5

Signal Extraction from the Components of the Philippine National Accounts Statistics Using ARIMA Model-Based Methodology[1]

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The set of macroeconomic variables comprising the country's national accounts statistics is one of the most eagerly monitored databases anywhere. Economists, financial analysts, and other social scientists keenly watch the movements of the components of the gross domestic product (GDP) to make their prognostications on the health of the economy over time. Economic growth is frequently equated to sustained upward movements of the real gross domestic product and its main component parts while spells of stagnation, even recessions, have been indicated by down-trending movements of the real aggregate GDP and most of its various components. Accurately anticipating the future magnitudes and directions of these macroeconomic variables, as well as deriving from them relevant predictive signals, has become a major requisite of effective fiscal and development planning.

Forecasting macroeconomic variables is one of the most fruitful applications of time series econometrics. In the light of the ever-improving coordination among data monitoring and collecting agencies, reliable and timely statistics of varying periodicities have become more readily available to researchers than ever before. This development, coupled with the widespread availability of cheaper yet powerful computational devices, and the advances in information technology have been narrowing the gap between the theory and practice of economic forecasting. As the state-of-the-art time series econometrics rapidly unfolds, analysts can now effectively extract additional predictive information from available sub-annual macro variables, creating more value to the forecasting task. This study is an attempt to apply the current modeling technology (which is now standard in most Western countries) to the different components of the country's gross domestic product and other quarterly national accounts statistics. The goal is to ascertain the plausibility of adopting a leading edge, model-based forecasting and signal extraction methodology in isolating unobserved signals from the available series that may be of utmost interest to a wide variety of analysts and planners.

The ARIMA Model-Based Signal Extraction from Univariate Series

The observed realization of a time series variable has been thought to consist of unobserved but intuitively appealing components (which in this study are collectively referred to as signals) such as secular trend (τ_t), cyclical fluctuations (C_t), seasonal variations (S_t), and irregular variations or noise (ε_t). Secular trend represents the upward or downward movement of the data over a long period of time, generally associated with the underlying structural causes of the phenomenon. Seasonal variations represent the pattern of changes in the data that completes itself within a calendar year, which are mainly the effects of climatic and institutional events that repeat more or less regularly every year. Cyclical fluctuations (popularly called business cycle) are characterized by upward and downward change in the data pattern that occurs over the duration of 2 to 10 years or longer mainly due to fluctuations in economic activity. Finally, the noise is the erratic movements of the data that have no predictable pattern.

The conventional practice in applied time series analysis relies heavily on the use of moving average filters in extracting these unobserved signals from macro variables. Some of the most popular techniques are the classical (multiplicative or additive) decomposition (in isolating τ_t, C_t, and S_t), the Census X-11 method of seasonal adjustment, and the Hodrick-Prescott filter of extracting the business cycle (Hodrick & Prescott, 1997). However, over time the application of these mathematically elegant but basically ad-hoc filtering methodologies, manifested various limitations, most of which stem from the fixed nature of the signals wherein underestimations or overestimations are likely to occur.

An alternative approach was suggested by Cleveland and Tiao (1976) and Burman (1980), whereby filtering is accomplished by a statistical model called autoregressive integrated moving average (ARIMA), introduced earlier by Box and Jenkins (1970). The approach known as the ARIMA model–based (AMB) technique consists of a two-pronged strategy: first, an appropriate ARIMA model is fitted to the observed time series, and second, signal extraction techniques are employed to isolate the unobserved components of the series with filters that are, in certain well-defined ways, optimal.

Among the different AMB methodologies that achieved widespread use is the signal extraction in ARIMA time series (SEATS) developed by Bank of Spain mathematicians Gomez and Maravall (1996). Signal extraction by SEATS presupposes the prior cleansing of the raw data and the development of a highly desirable ARIMA model of the pre-treated data. Cleansing requires corrections or adjustments to account for certain factors that distort the inherent patterns of the data. These factors are classified into three categories: outliers (additive outliers, level shifters, and transitory changes), calendar effects (i.e., trading day, Easter effect, leap year effect, and holidays), and intervention variables (i.e., strikes, devaluations, natural disasters, political events, etc.).

Data cleansing and the development of the optimal ARIMA model are accomplished by the companion program to SEATS called time series regression with ARIMA noise, missing observations and outliers (TRAMO). The two programs are traditionally considered as just one expert system known worldwide as TRAMO-SEATS.

TRAMO-SEATS can efficiently handle, in an automatic manner, applications to a single series or thousands of series making it extremely suitable for production use by data monitoring and producing agencies, policy-making institutions, private think-tank groups, and business firms. Its most widespread use is in seasonal adjustment. These two programs are virtually fused, with the latest version residing within TRAMO-SEATS for Windows (TSW), a Windows interface also developed at the Bank of Spain (Caporello & Maravall, 2004; 2010). The objective of TSW is to estimate a seasonal ARIMA model and to decompose it into additive signal components; estimation is done by TRAMO and decomposition, by SEATS.

Literature Review

The Evolution of the AMB Signal Extraction Approach

Although the traditional approach to model the unobserved components of time series variables has been generally attributed to Macaulay (1931), the practice of mathematically isolating predictive parts of historical data originated further back in history during the early part of the last century. It was noted that observed time series appeared to be coming from unobserved manifestations coinciding with well-recognized events (Bell & Hillmer, 1992), and, ever since, the idea has stuck. Early researchers concentrated on removing the trend and seasonal differentials from annual data (mostly production figures and prices) by averaging over several years or by freehand fitting of mathematical equations. Anderson (1914) introduced the fitting of linear and higher order polynomials to eliminate the trend component, thereby ushering in the era of "trend analysis." During the same period, Henderson (1916) and Flux (1921) were active in trying to forecast the stages of the economic cycle by removing both the trend (via trend analysis) and seasonality (via averaging) from economic data to derive residual series that was seen to contain indications of cyclical changes. What appeared to be lacking during the era was a unified procedure or model that would link the various techniques of extracting these unobserved components.

A flurry of research activities was noted during the 1920s and the 1930s, precipitated by the work of Persons (1919) in the area of seasonal adjustment. His method, called the "link relative method," specifies an algebraic representation of a time series as a product of its (unobserved) component parts that is:

$$X_t = S_t T_t C_t R_t$$

where S_t is the *seasonal component*, T_t is the *trend component*, C_t is the *cyclical component*, and R_t is the *random component* of time series X_t observed at time *t*. The link relative method employs simple transformations to isolate T_t and S_t via averaging and the judicious use of running medians. The end products of applying the method are the fixed estimates of the four components of the series.

The Classical Decomposition Method

Macaulay (1931) improved on the link relative method by employing both the curve fitting technique of Anderson (1914) in isolating the trend and an innovative approach called the ratio-to-moving average method in extracting the other components of the time series. The system proposed by Macaulay came to be known as the "Classical Decomposition Methodology," which is still being used extensively today by "traditionalists." The Macaulay approach also laid the groundwork for many modern signal extraction systems including the extremely popular Census X-11 (Shiskin & Eisenpress, 1958) and its successor, Census X-12 (Shiskin, Young, & Musgrave, 1967).

After the introduction of the Macaulay method, two major developments occurred in the early 1950s. The first was the emergence of a wide array of exponential smoothing techniques, which greatly simplified the rigorously repetitive computations and, in addition, produced estimates with remarkable forecasting performance. The second development was the introduction of computers, thereby facilitating the forecasting and signal extraction tasks using the techniques of the era (Shiskin & Eisenpress, 1958). This development also allowed researchers to develop even more intricate techniques, spearheaded by the Census I method (1954), which formalized the Macaulay (1931) ratio-to-moving average method into a computer amenable form with substantial enhancements. The Census I method was later modified to produce a more complex Census II method (1955). Both systems were developed by the U.S. Bureau of Census with technical help and funding from the National Bureau of Economic Research (NBER) (Shiskin & Eisenpress, 1958).

Critical reviews of the Census II method revealed areas for improvement, which, eventually, led to a sequence of progressively more sophisticated variants of the technique, presently referred to as the Census X-3 to Census X-10 methods. The high watermark level of these methods was reached in 1965 when the Census X-11 method was introduced, which to this day remains to be one of the most widely used seasonal adjustment programs worldwide. This modification of Census II also retained the use of the ratio-to-moving average procedure introduced by Macaulay (1931) and incorporated enhancements which included 1) adjustments for trading day and other outliers, 2) the use of efficient ad hoc filters, and 3) improved model options and output generation. The ad hoc filters cleanse or adjust the series from the variance that falls in a certain band around the frequencies, which are regarded as noise. After its introduction in 1965, many statistical agencies around the world adopted the technique and soon became a mainstay tool in various econometric software.

The Model-Based Approach to Signal Extraction

The modern approach to time series analysis can be traced back to Yule (1927), who introduced the autoregressive models, and to Slutsky (1937), who proposed the moving average models. Wold (1938) started the application of these models to actual data and also described the mixed autoregressive moving average (ARMA) models. The application of the ARMA family of models was limited to a special type of time series data called stationary series, which are not commonly encountered in practice. Furthermore, the computational aspect of estimating and diagnosing such models was enormously tedious using the facilities of the era. Hence, prior to the introduction of the computer, large-scale application of such models was simply not feasible. These difficulties put major stumbling blocks for data-producing agencies and researchers to use the ARMA modeling technology in the area of routine signal extraction and forecasting in their ever growing time series archives.

Following the publication of the work of Box and Jenkins (1970) on autoregressive integrated moving average (ARIMA) models of non-stationary time series, a new modification of Census X-11 method called X-11 ARIMA emerged. This variation of the X-11 method was developed by Statistics Canada (Dagum, 1975, 1978, 1980), beating the U.S. Bureau of Census in launching a true model-based technique in the spirit of Cleveland and Tiao (1976) and Burman (1980). The introduction of X-11 ARIMA offered an attractive alternative to the ad hoc filtering methods (which characterized the traditional approach) of signal extraction and forecasting, not only because of its intuitive appeal but also due to its sound statistical underpinnings.

Model-based approach to signal extraction provides a sound basis for statistical inference to be made on the non-observable components of the time series, allowing analysts to make appropriate diagnosis of the results. Properties of the estimates can be assessed and standard errors, as well as confidence intervals of the extracted signals, can be properly established to reflect the inaccuracies with which these components are estimated. The necessity for measuring the precision of these estimates has been emphasized by experts for a long time (Bach et al., 1976; Moore, Box, Kaltz, Stephenson, & Zellner, 1981).

The success of the X-11 ARIMA and that of the model-based technology provided a strong impetus to the U.S. Bureau of Census to come up with an AMB enhancement to the X-11 Census method. This resulted in the emergence of the X-12 ARIMA, which employed the basic X-11 ARIMA procedure but with certain alterations like 1) the implementation of the sliding span diagnostics for improved model-selection, 2) the ability to efficiently process many series at once, and 3) a revolutionary routine that handles data pretreatment (to cleanse the data) prior to signal extraction. This pretreatment routine has come to be known as the regression models with ARIMA noise (RegARIMA) procedure, which is designed to estimate calendar effects, extreme values, and different forms of outliers via built-in or user-defined regressors. Estimation is undertaken by the exact maximum likelihood technique (Findley, Monsell, Bell, Otto, & Chen, 1998).

Experimental versions of the X-12 ARIMA called X-13A-S and X-13A-T, which are fusions of the X-12 ARIMA and SEATS, and X-12-ARIMA and TRAMO, respectively, are currently being developed at the U.S. Bureau of Census in cooperation with the Bank of Spain and NBER (Findley, 2005).

The introduction of the model-based signal extraction system (particularly the AMB system) was received enthusiastically by the international research community and statistical data agencies, especially after Gomez and Bengoechea (2000), Findley et al. (1998), Depoutot and Planas (1998), Hillmer and Tiao (1982), and Kuiper (1978) confirmed the relative superiority of model-based approach over the traditional approach.

