional and international cooperation with the objective of boosting the aforementioned agencies' capability of conducting macroeconomic surveillance, analysis and policy simulations. This paper then contributes to this goal as it is the first step in the pursuit of establishing a new macroeconometric model for the Philippines. This scoping paper attempts to explore the present inventory of macroeconometric models in the Philippines. It serves as a precursor to the construction of a macroeconometric model for the Philippines done in partnership between the Philippine Institute for Development Studies (PIDS) and the Bangko Sentral ng Pilipinas (BSP). This project is an attempt to resolve the apparent lack of a single working macroeconometric model for the Philippine government.

This exploration begins in Section 2 with a review of the transition of macroeconometric models found in the literature from the Cowles Commission Approach down to the more recent Dynamic Stochastic General Equilibrium (DSGE) model following the comprehensive review by Yap (2002). His study distinguishes between macroeconometric models and CGE models – the two most common models existing in the Philippines.

Section 3, meanwhile, proceeds with an inventory of macroeconometric models in the Philippines as described by Yap (2002) in the period 1990-2002. In parallel, the pioneering works of Velasco (1980) and Bautista (1988) will be briefly discussed considering their contribution in reviews from models dating before 1990.

Section 4 enumerates and describes the current status of the macroeconometric models in the Philippines will be discussed in the period 2003-2017.

Finally, the scoping paper ends with ways forward through the PIDS-BSP Philippine macroeconometric model. This section is based heavily on the minutes of a meeting between the PIDS and the BSP held on November 29, 2017 discussing the modelling project that this scoping paper encompasses.

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2. Macroeconometric models in transition

The term macroeconomic model can be distinguished further into either macroeconometric models (MEMs) and computable general equilibrium (CGE) models. This distinction has been discussed by Yap (2002) wherein MEMs need not be economy-wide as is the case of VAR systems with only a few equations, and in the case of CGE models that will often touch on traditionally microeconomic territory through explicitly specifying household behaviour in the model.

This distinction is important as the focus of the PIDS-BSP project is the formulation of a macroeconometric model. Briefly, this section will present a timeline of the evolution of the formulation of macroeconometric models together with the criticisms given to each. Contained in this section are the Cowles Commission Approach, Cointegration Analysis, and the LSE approach. Furthermore, alternatives such as the Vector Autoregressive (VAR) models and the DSGE models are likewise included.

2.1 Cowles Commission approach and the Lucas critique

The Cowles Commission approach served to synthesize the existing information during the early stages of applied macroeconometrics associated with large-scale macroeconometric modelling or the "system-of-equations" approach. Its estimation emphasized the overcoming of the problem of simultaneity. Once overcome, these models shifted to its main purpose of conducting policy evaluation. This follows on the Keynesian perspective that the macroeconomy can be fine-tuned.

At the onset of the late 1960s to the early 1970s, the Cowles Commission approach has been met with several theoretical or statistical criticisms.. The former was borne from the theoretical soundness of Keynesian foundations being questioned under the apparent scepticism and disenchantment of economists. The inability of Keynesian macroeconomics to address economic problems at the time has led to concerns questioning its adequacy to address emerging problems such as with the simultaneous presence of high inflation and unemployment in the 1970s.

Following this period of high unemployment and high inflation, economists have raised concerns on the statistical soundness of the Keynesian approach. Another weakness pertains to the relatively lack of value added MEMs provide despite the volumes of data it needs to run. In the 1970s, studies have shown that simple statistical extrapolations often forecasted macroeconomic activity just as well as large-scale Keynesian macroeconomic models. For a comprehensive discussion of the Cowles Commission approach, see the account of Diebold (as cited in Yap, 2002).

In addition, there exists the Lucas critique famous for its argument that analyses based on decision rules is unsuitable for producing conditional forecasts. This stems from the parameters of decision rules being susceptible to policy regime changes, that is, an apparent inconsistency inherent to the model.

2.2 Improvements on MEMs borne from criticisms on the Cowles Commission approach

These criticisms on the Cowles Commission led to the strengthening or development of alternative approaches to macroeconometric models, and the modification of the traditional approach to constructing large-scale MEMs. Generally, these effects can be classified into three namely (1) the greater use of economic theory in model specification, (2) greater focus on long-run relationships, and (3) the inclusion of more rational expectations.

With these changes, MEMs started to share a number of important features focused on three basic building blocks discussed by Garrat and his colleagues (as cited in Yap, 2002) consisting of equilibrium conditions, expectations formation, and dynamic adjustments. These improvements have led to greater interest to the supply side of the model associated with the long-run properties of MEMs. Furthermore, a direct response to the Lucas critique was in the specification of expectations now separate from the model.