The widespread adoption of the AMB methodology encouraged model developers to come up with a wide range of alternative AMB systems to the standard X-12 ARIMA. These systems include the following: X-11 ARIMA/88 and X-11 ARIMA/2000 by Statistics Canada (Dagum, 1988), X-12 ARIMA UK Version (Thorp, 2003), TRAMO-SEATS by the Bank of Spain (Gomez & Maravall, 1996), STAMP (Koopman, Harvey, Doornik, & Shephard, 2000) by the Bank of England, DEMETRA by Eurostat (Eurostat, 2002), SEASABS by Statistics Australia (McLaren, McCaskill, & Zhang, 2006), DAINTIES by the European Commission (Fok, Franses, & Paap, 2005), SABL by Bell Laboratories (Cleveland, Dunn, & Terpenning, 1978), and BV4 by the Federal Statistical Office of Germany (Cieplik, 2006; Speth, 2006). Currently, the list of countries that use the X-12 ARIMA include the United States, United Kingdom, Canada, New Zealand, Japan, Israel, Argentina, and other industrialized countries.

Among the current crop of model-based systems, the twin models developed at the Bank of Spain named TRAMO-SEATS have been receiving good reviews (Fok et al., 2005; Pollock, 2002; Hood, 2002; Maravall & Gomez, 2001; Gomez & Bengoechea, 2000; Hood, Ashley, & Findley, 2000; Albert, 2002; Monsell, Aston, & Koopsman 2003; Scott, Tiller, & Chow 2007; McDonald-Johnson, Hood, Monsell, & Li, 2008) and have an excellent capability of implementing automatic simultaneous modeling of and signal extraction from hundreds or even thousands of time series. The goal is to implement a model-based procedure of seasonal adjustment and trend extraction that requires little intervention on the part of the user. TRAMO cleanses the data then identifies and estimates the appropriate seasonal ARIMA model for each time series as a prelude to signal extraction by SEATS via optimal filters like the Weiner-Kolmogorov and Kalman filters.

In many ways, TRAMO presents similarities with the pre-treatment RegARIMA program of X-12 ARIMA, particularly on the automatic modeling aspect. Current research undertakings involve the fusing of the X-12 ARIMA with TRAMO and/or SEATS to take advantage of the good features of the programs such as that of Monsell et al. (2003) and Hood

(2002). The TRAMO-SEATS procedure is currently being used extensively by Eurostat for routine seasonal adjustments of thousands of time series produced by the different European Union countries (Eurostat, 2009).

Seasonal Adjustment of Philippine Time Series

In the Philippines, the current official methodology adopted by the National Statistical Coordination Board (NSCB) is the X-11 ARIMA method (Bersales, 2010). The version of X-11 ARIMA employed by NSCB for production use is the X-11 ARIMA 2000 developed by Statistics Canada, mainly for routine seasonal adjustment tasks. The computation of seasonally adjusted time series in the Philippine statistical system commenced in 1992 under the technical assistance of Asian Development Bank, with Dr. Estela Bee Dagum of Statistics Canada as one of the consultants (National Statistical Coordination Board, 2005).

The first seasonally adjusted national accounts (SANA) were released in 1994, with the first quarter of 1988 as starting point. The SANA is now being published concurrently with the regular quarterly system of national accounts (SNA). The national accounts series being seasonally adjusted and published are gross national product (GNP); the agriculture, fishery and forestry (AFF) sector; the industry sector; the services sector; and the gross domestic product (GDP)—aggregation of major sectors and personal consumption expenditure (PCE) as per the Technical Working Group on Seasonal Adjustment of Philippine Time Series (2007).

In 2002, Albert (2002) explored the viability of applying X12 ARIMA and TRAMO-SEATS methods to some Philippine time series data. The study sought to consider, on the grounds of some empirical criteria, which procedure should be preferred for routine seasonal adjustment of Philippine time series. The conclusion was clear: "for the domain of Philippine time series studies, TRAMO-SEATS is recommended" (Albert, 2002).

The current study may also be considered as an attempt to provide additional empirical basis for the recommendation of the Albert (2002) study on the judiciousness of the use of TRAMO-SEATS for routine large-scale seasonal adjustment, forecasting, and signal extraction involving the hundreds of time series being produced and maintained by the Philippine Statistical System.

Modeling Framework

Under the ARIMA model–based approach, each of the quarterly national accounts time series will be depicted as being generated by a stochastic process driven by a host of deterministic factors and a seasonal autoregressive integrated moving average (SARIMA)–type noise element. These factors, known as intervention variables, are mainly classified into three categories: 1) trading day (TD) effects caused by the different distribution of weekdays in different months and captured by the number of trading days of the month; 2) the Easter effect (EE), which captures the moving dates of Easter in different years; and 3) outliers, events that happen on certain months capable of shifting levels or directions of the time series. Outliers are further categorized into three different types: additive outliers (AO), transitory change (TC) outliers, and level shift (LS) outliers. AOs are events that cause one-time spikes in the series, and TC outliers create transitory changes, while LS outliers are shocks with permanent effects.

Symbolically, if Y_{it} is the observed value of the *i*th national account variable during quarter *t* and D_{sjit} is a dummy variable that indicates the position of the *s*th event of the category *j*th outlier (i.e., AO, TC, and LS for the *i*th country during time *t* and TD_t is the number of trading days in month t and $D_{EEt} = 1$ if Easter occurs during time *t*; 0 otherwise), the model can be specified as follows:

$$Y_{it} = \varphi_i + \psi_{TDt} TD_t + \psi_{EEt} D_{EEt} + \sum_{j=AO}^{LS} \sum_{s=1}^{n_j} \psi_{sjit} D_{sjit} + X_{it} \qquad (1)$$

for the *i*th national account component during time *t*. The parameter ψ_{sjit} is the effect of the *s*th event of the *j*th outlier type on the series during time *t* and X_{it} is a stochastic noise element (random error) that follows an $ARIMA(p,d,q)(P,D,Q)_{12}$ process for each country over time. Algebraically, the noise X_{it} is represented in lag polynomial form as

$$\phi_p(L)\Phi_P(L)\delta(L)X_{it} = \theta_q(L)\Theta_D \varepsilon_{it} \qquad (2)$$

where ε_{it} is a white noise innovation (i.e., independently and identically distributed [i.i.d.] with mean zero and constant variance) and $\phi_p(L), \Phi_P(L), \theta_q(L)$, and $\Theta_Q(L)$ are finite lag polynomials in L (lag notation with the property $L^n y_t = y_{t-n}$). The first two contain, respectively, the p stationary regular AR roots and the P seasonal AR roots of X_{it}. The last two are, respectively, the q invertible regular MA roots and Q seasonal MA roots of X_{it}. Algebraically, these lag polynomials are specified as

$\phi_p(L) = 1 - \phi_1 L - \phi_2 L^2 - \ldots - \phi_p L^p$ $\rightarrow$ regular autoregressive lag polynomial

$\Phi_P(L) = 1 - \Phi_1 L^s - \Phi_2 L^{2s} - \ldots - \Phi_P L^{Ps}$ $\rightarrow$ seasonal autoregressive lag polynomial

$\theta_q(L) = 1 + \theta_1 L + \theta_2 L^2 + ... + \theta_q L^q$ $\rightarrow$ regular moving average lag polynomial

$\Phi_Q(L) = 1 + \Phi_1 L^s + \Phi_2 L^{2s} + ... + \Phi_Q L^{Qs}$ $\rightarrow$ seasonal moving average lag polynomial

The lag polynomial $\delta(L) = (1-L)^d (1-L^s)^D = \nabla^d \nabla_s^D$ contains the d regular and the D seasonal unit roots of the noise component X_{it}. In this study, s = 4 since the data used of quarterly frequency.

Summary of the Estimation and Inference Procedures

The standard method implemented by the different well-known signal extraction software calls for the pre-adjustment of the series prior to signal extraction (i.e., the RegARIMA component of Census X-12 and the TRAMO component of TRAMO-SEATS implement this initial step). This procedure is necessary to establish the estimated models (1) and (2) for each national accounts variable and its stochastic noise element, respectively. In this study, the twin programs TRAMO-SEATS will be used in implementing all computational aspects.

The pre-adjustment procedure (TRAMO) assumes initially that the noise follows the parsimonious default model known as the airline model ($ARIMA(0,1,1)(0,1,1)_s$), where s is the frequency of the series (s = 12 for monthly and s = 4 for quarterly). The airline model is well suited for a large number of real-world time series (Box & Jenkins, 1970) and has become the benchmark model in modern time series analysis.

The airline model is initially applied to the series and then pre-tested for the log-level specification using the Schwarz information criterion (SIC), sometimes referred to as the Bayesian information criterion (BIC) as basis of choice. Once the decision to use either the level or log transformed version of the series is reached, regressions are then run for the residuals of the default model to test for the trading day (TD) and Easter (EE) effects, after which an iterative procedure is implemented to identify the various outliers. This procedure iterates between the following two stages: 1) outlier detection and correction and 2) identification of an improved model. To maintain the model's parsimony, model identification is confined within the following integral ranges: $0 \leq p, q \leq 3$ and $0 \leq P, Q \leq 2$ for the regular/seasonal autoregressive/moving average orders and $0 \leq d \leq 2$ and $0 \leq D \leq 1$ for the number of regular and seasonal unit roots, respectively. Pre-testing for the presence of deterministic mean μ_i of X_{it} is also embedded in the procedure, where, in case the mean is significant, the X_{it} in (1) and (2) is replaced by its demeaned value $x_{it} = X_{it} - \mu_i$.

Aside from testing the statistical adequacy of the parameters, the following diagnostic procedures will be implemented to handle the goodness-of-fit assessment of the alternative models for each series: 1) the Ljung-Box (Q) test for residual autocorrelation, 2) the Jarque-Bera (JB) test for normality of residuals, 3) the SK and Kur *t*-tests for skewness and kurtosis of the residuals, 4) the Pierce (QS) test of residual seasonality, 5) the McLeod and Li (Q2) test of residual linearity, and 6) the Runs *t*-test for residuals randomness. The exact maximum likelihood estimation (EML) procedure via Kalman filtering is used in parameter estimation and inference. The Hannan-Rissanen (H-R) method is used to get starting values for likelihood evaluation (Gomez & Maravall, 1996).

The general Box–Jenkins iterative methodology is followed in modeling the noise element of each quarterly national accounts series. For each series, the iteration will go on until the best noise model is established for use in coming up with a linearized series from which signals are to be extracted. This resulting series has been adjusted for the influence of the calendar factors and outliers as well as the impact of missing observations, if there are any. In the TRAMO-SEATS system, the signal extraction procedure is accomplished by the program SEATS.

SEATS was originally devised for seasonal adjustment of economic time series (i.e., removal of the seasonal signal) and the basic references are Cleveland and Tiao (1976); Box, Hillmer, & Tiao (1978); Burman (1980); Hillmer and Tiao (1982); and Bell and Hillmer (1984). Eventually, the program evolved into a full signal extraction system that decomposes a series that follows model (2) into several components. The decomposition can be multiplicative or additive, but since the former becomes the latter by taking logs, the additive model of decomposition provides a more universal way of presenting how the components are resolved. The components that SEATS considers are

x_{pt} = the TREND component,
x_{st} = the SEASONAL component,
x_{ct} = the CYCLICAL component, and
x_{ut} = the IRREGULAR component.

If the pre-adjusted log-linearized series is x_t, then $x_t = x_{pt} + x_{st} + x_{ct} + x_{ut}$. The SEATS program estimates these components via the Wiener–Kolmogorov filter (Gomez & Maravall, 1996). Both the

TRAMO and SEATS programs can handle routine applications for a large number of series and provide a complete model-based solution to the problems of forecasting, interpolation, and signal extraction for non-stationary time series. The flowchart of the process is exhibited in Figure 1.

Application of the Modeling Framework

The interest of the study centers on a large-scale application of TRAMO-SEATS to the various quarterly national accounts components of the Philippine Statistical System spanning the period from the first quarter of 1981 to the fourth quarter of 2010 (some of the series started only in the first quarter of 1991). A total of 194 quarterly time series data are the subject matter variables in the study. The complete list is presented together with their respective descriptive statistics in Appendix A. Because of the sheer size of the database, the automatic modeling capability of the program is heavily exploited in this study.

The first part of the program (TRAMO) estimates the possible outliers and calendar effects, which are treated as deterministic factors and, hence, decomposes the observed series Y_{it} into a deterministic portion and a stochastic component. The first four terms of the right-hand side (RHS) of model (1) add up to the deterministic element of the series and are referred to as the "pre-adjustment" component, and once it is removed from Y_{it}, an estimate of the stochastic part X_{it} is obtained. This stochastic component (called the noise) is assumed to be the output of a stochastic process specified by model (2) and is also referred to as the "linearized series" (Gomez & Maravall, 1996).

In the second part of the program (which is the SEATS), the ARIMA model–based (AMB) methodology is used to estimate the unobserved stochastic components (i.e., x_{pt}, x_{st}, x_{ct}, and x_{ut}) in the "linearized" series of X_{it} generated by TRAMO. Among these components, the seasonal (x_{st}) and the secular trend (x_{pt}) constitute the two most important signals to economists and policy makers, although, in recent times, substantial interests are generated by the cyclical component x_{ct}. If the program determines that the identified model in the TRAMO portion is deemed unacceptable by the signal extraction criteria of SEATS, an appropriate modification of the model will be implemented.

Results and Analysis

After establishing the input parameters needed by the TRAMO-SEATS system, the two programs are set in production (i.e., automatic modeling) mode and run using Intel i3 4GB RAM notebook computer. The TSW (TRAMO-SEATS for Windows) Version Beta 1.0.4 Rev 177 (June 2010) implemented the system. Total execution time is about 30 seconds. A sequence of matrices, graphs, and output series generated from which the results are derived. This Windows interface of the expert system can be implemented using minimal analyst intervention as it is suitable to handle up to 10,000 sub-annual (quarterly and monthly) time series variables. The number of observations the software can handle is limited by the memory of the PC hardware used. As with any ARIMA modeling exercise, application of the procedure requires at least 50 data points for each univariate series in order to turn out robust results. The system also has an optimal procedure to handle/interpolate missing observations, which is not used in the current study due to lack of missing observations.

TRAMO Analysis

When automatic model identification (AMI) mode is activated, all of the 194 quarterly series are simultaneously modeled using the procedure described earlier. Under this mode of operation, the most important output is the eight-worksheet matrix called "Out Matrix" for TRAMO analysis and the companion three-worksheet matrix for SEATS analysis. For the TRAMO portion of the results, the primary worksheet is presented in Appendix B detailing the modeling results for all of the 194 national accounts series. It exhibits the empirical noise model identified automatically by TRAMO for each series and the results of the various diagnostic tests performed to assess the statistical and econometric adequacy of the models. Out of the information presented in the worksheet, a series of summary tables (Tables 1 to 4) were created to highlight the overall results of the modeling process.

It can be seen in Table 1 that close to 87% of the series requires logarithmic transformation prior to modeling, with the rest being modeled in their level values. About 94% are deemed non-stationary, necessitating the extraction of regular/seasonal unit root(s). Only 6% are inherently stationary (integrated of order zero). About 1 in 20 (5%) series has no multiplicative seasonal structure (purely regular). For 66 of the series (34%), the default airline model ($ARIMA(0,1,1)(0,1,1)_4$) proved to be the most appropriate noise process.

Among the nonstationary series, 87 (45%) require the $\nabla\nabla_4$ transformation (regular and seasonal differencing) for conversion into stationary series, with only 15 series (8%) needing the ∇ transformation (regular differencing), while 80 series (41%) are required to undertake the ∇_4 transformation (seasonal differencing). No series turned out to contain more than one unit roots (regular or seasonal). Table 2 details the cross tabulation of the regular (d) and seasonal (D) unit roots.

The features of ARMA parameters of the stationarized series are presented in Table 3. The average number of the ARMA parameters (regular and seasonal) is 1.64 implying the highly parsimonious nature of the models identified by TRAMO to characterize the noise process of the national accounts series. Most of the parameters are of the autoregressive variety (AR(1), AR(2), or AR(3)) with 49.48%, followed by the first-order seasonal moving average (SMA(1)) with a share of 43.30%. The least frequent ARMA parameter is the first-order seasonal autoregressive (SAR(1)), which accounts for only 11.34% of the series.

The results of various diagnostic tests are presented in Table 4. The statistic *Q* refers to the Ljung-Box test for residual autocorrelation, which in our case follows a χ^2 distribution with approximately 22 degrees of freedom. JB is the Jarque-Bera test for normality of the residuals having χ^2 distribution with 2 degrees of freedom. SK and Kur are *t*-test for skewness and kurtosis, respectively, in the residual series. QS is the modified Pierce test for seasonality of the residuals, which is χ^2 with 2 degrees of freedom. Q2 represents the McLeod–Li test of residual linearity (χ^2 with 24 degrees of freedom). Finally, Runs is a *t*-test for randomness in the algebraic signs of the residuals. Very few of the series failed some of the diagnostics at the 5% level; however, all passed the most relevant Ljung-Box test of residual autocorrelation signifying the success of the differencing transformation in converting the series into stationary stochastic processes.

SEATS Analysis

After TRAMO generates the pre-adjusted linearized series, SEATS starts the actual signal extraction process. The program produces an output matrix that shows the results of the various procedures employed. The matrix labeled "General shows, for each series, the following information: 1) whether or not the model identified by TRAMO is modified by SEATS, 2) the final model used in the ultimate signal extraction, 3) the standard error of the residuals of the final model, 4) the result of the spectral factorization (i.e., if decomposition of the model has been successful), 5) if the empirical ACF/CCF is in agreement with the theoretical ACF/CCF, and 6) if the signals (trend-cycle, seasonal, irregular, and transitory component) estimated by SEATS are modified by some of the deterministic effects captured by TRAMO. The "General" matrix is shown in Appendix C from which the information presented in Table 5 are derived.

Out of the 194 models pre-adjusted by TRAMO, only 28 (14.43%) are modified by SEATS before the actual signal extraction is undertaken for each series. One reason for the modification is the inadmissibility of the pre-adjusted model for spectral decomposition procedure, and this happened to 18 (9.28%) of the models. The other models modified resulted in the fine-tuning steps undertaken by SEATS. The quality of the final models used can be gleaned from the proportion of these models in agreement with the theoretical autocorrelation (ACF) and cross-correlation (CCF) patterns. All models (100%) passed the cross-correlation criterion, while 97.94% concurred with the autocorrelation patterns predicted by theory.

Conclusions

Among the most important economic data produced by the Philippine Statistical System are the quarterly time series of the components of the country's national accounts. These sub-annual macroeconomic statistics represent an essential input for economic policy-making, business cycle analysis, and forecasting. However, these statistics are often swayed by a variety of short-term movements, which distort one's perception of the true evolution of the variables and, thus, impede a clear understanding of the economic phenomena.

The key aspect of handling these mostly unobserved influences is to treat them as important signals that have to be isolated in aid of analysis. Central among these influences is the seasonality (or seasonal fluctuations) of the time series. Statistical agencies worldwide routinely subject most of the sub-annual statistics that they produce to seasonal adjustments due to the heavy demand for these treated data from central banks, research institutions, and think-tank organizations.

The state of the art in signal extraction gradually evolved from the use of a mechanical form of moving average filters to the present sophisticated model-based techniques that are capable of performing automatic modeling and signal extraction involving hundreds or even thousands of time series in one production run. The leading edge of technology is being shared by two ARIMA model–based systems: ARIMA X-12 of the U.S. Bureau of Census and the twin programs TRAMO-SEATS developed at by the Bank of Spain. These specialized expert systems have been adopted by most of the statistical agencies of advanced OECD countries and the European community. The Philippines, on the other hand, is still using the ARIMA X-11 system modified by the Bank of Canada in its routine seasonal adjustment and time series decomposition tasks.

This study is an attempt to implement the ARIMA model–based (AMB) approach of extracting unobserved signals from 194 quarterly national accounts statistics of the Philippines using the TRAMO-SEATS system in a fully automatic modeling mode. The highly successful result of the application adequately demonstrates the feasibility of adopting a system being used routinely by countries in more advanced economies.

A follow-up study involving the use of monthly time series data of the Philippine Statistical System is proposed to be done to clarify the robustness of the system with the other type of sub-annual series, thus accentuating its general suitability to routine signal extraction in the Philippine context.

Note

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Tables and Figures

Table 1. General Features of the Final Noise Models for the Series Identified by TRAMO

Model features	Number of Series	Percent (%)
Levels	26	13.40
Logs	168	86.60
Regular differenced	102	52.58
Seasonal differenced	167	86.08
Stationary	12	6.19
Nonstationary	182	93.81
Purely regular	9	4.64
Airline model (default)	66	34.02

Table 2. Breakdown of Series with Regular (d) and Seasonal (D) Unit Roots

Number of Series ith	d = 0	d = 1	d = 2	Total
D = 0	12 (6.19%)	15 (7.73%)	0 (0.00%)	27 (13.92%)
D = 1	80 (41.24%)	87 (44.85%)	0 (0.00%)	167 (86.08%)
Total	92 (47.42%)	102 (52.58%)	0 (0.00%)	194 (100%)

Table 3. ARMA Parameters of the Noise Models

Percent of Series With AR or MA Order	AR(p)	MA(q)	SAR(P)	SMA(Q)
0	50.52%	58.25%	88.66%	56.70%
1	39.18%	38.14%	11.34%	43.30%
2	6.19%	3.09%	0.00%	0.00%
3	4.12%	0.52%	0.00%	0.00%
Total > 0	49.48%	41.75%	11.34%	43.30%
Average of parameters	0.64	0.46	0.11	0.43

Table 4. Summary of the Diagnostic Tests for the Final Noise Models

Diagnostic Test	Mean Score	Standard Deviation (SD)	Maximum	Minimum	Approximately 1% CV	Beyond 1% CV	% of Series That Pass Test
Ljung-Box (LB test of residual autocorrelations	13.30	5.25	28.61	3.74	30.58	0.00	100.00
Jarque–Bera (JB) test of normality of residuals	5.43	12.65	116.42	0.00	9.21	14.95	85.05
Skewness of residuals t- test	0.06	1.28	4.35	-2.65	2.58	4.12	95.88
Kurtosis of residuals t-test	0.79	1.78	10.49	-1.52	2.58	12.37	87.63
Pierce QS test for residual seasonality	—	—	6.87	0.00	9.21	0.00	100.00
McLeod and Li Q2 linearity test	15.40	9.45	61.42	2.85	32.00	4.64	95.36
Runs test for residual randomness	-0.17	0.91	2.26	-3.30	2.58	0.52	99.48

Table 5. Summary of Regression Outliers and Calendar Variations

Attributes	Outliers					Calendar Variations		
	Missing Observations (MO)	Additive Outliers (AO)	Transitory Changers (TC)	Level Shifters (LS)	Total	Trading Day (TD)	Easter Effect (EE)	Total
Percent of series with	0.00	46.91	42.27	53.61	77.84	10.82	4.12	14.43
Average per series	0	0.77	0.61	0.91	2.29			
Maximum number per series	0	5	5	6	14			
Minimum number per series	0	0	0	0	0			

Table 6. Summary Results of Models Used by SEATS

Features of the Models Used by SEATS	Number of Series	Percent of Total Series
Models pre-adjusted by TRAMO	194	100.00
Pre-adjusted models modified by SEATS	28	14.43
Models modified by SEATS due to inadmissible spectral decomposition	18	9.28
Models with successful spectral factorization	194	100.00

Table 6 continued...