2.3 Cointegration analysis and the LSE approach

Alternatives beyond these improvements on the Cowles Commission approach can be found under the LSE approach. Its name was coined because of its association to the London School of Economics with the founder, Denis Sargan. Its criticism on the Cowles Commission approach was concentrated on the importance of statistical congruence of the specification over the determination of the most appropriate estimator. The LSE approach begins from the specification of a general statistical model or the data generating process. This is followed by adding restrictions on the econometric model.

Primarily, the LSE approach is better known for its introduction of an error correction mechanism (ECM) that proponents believe to be intuitively more appealing than that of the Cowles Commission approach. Theoretically, this is justified within a quadratic costs of adjustment framework and in capturing the idea that agents alter their behaviour based on indications of disequilibrium. Entering the picture is the development of cointegration analysis and the inclusion of an Engle-Granger two-step procedure that condenses the LSE approach to constructing a macroeconometric model. However, neither cointegration analysis nor ECM is monopolized by the LSE approach.

A variant of the LSE approach deals directly with systems of behavioural equations and accounts for the possibility of there being more than one cointegrating relationship among a set of three or more variables. This is done through specifying an unrestricted VAR system and with the use of the Johansen procedure to estimate all the possible cointegrating relationships. This procedure ends with a simplified VAR system called a vector error correction model (VECM).

2.4 Alternatives to traditional MEMs

While both the Cowles Commission approach and the LSE approach deals on traditional MEMs, alternatives through the VAR and the DSGE models exist. Introduced by Cristopher Sims, the VAR model is simply a multiple time series generalization that considers the identification of restrictions traditionally viewed as unrealistic. However, unlike the LSE approach, the VAR model actually questions the potential of traditional MEMs for policy simulation and evaluation. It is to be noted that a convergence between VAR models, cointegration analysis, and the LSE approach can be found in terms of their estimation methodology. For instance, when the problem of nonstationary arises the appropriate

response is to transform the VAR into a VECM representation using underlying cointegrating relations among the variables (Yap, 2002).

The DSGE model, on the other hand, refers to models of the real business cycle that employs the calibration approach. Its framework is with intertemporally optimized models applied to decision problems of households and firms. Thus, DSGE models estimate first the aggregate demand and supply functions in order to identify deep parameters of interest. These models can then be used to evaluate policies through the comparison of actual data to simulated data.

3. An inventory of macroeconometric models in the Philippines (1990-2002)

Preceding Yap's comprehensive review of MEMs in 2002, the pioneering works of Velasco (1980) and Bautista (1988) explored earlier studies before 1990. In particular, Velasco's work was used as part of the macroeconometric modelling project between PIDS and the National Economic and Development Authority (NEDA). Part of Velasco's recommendations included the agglomeration of individual strengths found in the different models existing at the time. For instance, the explicit consideration of the trade deficit and investment-savings gap and the determination of the required capital flows defined by these imbalances were identified.

Moreover, the need for a more disaggregated trade sector and a clear link between the trade and production was emphasized. Weak linkages between the financial and the real sector especially found in early BSP models' insufficiency to extensively describe the real sector was likewise raised. Notably, the early BSP models' focus was instead on linkages through investments.

Meanwhile, Bautista's (1988) analysis of the structure of different MEMs in the Philippines has led to him emphasizing various shortcomings in MEMs to the conclusion that CGE models can better compensate. Since this project is on the building of a macroeconometric model, further discussions on Bautista's analyses will no longer be pursued. Instead, it is enough to note that a more robust specification of the dynamic behaviour of MEMs and a more realistic treatment of expectations are among Bautista's recommendations.

3.1 The PIDS-NEDA annual model

The main objective of the PIDS-NEDA model was to provide a coordinated framework for the formulation of the medium-term development plan of the Philippines. It has been extensively used during the negotiations involving the country's external debt during the early years of the Aquino administration in the late 1980s. Moreover, it was also used to evaluate the impact of stabilization policies on the Philippine economy.

Later versions of the PIDS-NEDA model were structuralist although the expenditure sector was consistent to a Keynesian income-expenditure model. It takes into account supply bottlenecks acknowledged to affect certain sectors of the economy and allows for less than full employment equilibrium. This apparent recognition to the supply side of the model is an important characterization of developing economies.

At its core, the PIDS-NEDA model focuses on the real sector. This determines domestic output, its production and expenditure components, prices, employment, and wages. Gross Domestic Product (GDP) is determined by an interaction between production and

expenditure. The PIDS-NEDA model incorporates as well a separation among the fiscal, financial, and trade sectors. Government expenditure here is treated as exogenous. The financial sector determines money supply and interest rate with linkages better specified as compared to earlier MEMs. Varying degrees of disaggregation in the trade sector can be found.

The PIDS-NEDA model was considered to be a vast improvement over earlier MEMs. The major upgrades are on the explicit treatment of certain features of the Philippine economy and on strong linkages among various sectors. Nonetheless, it falls prey to criticisms under the Cowles Commission approach.