Models in agreement with theoretical autocorrelation function (ACF)	190	97.94
Models in agreement with theoretical cross-correlation function (CCF)	194	100.00
Models with components modified by deterministic effects (outliers) estimated by TRAMO	166	85.56

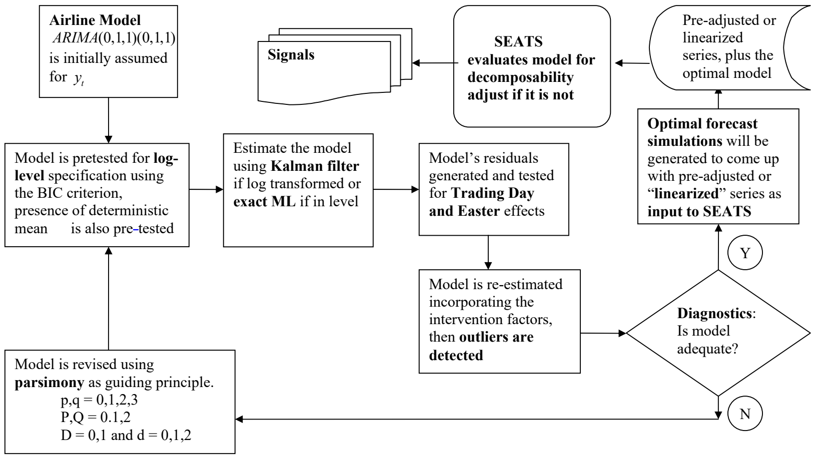

Figure 1. The TRAMO-SEATS procedure.

Appendices

Appendix A. Listing of the Quarterly National Accounts Variables Used in the Study and their Descriptive Statistics

Variable	Description	Obsv	Mean	Std Dev	Min	Max
gnppceco	Gross National Product by (1) Personal Consumption Expenditure (constant)	120	176,568.60	61,243.41	94,727	350,112
gnppcecu	Gross National Product by (1) Personal Consumption Expenditure (current)	120	510,742.30	437,122.10	39,297	1,772,127
gnpgceco	Gross National Product by (2) government consumption (constant)	120	16,907.63	4,444.33	10,006	30,463
gnpgcecu	Gross national product by (2) government consumption (current)	120	76,152.97	63,359.46	5,780	250,835
gnpcfco	Gross national product by (3) capital formation (constant)	120	47,440.83	13,428.49	17,616	75,986
gnpcfcu	Gross national product by (3) capital formation (current)	120	126,352.30	90,375.07	17,723	353,019
gnpcffcco	Gross national product by (A) fixed capital (constant)	120	47,105.77	12,610.16	20,683	82,675
gnpcffccu	Gross national product by (A) fixed capital (current)	120	124,692.30	88,886.61	18,351	402,892
gnpcffccon~o	Gross national product by fixed capital—construction (constant)	120	22,187.21	6,572.77	8,387	48,639
gnpcffccon~u	Gross national product by fixed capital—construction (current)	120	62,852.53	49,713.16	8,992	268,978
gnpcffcdeco	Gross national product by fixed capital—durable equipment (constant)	120	21,576.87	6,667.97	8,057	35,466
gnpcffcdecu	Gross national product by fixed capital—durable equipment (current)	120	52,066.36	34,027.97	6,352	123,967
gnpcffcbso~o	Gross national product by fixed capital—breeding stock and orchard development (constant)	120	3,341.68	936.60	1,686	5,454
gnpcffcbso~u	Gross national product by fixed capital—breeding stock and orchard development (current)	120	9,773.27	7,998.76	1,164	38,034
gnpcfcisco	Gross national product by (B) changes in stocks (constant)	120	335.05	3,414.75	-10,630	8,536
gnpcfciscu	Gross national product by (B) changes in stocks (current)	120	2,129.67	11,645.72	-49,873	45,178
gnpexco	Gross national product by (4) exports (constant)	120	93,964.48	47,171.23	32,562	220,118
gnpexcu	Gross national product by (4) exports (current)	120	332,338.30	329,624.20	15,424	1,352,281

Appendix A continued...

gnpextmeco	Gross national product by (A) total merchandise exports (constant)	63	105,896.70	30,284.46	56,686	183,196
gnpextmecu	Gross national product by (A) total merchandise exports (current)	60	456,397.00	162,296.00	121,873	748,024
gnpexnfsco	Gross national product by (B) non-factor services (constant)	63	25,555.98	9,397.29	12,917	53,788
gnpexnfscu	Gross national product by (B) non-factor services (current)	60	140,105.00	150,368.60	38,774	604,257
gnpmco	Gross national product by (5) imports (constant)	120	105,011.20	48,896.12	28,529	217,042
gnpmcu	Gross national product by (5) imports (current)	120	313,643.80	264,410.50	17,349	811,634
gnpmtmico	Gross national product by (A) total merchandise imports (constant)	63	134,031.40	23,832.97	84,709	199,992
gnpmtmicu	Gross national product by (A) total merchandise imports (current)	60	494,667.50	162,980.80	205,044	756,705
gnpmnfsco	Gross national product by (B) non-factor services (constant)	63	12,166.76	4,624.60	6,551	26,618
gnpmnfscu	Gross national product by (B) non-factor services (current)	60	54,886.17	18,448.43	23,164	109,605
gnpsdco	Gross national product by (6) statistical discrepancy non-factor (constant)	120	525.07	13,795.46	-46,769	42,086
gnpsdcu	Gross national product by (6) statistical discrepancy (current)	120	17,576.67	54,222.99	-101,265	182,198
gnpmitglci~o	Gross national product by memorandum items: trading gain/loss from changes in trade (constant)	120	4,810.34	13,468.95	-40,920	54,059
gnpmignico	Gross national product by memorandum items: gross national income (constant)	117	242,385.80	86,702.87	124,260	510,605
gdpexpco	Gross domestic product by expenditure shares (constant)	120	230,395.40	72,028.90	130,098	425,927
gdpexpcu	Gross domestic product by expenditure shares (current)	120	716,109.70	613,290.70	66,656	2,431,902
nfiaexpco	Net factor income from abroad by expenditure shares (constant)	120	13,045.03	17,726.78	-7,437	62,986
nfiaexpcu	Net factor income from abroad by expenditure shares (current)	120	55,516.34	84,187.65	-6,492	328,192
gnpexpco	Gross national product by expenditure shares (constant)	120	243,440.40	89,210.48	123,705	488,913
gnpexpcu	Gross national product by expenditure shares (current)	120	771,626.10	693,563.30	66,087	2,760,094
gnpaffco	Gross national product by (1) agriculture, fishery, and forestry (constant)	120	46,651.18	11,445.01	26,718	79,658

Appendix A continued...

gnpaffcu	Gross national product by (1) agriculture, fishery, and forestry (current)	120	116,714.40	84,503.68	14,022	390,919
gnpisco	Gross national product by (2) industry sector (constant)	120	78,410.72	21,453.66	48,248	140,049
gnpiscu	Gross national product by (2) industry sector (current)	120	228,549.90	189,770.40	26,037	766,323
gnpssco	Gross national product by (3) service sector (constant)	120	101,510.70	40,637.11	54,623	206,093
gnpsscu	Gross national product by (3) service sector (current)	120	370,845.30	341,289.20	24,077	1,274,660
gnpindgdpco	Gross national product—by industry—gross domestic product (constant)	120	226,577.50	71,913.49	130,098	425,927
gnpindgdpcu	Gross national product—by industry—gross domestic product (current)	120	716,109.70	613,290.70	66,656	2,431,902
gnpindnfiaco	Gross national product—by industry—net factor income from abroad (constant)	120	12,332.18	17,699.97	-7,437	62,986
gnpindnfiacu	Gross national product—by industry—net factor income from abroad (current)	120	55,516.34	84,187.65	-6,492	328,192
gnpindco	Gross national product by industry (constant)	120	238,909.60	89,064.06	123,705	488,913
gnpindcu	Gross national product by industry (current)	120	771,626.10	693,563.30	66,087	2,760,094
gdcfdemspico	Gross domestic capital formation in durable equipment by (A) machinery for particular industries (constant)	56	9,563.27	2,450.46	6,111	14,810
gdcfdemspicu	Gross domestic capital formation in durable equipment by (A) machinery for particular industries (current)	56	32,667.46	7,370.31	21,294	46,601
gdcfdegimeco	Gross domestic capital formation in durable equipment by (B) general industrial machinery and equipment (constant)	56	7,092.27	1,473.79	4,444	10,618
gdcfdegimecu	Gross domestic capital formation in durable equipment by (B) general industrial machinery and equipment (current)	56	19,219.04	4,226.66	12,369	28,641
gdcfdeteco	Gross domestic capital formation in durable equipment by (C) transport equipment (constant)	56	4,506.27	2,373.65	1,759	11,867

Appendix A continued...

gdcfdetecu	Gross domestic capital formation in durable equipment by (C) transport equipment (current)	56	18,782.29	11,576.47	5,956	52,274
gdcfdemeco	Gross domestic capital formation in durable equipment by (D) miscellaneous equipment (constant)	56	5,304.63	1,175.26	3,071	7,688
gdcfdemecu	Gross domestic capital formation in durable equipment by (D) miscellaneous equipment (current)	56	13,018.14	2,297.95	8,615	18,518
pceco	Personal consumption expenditure (constant)	56	226,744.90	46,235.41	156,862	350,112
pcecu	Personal consumption expenditure (current)	56	886,656.80	360,048.30	396,431	1,772,127
pcecfco	Personal consumption expenditure by (A) clothing and footwear (constant)	56	7,414.00	1,128.82	5,384	10,344
pcecfcu	Personal consumption expenditure by (A) clothing and footwear (current)	56	20,356.41	5,335.74	11,153	33,022
pcebevco	Personal consumption expenditure by (B) beverages (constant)	56	4,704.66	699.72	3,224	6,341
pcebevcu	Personal consumption expenditure by (B) beverages (current)	56	15,230.50	4,515.25	7,955	25,845
pcefco	Personal consumption expenditure by (C) food (constant)	56	122,018.30	26,156.84	85,621	197,583
pcefcu	Personal consumption expenditure by (C) food (current)	56	414,332.30	171,071.50	202,091	882,053
pceflwco	Personal consumption expenditure by (D) fuel, light. and water (constant)	56	9,278.36	1,314.96	6,685	11,997
pceflwcu	Personal consumption expenditure by (D) fuel, light, and water (current)	56	41,105.21	16,928.76	15,710	79,825
pcehhfco	Personal consumption expenditure by (E) household furnishings (constant)	56	6,366.05	1,451.73	4,557	10,516
pcehhfcu	Personal consumption expenditure by (E) household furnishings (current)	56	14,188.07	4,158.81	8,489	25,786
pcehhoco	Personal consumption expenditure by (F) household operations (constant)	56	20,089.89	2,150.11	16,517	24,164

Appendix A continued...

pcehhocu	Personal consumption expenditure by (F) household operations (current)	56	92,035.16	24,566.94	51,475	139,666
pcetobco	Personal consumption expenditure by (G) tobacco (constant)	56	4,821.18	584.43	3,857	6,873
pcetobcu	Personal consumption expenditure by (G) tobacco (current)	56	14,943.25	4,014.01	8,461	27,259
pcetcco	Personal consumption expenditure by (H) transportation and communication (constant)	56	17,738.89	6,979.40	8,301	29,000
pcetccu	Personal consumption expenditure by (H) transportation and communication (current)	56	78,929.57	52,257.81	16,766	170,711
pcemiscco	Personal consumption expenditure by (I) miscellaneous (constant)	56	34,313.43	7,630.84	22,716	56,437
pcemisccu	Personal consumption expenditure by (I) miscellaneous (current)	56	195,536.30	83,813.75	71,733	416,919
gvaaffco	Gross value added in agriculture, fishery, and forestry (constant)	56	55,049.07	10,311.44	37,680	79,786
gvaaffcu	Gross value added in agriculture, fishery, and forestry (current)	56	186,824.90	70,748.87	100,422	390,919
gvaindaico	Gross value added in agriculture, fishery, and forestry by industry (1) agriculture industry (constant)	56	54,735.66	10,356.02	37,509	79,658
gvaindaicu	Gross value added in agriculture, fishery, and forestry by industry (1) agriculture industry (current)	56	185,929.20	70,739.79	99,780	390,511
gvaindaiag~o	Gross value added in agriculture, fishery, and forestry by industry (a) agriculture (constant)	56	42,766.07	8,049.38	29,539	61,256
gvaindaiag~u	Gross value added in agriculture, fishery, and forestry by industry (a) agriculture (current)	56	157,835.80	62,258.31	82,963	345,437
gvaindaifi~o	Gross value added in agriculture, fishery, and forestry by industry (b) fishery (constant)	56	11,969.66	2,952.13	7,129	18,403

Appendix A continued...

gvaindaifi~u	Gross value added in agriculture, fishery, and forestry by industry (b) fishery (current)	56	28,093.36	9,699.89	15,182	46,759
gvaindfico	Gross value added in agriculture, fishery, and forestry by industry (2) forestry (constant)	56	313.43	133.98	54	640
gvaindficu	Gross value added in agriculture, fishery, and forestry by industry (2) forestry (current)	56	895.71	427.07	139	2,111
gvconsco	Gross value in construction (constant)	56	26,583.89	5,042.44	19,054	48,639
gvconscu	Gross value in construction (current)	56	104,697.70	42,115.78	64,879	268,978
gvconsgv~bco	Gross value of construction and gross value added in construction by type of construction (1) public (constant)	56	11,634.32	4,351.88	5,395	29,244
gvconsgv~bcu	Gross value of construction and gross value added in construction by type of construction (1) public (current)	56	44,742.43	24,596.16	22,571	164,462
gvconsgv~vco	Gross value of construction and gross value added in construction by type of construction (2) private (constant)	56	14,949.57	2,530.76	11,009	23,430
gvconsgv~vcu	Gross value of construction and gross value added in construction by type of construction (2) private (current)	56	59,955.23	23,010.06	31,975	125,086
gvaconsco	Gross value added in construction (constant)	56	14,127.48	3,289.36	9,524	28,316
gvaconscu	Gross value added in construction (current)	56	60,838.39	24,725.21	37,361	159,566
gvamfgco	Gross value added in manufacturing (constant)	56	68,867.84	12,078.21	50,408	103,400
gvamfgcu	Gross value added in manufacturing (current)	56	276,331.90	108,491.40	118,701	565,686
gvamfgfmco	Gross value added in manufacturing by food manufactures (constant)	56	27,349.95	7,534.46	17,270	48,071
gvamfgfmcu	Gross value added in manufacturing by food manufactures (current)	56	132,145.30	64,184.92	50,204	314,267

Appendix A continued...

gvamfgbico	Gross value added in manufacturing by beverage industries (constant)	56	2,501.52	691.13	1,345	4,018
gvamfgbicu	Gross value added in manufacturing by beverage industries (current)	56	10,288.34	4,101.12	3,927	20,475
gvamfgtomco	Gross value added in manufacturing by tobacco manufactures (constant)	56	987.71	501.80	219	2,058
gvamfgtomcu	Gross value added in manufacturing by tobacco manufactures (current)	56	2,832.73	1,259.64	759	6,145
gvamfgtemco	Gross value added in manufacturing by textile manufactures (constant)	56	1,179.38	262.62	788	1,753
gvamfgtemcu	Gross value added in manufacturing by textile manufactures (current)	56	3,866.70	1,079.51	2,052	6,232
gvamfgfwaco	Gross value added in manufacturing by footwear wearing apparel (constant)	56	3,008.20	1,010.83	1,574	5,330
gvamfgfwacu	Gross value added in manufacturing by footwear wearing apparel (current)	56	12,494.66	4,523.24	4,188	20,899
gvamfgwcpco	Gross value added in manufacturing by wood and cork products (constant)	56	511.95	174.66	208	874
gvamfgwcpcu	Gross value added in manufacturing by wood and cork products (current)	56	1,481.54	425.93	704	2,506
gvamfgffco	Gross value added in manufacturing by furniture and fixtures (constant)	56	988.93	334.35	549	2,083
gvamfgffcu	Gross value added in manufacturing by furniture and fixtures (current)	56	3,590.13	1,339.82	1,536	7,327
gvamfgpppco	Gross value added in manufacturing by paper and paper products (constant)	56	562.68	99.60	382	813
gvamfgpppcu	Gross value added in manufacturing by paper and paper products (current)	56	1,391.50	327.19	717	2,227
gvamfgppco	Gross value added in manufacturing by publishing and printing (constant)	56	801.61	241.87	332	1,174
gvamfgppcu	Gross value added in manufacturing by publishing and printing (current)	56	2,477.98	949.71	1,009	4,262

Appendix A continued...

gvamfgllpco	Gross value added in manufacturing by leather and leather products (constant)	56	46.05	30.36	2	109
gvamfgllpcu	Gross value added in manufacturing by leather and leather products (current)	56	123.52	100.03	6	440
gvamfgrpco	Gross value added in manufacturing by rubber products (constant)	56	482.32	77.54	304	655
gvamfgrpcu	Gross value added in manufacturing by rubber products (current)	56	1,279.39	324.21	730	2,082
gvamfgccpco	Gross value added in manufacturing by chemical and chemical products (constant)	56	4,031.70	855.85	2,690	6,363
gvamfgccpcu	Gross value added in manufacturing by chemical and chemical products (current)	56	18,705.86	6,882.12	9,251	38,930
gvamfgppcco	Gross value added in manufacturing by products of petroleum and coal (constant)	56	9,850.50	1,404.59	5,930	12,829
gvamfgppccu	Gross value added in manufacturing by products of petroleum coal (current)	56	24,910.02	12,831.19	9,076	58,457
gvamfgnmmpco	Gross value added in manufacturing by non-metallic mineral products (constant)	56	1,653.46	415.98	1,018	2,826
gvamfgnmmpcu	Gross value added in manufacturing by nonmetallic mineral products (current)	56	7,576.20	3,159.56	4,204	17,898
gvamfgbmico	Gross value added in manufacturing by basic metal industries (constant)	56	1,705.55	738.74	714	3,912
gvamfgbmicu	Gross value added in manufacturing by basic metal industries (current)	56	7,320.30	4,398.06	2,313	20,796
gvamfgmico	Gross value added in manufacturing by metal industries (constant)	56	1,482.23	597.83	696	3,132
gvamfgmicu	Gross value added in manufacturing by metal industries (current)	56	4,869.52	2,410.46	1,723	10,823
gvamfgmeeco	Gross value added in manufacturing by machinery except electrical (constant)	56	1,010.73	221.28	660	1,684
gvamfgmeecu	Gross value added in manufacturing by machinery except electrical (current)	56	2,491.48	570.33	1,479	4,167

Appendix A continued...

gvamfgemco	Gross value added in manufacturing by electrical machinery (constant)	56	8,026.21	2,174.75	4,073	12,565
gvamfgemcu	Gross value added in manufacturing by electrical machinery (current)	56	28,289.55	9,906.89	9,942	47,532
gvamfgteco	Gross value added in manufacturing by transport equipment (constant)	56	657.96	196.33	358	1,275
gvamfgtecu	Gross value added in manufacturing by transport equipment (current)	56	2,757.89	1,133.77	1,041	6,058
gvamfgmmco	Gross value added in manufacturing by miscellaneous manufactures (constant)	56	2,029.07	620.75	964	3,947
gvamfgmmcu	Gross value added in manufacturing by miscellaneous manufactures (current)	56	7,439.27	2,518.93	2,457	12,533
gvamqco	Gross value added in mining and quarrying (constant)	56	4,534.55	2,119.50	2,179	12,408
gvamqcu	Gross value added in mining and quarrying (current)	56	15,570.89	11,882.26	3,672	50,662
gvamqcmco	Gross value added in mining and quarrying by (1) copper mining (constant)	56	152.52	127.37	52	800
gvamqcmcu	Gross value added in mining and quarrying by (1) copper mining (current)	56	677.21	587.19	169	2,817
gvamqgmco	Gross value added in mining and quarrying by (2) gold mining (constant)	56	1,282.55	204.16	776	1,664
gvamqgmcu	Gross value added in mining and quarrying by (2) gold mining (current)	56	5,572.91	3,592.24	1,359	16,390
gvamqchmco	Gross value added in mining and quarrying by (3) chromium mining (constant)	56	7.46	6.72	0	29
gvamqchmcu	Gross value added in mining and quarrying by (3) chromium mining (current)	56	17.36	12.14	0	53
gvamqnmco	Gross value added in mining and quarrying by (4) nickel mining (constant)	56	196.89	266.67	5	1,307

Appendix A continued...

gvamqnmcu	Gross value added in mining and quarrying by (4) nickel mining (current)	56	1,889.73	3,444.98	14	17,947
gvamqommco	Gross value added in mining and quarrying by (5) other metallic mining (constant)	56	14.61	15.78	3	75
gvamqommcu	Gross value added in mining and quarrying by (5) other metallic mining (current)	56	60.70	87.30	7	395
gvamqcoco	Gross value added in mining and quarrying by (6) crude oil (constant)	56	887.63	794.86	14	3,251
gvamqcocu	Gross value added in mining and quarrying by (6) crude oil (current)	56	2,659.57	2,250.10	10	6,480
gvamqsqcsco	Gross value added in mining and quarrying by (7) stone quarrying, clay, and sandpits (constant)	56	617.07	197.16	285	1,093
gvamqsqcscu	Gross value added in mining and quarrying by (7) stone quarrying, clay, and sandpits (current)	56	1,510.41	470.03	596	3,020
gvamqonmco	Gross value added in mining and quarrying by (8) other nonmetallic (constant)	56	1,375.86	1,173.22	245	5,740
gvamqonmcu	Gross value added in mining and quarrying by (8) other nonmetallic (current)	56	3,183.05	3,144.25	404	12,707
gvaosco	Gross value added in other services (constant)	56	36,563.79	7,837.90	25,631	53,028
gvaoscu	Gross value added in other services (current)	56	267,157.10	111,049.30	105,110	510,750
gvaosgovtco	Gross value added in other services by (1) government (constant)	56	13,164.64	1,536.61	10,660	18,307
gvaosgovtcu	Gross value added in other services by (1) government (current)	56	100,646.80	29,829.38	51,491	177,231
gvaosprivco	Gross value added in other services by (2) private (constant)	56	23,399.11	6,479.83	14,575	38,286
gvaosprivcu	Gross value added in other services by (2) private (current)	56	166,510.40	82,215.95	53,619	342,575
gvaosprivb~o	Gross value added in other services by (A) business (constant)	56	4,510.27	2,593.01	1,725	10,178

Appendix A continued...