Providing a perspective to the use of the PIDS-NEDA model, an analysis of the impact of the external sector and of some economic policies on the Philippine economy for the period 1980-1986 was conducted by Constantino and Yap (1988). Here, the first scenario assumes an increase in manufactured exports equivalent while the money supply can either expand or contract depending on the net impact of a higher BOP surplus and of a lower budget deficit. Under this scenario, simulation exercises show that higher exports have the highest impact on GDP when the money supply and exchange rate is allowed to respond while imports are restricted. It has the lowest impact when imports and exchange rates are restricted while the money supply is allowed to respond.

The second scenario analyses the impact of changes in the world economic environment on the domestic economy. Simulations are done for cases assuming scenarios of growth in the world economy and increases in prices of traded primary commodities which are found to increase the price level that results in the reduction in the real value of government expenditures, and consequently, in GDP.

Following this, the third scenario assumes a 10% devaluation of the ER and simulation is done for cases with and without money supply response. Simulation results show an improvement in the budget deficit although the net decline in money supply has a simultaneous negative effect on the price level.

Finally, the fourth scenario assumes that the government provides a subsidy to exporters and simulations are done assuming an increase in tariff rates, reduction in the volume of manufactured imports, and reduction in manufactured imports. Simulation results indicate an increase in GDP and a deterioration in the budget deficit.

3.2 The NEDA Quarterly Macroeconometric Model (NEDA-QMM)

Under the guidance of Peter Pauly of the University of Toronto, the NEDA-QMM gave a fresh perspective to modelling approaches in the Philippine economy. It was borne from the interagency efforts of different government agencies with each one responsible for a particular block. For instance, the BSP specified and estimated the monetary block of the QMM.

The NEDA-QMM's key feature is in the use of the Engle-Granger two-step procedure similar to that of the LSE approach. By applying this methodology, the NEDA-QMM was able to distinguish between the short- and long-run behaviour of the model. The long-run values should converge to the levels dictated by the cointegrating relationship. However, Yap (2002)

cautions that this relationship is derived from empirical data and is not necessarily consistent with relationships obtained from optimizing models.

Despite the NEDA-QMM being a quarterly model, it remains similar still to the PIDS-NEDA model in that the real sector is at its core; and thus, prone to the similar criticism to the PIDS-NEDA model. For instance, Yap (2002) notices that private consumption is disaggregated into food and non-food albeit this does not provide a meaningful link between food consumption and agricultural production. Also, the production sector is not disaggregated into the different components of agriculture and industry, and value added in industry and services are affected by GDP instead of specific expenditure components. Yap adds that using such a model specification greatly weakens the feedback from the expenditure side to the production side since GDP is built up from the production sector.

3.3 The Ateneo Macroeconomic Forecasting Model (AMFM)

The AMFM, developed by Rodriguez and Briones (2002), is a multi-equation macroeconometric model that utilizes quarterly data. It is comprised by 13 stochastic equations and 53 identities. Its basis is largely attributed to the Murphy model of Australia.

Similar to the PIDS-NEDA and NEDA-QMM, the AMFM has the real sector at its core with distinctions on production and expenditure. Unlike the NEDA models, output in the AMFM is determined from the expenditure side instead. Interestingly, the production sector follows a two-stage process wherein price levels adjust to equate total expenditure with total production.

The first stage attempts to represent the optimizing behaviour observed on firms following profit maximization. The values derived therein are considered as equilibrium. In the second stage, a series of equations are used to depict the adjustment of economic variables to equilibrium. Yap (2002) notices that this largely resembles an ECM albeit the authors of the AMFM did not explicitly mention this. Moreover, Yap cautions as well that the authors of the AMFM did not test whether the differences between the actual and equilibrium values are stationary. This poses a problem since as a nonstationary series it would imply that either the theoretical model, or the assumed functional forms, or both are inappropriate descriptions of the Philippine economy.

Another criticism by Yap is that the AMFM specifies forward-looking inflationary expectations; thus, it could potentially make it difficult to achieve convergence in the process of obtaining model consistent inflationary expectations – a problem shared with the NEDA-QMM. Also, the absence of a link among the fiscal deficit, the BOP account, and the real sector limits the feedback mechanisms in the AMFM. This deficiency would lead to impaired ability to have adequate policy evaluation results.

4. Current status and inventory update of macroeconometric models in the Philippines (2003-2017)

Considering that the comprehensive review of Yap (2002) is more than a decade old, it would be interesting to know the current landscape of MEMs in the Philippines. Aside from the aforementioned MEMs, this section will discuss current MEMs in the Philippines and provide information on its current status.

Beginning with the earliest MEM identified in Section 3, the PIDS-NEDA model is currently no longer in use (PIDS-BSP, 2017). The latest version can be found in the study by Reyes and Yap in 1993 (as cited in Yap, 2002). The reason of its cessation is attributed to the transfer of personnel that handled it in PIDS. As such, this is a point of concern that should be addressed in order to ensure the continuity of succeeding models.