gvaosprivb~u	Gross value added in other services by (A) business (current)	56	40,747.09	30,902.48	7,449	108,997
gvaosprive~o	Gross value added in other services by (B) educational (constant)	56	2,241.71	327.51	1,572	2,883
gvaosprive~u	Gross value added in other services by (B) educational (current)	56	30,571.63	12,855.90	8,814	55,206
gvaosprivh~o	Gross value added in other services by (C) hotel and restaurant (constant)	56	3,752.32	722.35	2,766	5,708
gvaosprivh~u	Gross value added in other services by (C) hotel and restaurant (current)	56	22,735.04	8,686.32	10,448	44,391
gvaosprivm~o	Gross value added in other services by (D) medical and health (constant)	56	3,553.98	788.96	2,241	5,153
gvaosprivm~u	Gross value added in other services by (D) medical and health (current)	56	19,298.63	8,804.62	6,348	38,439
gvaosprivr~o	Gross value added in other services by (E) recreational (constant)	56	3,098.46	970.54	2,020	7,135
gvaosprivr~u	Gross value added in other services by (E) recreational (current)	56	14,109.34	7,181.90	4,894	40,601
gvaosprivp~o	Gross value added in other services by (F) personal (constant)	56	5,559.61	1,241.23	3,707	8,044
gvaosprivp~u	Gross value added in other services by (F) personal (current)	56	36,212.46	14,238.41	14,375	62,930
gvaosprivo~o	Gross value added in other services by (G) others (constant)	56	682.89	103.20	514	932
gvaosprivo~u	Gross value added in other services by (G) others (current)	56	2,836.21	887.09	1,291	4,761
Gvaodreco	Gross value added in ownership of dwellings and real estate (constant)	56	13,896.75	2,071.79	11,735	18,093
gvaodrecu	Gross value added in ownership of dwellings andreal estate (current)	56	74,739.50	22,891.81	40,669	117,831
gvaodrereco	Gross value added in ownership of dwellings and real estate by (1) real estate (constant)	56	3,191.11	1,079.74	1,958	5,630

Appendix A continued...

gvaodrerecu	Gross value added in ownership of dwellings and real estate by (1) real estate (current)	56	13,059.82	7,134.09	6,546	29,602
gvaodreodco	Gross value added in ownership of dwellings and real estate by (2) ownership of dwellings (constant)	56	10,705.61	1,072.20	9,122	12,677
gvaodreodcu	Gross value added in ownership of dwellings and real estate by (2) ownership of dwellings (current)	56	61,679.77	16,272.58	33,848	88,420
gvatrco	Gross value added in trade (constant)	56	47,776.20	11,768.41	29,674	77,985
gvatrcu	Gross value added in trade (current)	56	179,352.40	78,968.28	68,822	384,756
gvatrwsco	Gross value added in trade by (1) wholesale (constant)	56	11,519.36	2,282.78	8,122	17,744
gvatrwscu	Gross value added in trade by (1) wholesale (current)	56	39,041.32	14,505.79	18,242	73,088
gvatrrtco	Gross value added in trade by (2) retail (constant)	56	36,256.84	9,650.97	21,369	62,614
gvatrrtcu	Gross value added in trade by (2) retail (current)	56	140,311.10	65,061.29	50,580	319,473
gvatcsco	Gross value added in transportation, communication, and storage (constant)	56	23,251.25	6,825.38	12,844	34,854
gvatcscu	Gross value added in transportation, communication, and storage (current)	56	84,237.63	36,720.35	26,975	141,384
gvatcstsco	Gross value added in transport, communication, and storage by (1) transport and storage (constant)	56	11,440.23	1,596.99	8,715	15,001
gvatcstscu	Gross value added in transport, communication and storage by (1) transport and storage (current)	56	45,909.88	17,344.73	19,116	76,825
gvatcscomco	Gross value added in transport, communication, and storage by (2) communication (constant)	56	11,811.05	5,309.24	4,129	21,468
gvatcscomcu	Gross value added in transport, communication, and storage by (2) communication (current)	56	38,327.80	19,655.76	7,859	71,092

Appendix B. Summary of the Diagnostics Results for the Final Noise Models Automatically Identified by TRAMO

National Accounts _Component	Level(1) or Log(0)	With W/O 1,0 Mean	SARIMA Noise Model						SE	BIC/SI	LB-Stat	JB-Test	SK *t*-Test	KUR *t*-Test	QS	Q2	RUNS *t*-Test
			p	*d*	*q*	*P*	*D*	*Q*									
gnppceco	0	0	3	1	0	0	1	0	0.0130087	−8.31650	13.88	116.4	−2.54	10.5	3.57	28.98	−3.30
gnppcecu	0	0	0	1	3	0	1	0	0.0179651	−7.81263	23.53	9.61	−1.91	2.44	0.0	59.08	1.34
gnpgceco	0	1	0	0	1	0	1	0	0.0574648	−5.61643	18.21	1.57	−1.03	0.709	0.0	35.98	−2.07
gnpgcecu	0	0	0	1	1	0	1	1	0.0462528	−5.98541	14.16	0.923	−0.56	0.781	0.074	16.71	−0.38
gnpcfco	1	0	0	1	1	0	1	1	4925.086	17.1338	5.897	0.853	0.725	0.572	0.951	22.22	1.32
gnpcfcu	0	0	0	1	1	1	1	1	0.1001066	−4.37702	6.700	1.89	−0.80	1.12	0.0	8.583	−0.95
gnpcffco	1	0	1	1	0	1	0	1	3772.604	16.6603	9.202	0.649	−0.76	0.261	0.034	15.70	1.68
gnpcffcu	0	1	1	1	0	1	0	0	0.0978567	−4.55355	10.38	4.71	1.80	1.22	0.113	23.95	−0.18
gnpcffccon~o	1	0	0	1	1	0	1	0	2741.666	16.0266	19.20	5.92	0.956	2.24	0.000	14.93	−-0.96
gnpcffccon~u	0	0	0	1	1	0	1	1	0.1210345	−3.99734	10.37	9.65	1.87	2.48	1.07	10.41	−0.19
gnpcffcdeco	1	0	0	1	1	0	1	1	1956.013	15.3513	13.04	8.39	−2.65	1.16	0.0	14.72	−0.95
gnpcffcdecu	0	1	0	1	1	0	0	1	0.1036624	−4.43828	8.485	0.280	0.528	0.029	0.0	26.22	−0.55
gnpcffcbso~o	0	1	0	0	0	1	1	0	0.0370694	−6.20737	18.67	22.2	0.871	4.63	0.459	27.63	−2.55
gnpcffcbso~u	0	1	0	0	2	0	1	1	0.0526577	−5.59984	9.512	8.15	−2.08	1.95	0.002	17.34	−0.96
gnpcfcisco	1	0	0	0	1	0	1	1	2598.085	15.8539	19.35	2.82	1.42	−0.90	1.52	13.49	2.26
gnpcfciscu	1	0	0	0	0	0	1	1	6105.783	17.6586	25.57	37.7	−1.74	5.89	0.114	16.37	−0.57
gnpexco	0	1	1	0	0	0	1	1	0.0788665	−4.91916	9.509	5.12	−1.55	1.64	2.20	15.77	−1.70
gnpexcu	0	0	0	1	0	0	1	1	0.0684963	−5.23231	11.16	1.62	−1.19	−0.46	0.0	20.95	0.570
gnpextmeco	0	1	1	0	0	0	1	0	0.0796980	−4.85278	4.684	5.44	−2.24	0.649	0.049	12.96	0.270
gnpextmecu	0	1	1	0	0	1	0	1	0.0740378	−4.90228	13.29	1.06	−0.63	−0.82	0.0	8.001	1.34
gnpexnfsco	0	1	1	0	0	0	0	0	0.0894367	−4.34365	7.895	1.20	0.133	−1.09	0.182	8.967	0.0
gnpexnfscu	0	1	0	1	0	0	0	0	0.1131168	−4.12613	17.13	1.06	0.894	−0.51	3.29	7.635	−0.30
gnpmco	0	0	1	1	0	0	1	1	0.0594763	−5.39805	16.91	9.34	−-2.58	1.63	2.07	10.91	−0.61
gnpmcu	0	1	0	1	1	0	0	0	0.0891262	−4.73213	15.10	0.007	0.080	0.030	2.87	22.69	−0.59
gnpmtmico	0	1	1	0	0	0	1	1	0.0738420	−5.00542	12.75	1.31	−1.10	0.325	0.186	10.57	−1.07
gnpmtmicu	0	1	2	1	0	0	0	0	0.0858167	−4.73599	17.40	0.474	−0.63	0.280	0.975	26.24	1.46
gnpmnfsco	0	0	0	1	1	0	1	1	0.1423369	−3.63923	12.52	0.507	0.680	0.211	0.020	6.348	−-1.36
gnpexco	0	1	1	0	0	0	1	1	0.0788665	−4.91916	9.509	5.12	−1.55	1.64	2.20	15.77	−1.70
gnpexcu	0	0	0	1	0	0	1	1	0.0684963	−5.23231	11.16	1.62	−1.19	−0.46	0.0	20.95	0.570
gnpextmeco	0	1	1	0	0	0	1	0	0.0796980	−4.85278	4.684	5.44	−2.24	0.649	0.049	12.96	0.270
gnpextmecu	0	1	1	0	0	1	0	1	0.0740378	−4.90228	13.29	1.06	−0.63	−0.82	0.0	8.001	1.34
gnpexnfsco	0	1	1	0	0	0	0	0	0.0894367	−4.34365	7.895	1.20	0.133	−1.09	0.182	8.967	0.0
gnpexnfscu	0	1	0	1	0	0	0	0	0.1131168	−4.12613	17.13	1.06	0.894	−0.51	3.29	7.635	−0.30
gnpmco	0	0	1	1	0	0	1	1	0.0594763	−5.39805	16.91	9.34	−-2.58	1.63	2.07	10.91	−0.61
gnpmcu	0	1	0	1	1	0	0	0	0.0891262	−4.73213	15.10	0.007	0.080	0.030	2.87	22.69	−0.59
gnpmtmico	0	1	1	0	0	0	1	1	0.0738420	−5.00542	12.75	1.31	−1.10	0.325	0.186	10.57	−1.07
gnpmtmicu	0	1	2	1	0	0	0	0	0.0858167	−4.73599	17.40	0.474	−0.63	0.280	0.975	26.24	1.46
gnpmnfsco	0	0	0	1	1	0	1	1	0.1423369	−3.63923	12.52	0.507	0.680	0.211	0.020	6.348	−-1.36

Appendix B continued...

gnpmnfscu	0	1	1	0	0	1	0	0	0.1264826	-3.79369	20.75	1.98	−1.13	–-0.83	0.497	12.08	–-0.30
gnpsdco	1	0	0	1	1	0	1	0	8069.371	18.1213	19.09	3.96	−1.84	0.756	0.0	61.42	−1.33
gnpsdcu	1	0	1	0	0	0	1	1	13155.62	19.4765	15.12	1.33	0.704	0.913	0.0	17.06	0.796
gnpmitglci~o	1	0	1	0	0	1	0	0	6789.748	17.8033	21.75	2.41	1.39	0.689	5.32	61.08	−0.37
gnpmignico	0	0	2	0	0	0	1	0	0.0398860	–-6.27954	9.511	7.47	1.71	2.13	1.80	15.39	−0.19
gdpexpco	0	0	1	1	1	0	1	0	0.0273671	−7.06719	17.80	2.41	0.098	1.55	0.494	30.55	−0.19
gdpexpcu	0	0	0	1	0	0	1	1	0.0180416	−7.83618	13.48	1.53	0.697	1.02	0.0	30.23	−0.77
nfiaexpco	1	0	1	1	0	0	1	1	1985.341	15.3489	10.41	1.88	0.978	0.963	0.0	47.44	0.0
nfiaexpcu	1	0	1	1	0	0	1	0	5531.763	17.4625	19.77	18.8	1.45	4.09	0.0	25.56	−0.77
gnpexpco	0	0	1	1	0	0	1	0	0.0257409	−7.09333	26.34	12.1	0.688	3.41	1.17	11.37	−1.54
gnpexpcu	0	0	0	1	0	0	1	1	0.0218100	−7.52114	18.58	0.872	–-0.60	0.717	0.0	14.32	0.380
gnpaffco	1	0	0	1	1	0	1	0	1366.184	14.5692	8.072	1.24	−0.77	-0.80	0.0	13.02	0.0
gnpaffcu	0	1	1	0	0	0	1	1	0.0507916	−5.79921	14.98	2.26	1.41	0.537	0.208	14.36	0.378
gnpisco	0	0	1	0	0	0	1	0	0.0356960	−6.53661	12.98	0.113	0.329	0.068	0.068	32.92	0.567
gnpiscu	0	0	1	1	1	0	1	1	0.0384227	−6.29219	10.70	4.85	0.112	2.20	0.003	18.72	0.954
gnpssco	0	0	0	1	1	0	1	1	0.0118041	−8.55699	17.05	13.6	2.66	2.56	0.0	15.43	0.583
gnpsscu	0	0	1	1	0	0	1	0	0.0125054	−8.40987	28.44	14.9	−2.15	3.20	0.427	9.925	0.196
gnpindgdpco	0	1	1	0	0	0	1	0	0.0154148	−8.08848	21.63	1.98	−1.26	-0.62	0.021	15.98	0.385
gnpindgdpcu	0	0	0	1	0	0	1	1	0.0180416	−7.83618	13.48	1.53	0.697	1.02	0.0	30.23	−0.77
gnpindnfiaco	1	1	3	1	0	1	0	1	1763.856	15.2643	19.40	4.89	1.75	1.34	0.0	35.40	1.13
gnpindnfiacu	1	0	1	1	0	0	1	0	5531.763	17.4625	19.77	18.8	1.45	4.09	0.0	25.56	−0.77
gnpindco	0	0	0	1	1	0	1	0	0.0209906	−7.53338	26.24	7.44	2.33	1.42	0.067	21.98	0.0
gnpindcu	0	0	0	1	0	0	1	1	0.0218100	−7.52114	18.58	0.872	−0.60	0.717	0.0	14.32	0.380
gdcfdemspico	0	0	1	0	0	0	1	0	0.0819812	−4.72370	14.82	0.102	0.221	0.230	0.0	5.440	0.0
gdcfdemspicu	0	0	1	0	0	1	1	0	0.0978616	−4.47987	12.04	0.202	0.254	0.371	0.0	11.75	−0.57
gdcfdegimeco	0	1	1	0	0	1	0	0	0.1280144	−3.89781	10.69	0.217	−0.38	−0.27	0.638	8.766	0.0
gdcfdegimecu	0	0	0	0	2	0	1	0	0.1505142	−3.67465	5.733	0.688	–-0.01	-0.83	0.0	23.57	0.0
gdcfdeteco	0	0	0	1	1	0	1	1	0.2395015	−2.68773	9.009	2.61	1.37	0.857	0.0	4.778	−1.71
gdcfdetecu	0	0	0	1	1	1	0	0	0.2201169	−2.81126	6.661	0.001	0.039	0.003	0.095	13.34	1.11
gdcfdemeco	0	1	3	0	1	0	1	1	0.1057385	−4.05274	17.26	3.77	1.01	1.66	0.0	14.55	−0.29
gdcfdemecu	0	1	1	0	0	1	0	0	0.1285242	−3.94269	10.90	1.29	0.160	1.12	0.377	12.14	0.272
pceco	0	0	1	1	0	0	1	0	0.0056047	−10.1416	16.81	7.65	−0.73	2.67	2.37	16.53	−0.88
pcecu	0	0	1	1	0	0	1	0	0.0128705	−8.59145	16.20	1.09	-0.49	0.925	0.0	15.52	−0.57
pcecfco	0	1	0	0	0	0	1	0	0.0230440	−7.20739	10.70	1.87	0.924	1.01	0.622	19.93	−0.60
pcecfcu	0	1	0	0	0	0	1	0	0.0245154	−7.13808	7.880	1.53	−0.11	1.23	0.675	8.836	0.885
pcebevco	0	1	0	0	1	0	1	1	0.0124567	–-8.43768	9.653	0.018	0.038	0.128	0.0	9.862	−1.46
pcebevcu	0	0	0	1	1	0	1	0	0.0237830	−7.36338	20.87	2.76	1.66	−0.01	0.0	12.09	−0.29
pcefco	0	0	1	1	0	0	1	0	0.0071008	−9.78091	8.644	5.40	−1.54	1.74	0.909	14.15	0.0
pcefcu	0	0	1	1	0	0	1	0	0.0170740	−8.02621	18.38	24.2	−1.62	4.65	0.0	5.738	0.0
pceflwco	0	0	0	1	1	0	1	0	0.0221467	−7.22811	20.82	44.0	4.05	5.25	0.568	5.675	−1.21
pceflwcu	0	0	1	1	0	0	1	1	0.0270528	−6.82790	13.82	2.83	−0.93	1.40	0.0	12.79	−0.60
pcehhfco	0	0	0	0	1	1	1	1	0.0205256	−7.27834	18.54	1.67	1.13	0.635	0.015	12.58	0.596
pcehhfcu	0	0	0	1	0	0	1	1	0.0374097	−6.40099	14.07	15.5	2.53	3.01	0.537	17.93	−0.87
pcehhoco	1	0	2	1	0	0	1	0	76.01081	8.83241	7.884	0.821	−0.41	0.808	0.0	6.111	0.572
pcehhocu	0	0	0	1	1	0	1	0	0.0067048	−9.72758	19.14	1.59	−1.26	-0.09	0.0	17.41	0.0
pcetobco	0	1	0	0	2	0	1	0	0.0288786	−6.75600	24.97	20.5	2.66	3.66	5.28	16.97	1.46
pcetobcu	0	1	0	0	0	0	1	0	0.0326529	−6.61974	24.23	29.6	1.93	5.08	6.87	15.00	−1.17
pcetcco	0	0	0	1	0	0	1	1	0.0188025	−7.83335	9.104	1.71	1.18	−0.56	0.162	11.70	0.572
pcetccu	0	0	0	1	1	0	1	1	0.0371318	−6.41590	7.128	0.441	0.138	−0.65	0.0	19.62	0.0
pcemiscco	0	0	0	1	0	0	1	1	0.0132176	−8.54854	10.57	0.022	−0.14	−0.05	0.0	13.78	0.572
pcemisccu	0	0	0	1	1	0	1	0	0.0137337	−8.40515	10.15	0.876	0.896	−0.27	0.0	13.19	−0.58

Appendix B continued...

gvaaffco	1	1	1	0	0	0	1	1	1754.414	15.1083	5.019	10.2	−2.41	2.10	0.764	9.984	0.566
gvaaffcu	0	1	1	0	0	0	1	1	0.0334867	−6.45990	15.02	0.523	0.146	0.708	0.0	15.28	−1.75
gvaindaico	0	1	0	0	2	0	1	0	0.0282708	−6.90795	9.501	2.15	−0.60	−1.34	0.0	9.686	−0.29
gvaindaicu	0	1	1	0	0	0	1	1	0.0336457	−6.45043	14.48	0.735	−0.02	0.857	0.0	14.73	−0.58
gvaindaiag~o	1	1	0	0	0	0	1	1	1174.524	14.3611	10.84	0.581	−0.09	−0.76	0.743	16.11	−2.31
gvaindaiag~u	0	1	1	0	0	0	1	1	0.0374311	−6.18319	10.10	1.01	0.757	0.659	0.0	4.652	−.59
gvaindaifi~o	0	0	0	1	1	0	1	0	0.0360104	−6.53371	11.25	4.24	1.84	0.922	0.0	7.880	−0.86
gvaindaifi~u	0	1	3	1	1	0	0	0	0.0373247	−6.20231	11.56	1.27	−0.78	0.813	0.636	9.229	−0.56
gvaindfico	0	1	0	0	0	1	0	0	0.3560555	−1.90475	9.680	0.261	−0.27	−0.44	0.0	19.98	−2.47
gvaindficu	0	0	1	0	0	0	1	0	0.3999998	−1.71983	10.45	1.25	−0.19	1.10	0.0	10.21	−0.28
gvconsco	0	0	1	0	0	0	1	1	0.0727864	−4.96162	6.698	1.54	0.849	0.903	0.241	4.211	−0.29
gvconscu	0	1	1	0	0	0	1	1	0.0715230	−4.94216	6.919	2.92	1.69	0.258	0.0	12.12	0.0
gvconsgv~bco	0	0	1	0	0	0	1	0	0.1679410	−3.39975	16.38	0.087	−0.26	−0.13	0.0	7.684	0.286
gvconsgv~bcu	0	0	0	1	1	0	1	1	0.1874534	−3.17779	14.69	0.586	0.759	−0.10	0.0	11.43	−0.29
gvconsgv~vco	0	1	0	1	1	0	1	1	0.0817186	−4.83829	10.40	1.30	0.376	−1.08	2.28	14.91	0.857
gvconsgv~vcu	0	1	0	1	1	0	1	1	0.0771542	−4.95324	8.981	1.40	0.037	−1.18	0.181	14.96	0.286
gvaconsco	0	0	1	0	0	0	1	0	0.0851643	−4.75781	16.58	0.553	0.711	−0.22	0.0	12.65	0.857
gvaconscu	0	1	1	0	0	0	1	1	0.0737295	−4.88139	7.741	3.53	1.87	0.201	0.0	11.21	0.0
gvamfgco	0	1	2	0	0	0	1	1	0.0171732	−7.74150	20.38	1.37	0.895	0.754	0.0	16.56	0.584
gvamfgcu	0	1	2	0	0	0	1	0	0.0285754	−6.83159	11.89	1.24	0.315	−1.07	0.0	10.53	−0.29
gvamfgfmco	0	1	0	0	1	0	1	0	0.0305141	−6.75524	9.586	0.469	0.355	−0.59	0.261	13.73	−1.44
gvamfgfmcu	0	1	2	0	0	0	1	0	0.0336644	−6.50380	5.342	0.226	0.084	−0.47	0.0	7.986	−0.87
gvamfgbico	0	1	1	0	0	0	1	1	0.0616083	−5.35002	13.39	0.737	−0.68	−0.53	0.926	19.21	−0.57
gvamfgbicu	0	1	1	0	0	0	1	1	0.0684685	−5.19423	9.086	1.80	−0.31	−1.31	0.294	25.54	−0.28
gvamfgtomco	0	0	1	0	0	0	1	0	0.1083244	−4.16642	13.81	0.209	−0.25	0.380	1.33	6.132	0.584
gvamfgtomcu	0	0	1	0	0	0	1	0	0.1148556	−4.04933	15.02	0.446	−0.03	0.667	0.322	9.286	0.0
gvamfgtemco	0	0	1	0	0	0	1	0	0.0997711	−4.55319	18.16	7.08	−1.35	2.29	0.0	18.99	−0.84
gvamfgtemcu	0	0	1	0	0	0	1	0	0.0941734	−4.66867	12.39	13.3	−2.14	2.95	0.0	20.81	−0.56
gvamfgfwaco	0	0	1	0	0	0	1	0	0.1103548	−4.29536	11.32	0.114	0.334	−0.05	0.0	17.31	−0.85
gvamfgfwacu	0	0	1	0	0	0	1	0	0.1065064	−4.42253	14.80	0.998	−0.95	−0.31	0.0	25.38	−0.56
gvamfgwcpco	0	0	1	0	0	0	1	0	0.1365669	−3.86913	19.20	0.230	0.428	0.216	0.0	12.28	0.0
gvamfgwcpcu	0	0	1	0	0	0	1	0	0.1069250	−4.24736	18.20	0.091	−0.05	−0.30	0.0	16.42	0.0
gvamfgffco	0	1	1	0	0	0	1	0	0.0942143	−4.50047	23.21	0.142	−0.22	−0.31	0.0	15.41	−0.87
gvamfgffcu	0	0	0	1	1	0	1	1	0.1114451	−4.27426	9.180	1.35	−0.09	1.16	0.001	15.85	−1.13
gvamfgpppco	0	0	1	0	0	0	1	1	0.0765967	−5.02565	10.88	0.393	−0.06	−0.62	0.0	20.50	−1.40
gvamfgpppcu	0	1	1	0	0	0	1	1	0.0805137	−4.87012	10.02	1.03	0.725	−0.71	0.096	19.09	−0.57
gvamfgppco	0	0	1	0	0	0	1	0	0.0685960	−5.19051	7.366	0.484	0.174	−0.67	0.0	6.277	−0.57
gvamfgppcu	0	1	1	0	0	0	1	0	0.0745568	−5.02386	15.58	1.76	−0.65	1.16	2.82	9.313	−1.14
gvamfgllpco	0	0	0	0	1	0	1	0	0.2760219	−2.35065	17.37	5.40	−0.25	2.31	3.87	40.49	1.16
gvamfgllpcu	0	0	2	0	1	0	1	0	0.2145076	−2.69150	7.956	4.72	−1.69	1.36	0.400	8.828	−0.29
gvamfgrpco	0	0	1	0	0	0	1	1	0.0755277	−4.88768	9.847	0.582	−0.15	−0.75	0.0	30.28	0.867
gvamfgrpcu	0	1	2	0	0	0	1	0	0.1046199	−4.29094	17.38	2.55	1.18	1.08	0.0	8.121	0.286
gvamfgccpco	0	0	0	1	1	0	1	1	0.0632143	−5.40827	10.14	2.56	−0.51	−1.52	0.523	10.30	0.283
gvamfgccpcu	0	1	1	0	0	0	1	1	0.0578981	−5.47424	21.48	1.80	−1.20	−0.59	0.078	13.54	−0.29