The status of the NEDA-QMM is currently unknown although it is also likely that it has ceased given that the latest study identifying the use of the NEDA-QMM can be found in Bautista, Mariano, and Bawagan's study in 2009. The AMFM, on the other hand, is currently active albeit privately owned by the Ateneo de Manila University (ADMU). It is actively being used through the economic briefings under the Ateneo Eagle Watch – a key initiative by the Ateneo Center for Economic Research and Development (ACERD). Based on the official ADMU website (eaglewatch.ateneo.edu), the last briefing was held in January 1, 2017 at the Ateneo Graduate School of Business.

While only the AMFM is confirmed to still function, there are other MEMs that have been developed recently. These would include the Asian Development Bank's (ADB) quarterly macroeconometric model of the Philippines (Ducanes et al, 2005), and the BSP's DSGE model (McNelis et al, 2010).

In the ADB model, the MEM is designed to provide economic forecasts and policy simulations for various member economies. In the Philippine version, it is composed of eight blocks namely private consumption, government, trade, production, prices, monetary, and labour sectors. The government block was specifically designed to allow simulating the impact of various policies on government debt. Moreover, it contains 48 behavioural and technical equations, 17 identities, and 81 variables. The behavioural equations here are framed as ECMs and were estimated using ordinary least squares (OLS). The status of the use of the ADB model is currently unknown with just the Ducanes study in 2005 being its sole citation.

On the other hand, the BSP's DSGE model acts as a complement to existing models used by the BSP for policy simulation. It is to be clarified though that not all models used by the BSP are MEMs as some of these are used to address specific needs concerning monetary policies. The BSP's DSGE model is a small open economy model with habit persistence, staggered pricing in home goods production, flexible wage adjustment cost to investment, and financial frictions. While the BSP's DSGE model is a sound MEM, it lacks further detail on the real sector albeit a comprehensive representation of the monetary sector. Several BSP models including the DSGE model cited are currently in use (PIDS-BSP, 2017).

Based on the above discussion, there are currently two MEMs in active use namely the AMFM and the BSP's DSGE model whereas there are two MEMs in unknown status particularly the NEDA-QMM and the ADB model of the Philippine economy. Shown in Table 4.1 below is a summary of the models cited in this study together with the years it was first and last used, the most recent version citing it, its status as of December 2017, and the institution responsible for maintaining the model. Notwithstanding, this scoping paper is by no means encompassing comprehensive study but is rather a more purposive review of Philippine MEMs. There are notably other MEMs that exists in the Philippines albeit having more limited uses (see Yap, 2002 for other MEMs not included in this study). Consequently, Table 4.1 no longer includes earlier MEMs surveyed by Velasco (1980).

Table 4.1 Summary of Philippine macroeconometric models

Summary of Philippine Macroeconometric Models					
Model	Version Cited in Literature		Most Recent Citation	Status (as of Dec 2017)	Responsible Institution
	Earliest	Latest			
PIDS-NEDA Model	1986[a]	1993[b]	Ducanes et al, 2005	Inactive	PIDS, NEDA
NEDA-QMM	1996[c]	2009[d]	Bautista, Mariano, & Bawagan, 2009	Unknown	NEDA
AMFM	2002[e]	2002	Ducanes et al, 2005	Active	ADMU
ADB Model	2005[f]	2005		Unknown	ADB
BSP's DSGE Model	2010[g]	2010	McNelis et al, 2010	Active	BSP

[a] Constantino et al, 1989
[b] Reyes & Yap, 1993 (as cited in Yap, 2002)
[c] Yap, 2002
[d] Bautista, Mariano, & Bawagan, 2009
[e] Rodriguez & Briones, 2002
[f] Ducanes et al, 2005
[g] McNelis et al, 2010

5. The PIDS-BSP Philippine macroeconometric model

The meeting between the PIDS and the BSP on November 29, 2017 concerning the conduct of the PIDS-BSP Philippine macroeconometric model project has led to the identification of potential points of interest and the division of tasks. As was the case with the NEDA-QMM, the BSP was assigned to handle the monetary sector whereas the PIDS will be responsible for the real, trade, and fiscal sectors. Particular sectors of interest would include a more detailed understanding of the BPO sector, an important facet of the Philippine economy.

In summary, the project will begin with the identification of available data that can be used to build an annual time-series dataset for the estimation of the Philippine macroeconometric model. Regular meetings between the PIDS and the BSP have been set for 2018. Following this timeline, the model is scheduled to be run for testing at the latter part of 2018. Since the project is still at its early stages, several important information for the estimation of the MEM is still ongoing; thus, the information found here is accurate only in reference to the November 29 meeting.

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