Appendix B continued...

gvamfgppcco	1	0	0	0	1	1	1	0	741.4462	13.4411	9.255	0.712	0.350	−0.77	0.821	6.113	1.14
gvamfgppccu	0	1	1	0	1	1	1	0	0.1239532	−3.89687	5.748	1.36	−0.99	0.622	0.0	8.069	−0.86
gvamfgnmmpco	0	1	0	1	1	0	1	1	0.0988364	−4.45792	15.38	0.536	−0.63	−0.37	0.0	7.510	0.286
gvamfgnmmpcu	1	1	1	0	0	0	1	0	750.1485	13.3533	20.55	0.499	0.121	−0.70	5.74	4.951	0.283
gvamfgbmico	0	0	1	0	0	0	1	0	0.1408780	−3.80697	6.000	0.224	0.411	−0.23	0.0	17.04	−0.57
gvamfgbmicu	0	1	1	0	0	0	1	0	0.1532130	−3.58332	10.27	0.441	−0.49	−0.45	0.0	17.66	−0.86
gvamfgmico	0	1	0	0	2	0	1	0	0.0767501	−4.80109	19.44	18.8	−2.13	3.78	6.33	7.628	−1.17
gvamfgmicu	0	0	0	1	1	0	1	0	0.0632522	−5.29455	28.61	0.078	−0.24	−0.15	0.0	10.29	0.584
gvamfgmeeco	0	1	2	0	0	0	0	1	0.1350775	−3.79040	8.944	0.250	0.498	−0.05	0.011	11.76	−0.54
gvamfgmeecu	0	0	0	1	1	0	0	1	0.1396417	−3.82867	10.01	1.56	−1.22	0.244	0.004	15.46	−0.54
gvamfgemco	0	0	0	1	1	0	1	1	0.1066307	−4.30611	6.410	2.05	1.40	0.325	0.0	7.664	−1.14
gvamfgemcu	0	1	1	0	0	1	0	0	0.1203233	−4.07456	11.18	1.28	1.06	−0.40	0.043	5.033	1.36
gvamfgteco	0	0	1	0	0	0	1	1	0.1334135	−3.91585	7.924	0.917	−0.50	−0.82	0.078	19.38	0.0
gvamfgtecu	0	1	1	0	0	0	1	1	0.1122092	−4.20625	8.521	1.25	−0.93	−0.62	1.37	15.52	0.566
gvamfgmmco	0	1	0	0	2	0	1	0	0.0666100	−5.24927	7.388	1.04	−0.54	−0.86	0.0	9.886	0.849
gvamfgmmcu	0	1	1	0	0	1	0	0	0.0699231	−5.10730	11.58	0.346	−0.44	-0.39	0.527	10.48	−0.82
gvamqco	0	0	0	1	1	0	1	1	0.1270625	−3.95549	8.848	0.256	−0.11	-0.49	0.0	4.133	−0.86
gvamqcu	0	1	3	1	0	0	0	0	0.0809268	−4.50048	9.896	1.01	0.556	−0.84	0.987	11.22	1.46
gvamqcmco	0	0	1	0	0	0	1	0	0.2156454	−2.89971	11.60	12.8	0.750	3.50	3.18	12.06	−2.29
gvamqcmcu	0	0	0	1	1	0	0	1	0.3103123	−2.17786	12.15	88.1	4.35	8.32	0.0	3.481	−2.20
gvamqgmco	1	0	0	1	1	0	1	1	167.1530	10.3520	13.73	2.25	−0.43	−1.44	0.0	15.11	0.566
gvamqgmcu	0	0	0	1	1	0	1	1	0.1665510	−3.47072	12.81	1.80	−0.54	−1.23	0.077	13.22	1.13
gvamqchmco	1	1	1	0	0	1	0	0	3.186927	2.58399	6.719	7.96	2.57	1.17	1.96	21.35	0.278
gvamqchmcu	1	0	0	1	1	0	1	1	7.078467	4.08477	12.59	1.57	0.787	−0.97	0.0	10.99	0.0
gvamqnmco	0	0	1	0	0	0	1	1	0.4773416	−1.20021	5.934	12.0	1.82	2.94	0.0	5.969	0.289
gvamqnmcu	0	0	1	0	0	0	1	1	0.7002703	−0.59983	10.47	1.68	−0.31	1.26	0.046	5.929	−1.12
gvamqommco	0	0	2	0	0	1	1	0	0.4386228	−1.42433	3.740	0.593	0.761	−0.12	0.0	43.93	0.283
gvamqommcu	0	0	0	1	1	0	0	0	0.3817321	−1.87156	14.89	0.082	0.00	−0.29	0.0	17.33	1.36
gvamqcoco	0	0	0	1	1	0	1	1	0.2874457	−2.32278	9.180	1.24	−0.69	−0.87	0.0	8.804	1.14
gvamqcocu	0	1	1	0	0	0	0	0	0.2765498	−2.35731	12.46	3.89	−1.93	0.400	4.97	12.91	−0.83
gvamqsqcsco	1	0	0	1	1	0	1	0	65.86956	8.71276	16.16	13.9	2.08	3.09	0.005	9.417	−1.19
gvamqsqcscu	1	0	1	0	0	0	1	0	186.4118	10.6798	8.623	2.31	−1.51	0.139	0.0	17.70	0.867
gvamqonmco	0	1	0	0	0	0	1	1	0.1912615	−3.08433	10.89	0.086	−0.29	−0.02	0.555	21.94	0.289
gvamqonmcu	0	0	0	1	1	1	1	0	0.2040111	−2.89687	22.09	1.04	1.01	0.158	0.696	22.86	−0.88
gvaosco	0	0	0	1	1	0	1	1	0.0100250	−9.03468	12.57	0.284	0.349	0.402	0.0	5.873	−1.14
gvaoscu	0	0	2	1	1	0	1	1	0.0127115	−8.44821	26.03	1.12	−1.04	0.219	0.0	7.781	−1.43
gvaosgovtco	0	0	0	1	1	0	1	0	0.0225136	−7.47309	6.016	22.8	2.50	4.07	0.0	15.74	0.857
gvaosgovtcu	0	1	3	1	1	0	0	0	0.0426323	−6.04129	8.975	34.3	3.68	4.55	1.68	2.846	−0.55
gvaosprivco	0	0	0	1	0	0	1	0	0.0087997	−9.29541	15.24	0.974	0.982	0.099	0.0	29.29	0.0
gvaosprivcu	0	1	0	1	0	0	1	1	0.0128826	−8.47706	17.88	1.82	1.34	−0.20	0.153	17.04	1.46
gvaosprivb~o	0	0	0	1	1	0	1	0	0.0241646	−7.16344	9.608	8.40	−2.38	1.65	0.0	10.13	−0.30
gvaosprivb~u	0	0	0	1	1	0	1	0	0.0287373	−6.76171	9.491	7.92	−1.73	2.22	0.004	16.41	−0.89
gvaosprive~o	0	1	1	0	0	0	1	0	0.0162872	−8.06622	13.68	2.15	−1.15	−0.91	5.48	16.99	0.286
gvaosprive~u	0	1	0	1	1	0	1	0	0.0194082	−7.71346	20.70	5.86	−1.46	1.93	0.462	20.93	−0.29
gvaosprivh~o	0	1	1	0	0	0	1	0	0.0219912	−7.52147	14.56	1.43	−0.05	−1.19	0.0	26.89	−0.57
gvaosprivh~u	0	1	1	0	0	0	1	0	0.0254614	−7.17265	14.29	2.35	−1.39	−0.65	0.0	13.72	−1.43
gvaosprivm~o	0	0	0	1	1	0	1	1	0.0192706	−7.67165	13.35	2.53	−1.47	0.598	0.335	14.47	−0.29
gvaosprivm~u	0	1	3	1	0	0	1	1	0.0118475	−8.31858	22.01	0.141	0.092	−0.36	0.485	19.22	0.0
gvaosprivr~o	0	0	0	1	0	0	1	1	0.0247443	−7.11603	8.256	0.373	0.611	0.003	0.0	3.592	0.0
gvaosprivr~u	0	0	0	1	0	0	1	0	0.0282637	−6.96169	18.71	12.7	2.71	2.32	0.0	8.765	0.584
gvaosprivp~o	0	0	0	1	1	0	1	0	0.0158156	−8.06682	14.30	1.81	1.10	0.772	0.462	7.546	0.292

Appendix B continued...

gvaosprivp~u	0	0	0	1	1	0	1	0	0.0242256	−7.32651	8.663	0.903	0.883	0.351	0.0	17.93	−1.71
gvaosprivo~o	0	0	0	1	1	0	1	0	0.0131259	−8.49568	11.91	1.74	1.20	−0.55	1.07	7.739	0.578
gvaosprivo~u	0	0	0	1	1	0	1	0	0.0199091	−7.66250	10.78	0.234	0.484	0.00	0.457	10.07	−0.58
gvaodreco	0	0	0	1	1	0	1	1	0.0144486	−8.30366	8.914	2.22	−1.49	-0.09	0.0	8.956	−1.14
gvaodrecu	0	0	0	1	0	0	1	1	0.0134819	−8.49863	4.990	1.26	−0.20	−1.10	0.0	7.540	1.14
gvaodrereco	0	0	0	1	0	1	0	0	0.0663300	−5.31755	11.13	3.32	−1.58	0.900	0.0	6.461	1.65
gvaodrerecu	0	0	0	1	0	0	1	1	0.0587173	−5.49938	13.64	0.513	−0.38	-0.61	0.0	8.193	0.289
gvaodreodco	1	0	0	1	1	0	1	1	20.53564	6.38173	21.41	12.9	−2.33	2.73	0.0	3.639	0.590
gvaodreodcu	1	0	3	1	1	0	1	0	327.8135	11.8672	4.110	2.30	1.52	0.000	0.0	14.36	1.14
gvatrco	0	0	2	0	0	0	1	0	0.0253849	−7.06837	9.155	57.4	−0.39	7.57	0.481	19.91	−0.87
gvatrcu	0	0	0	1	1	0	1	1	0.0168462	−7.88498	7.672	0.584	−0.63	0.436	0.0	8.932	1.17
gvatrwsco	0	0	0	1	1	0	1	0	0.0204871	−7.22323	10.45	0.935	−0.87	−0.43	0.0	12.04	0.312
gvatrwscu	0	0	0	1	0	0	1	1	0.0371251	−6.41627	17.15	0.433	−0.45	−0.48	0.0	7.997	0.578
gvatrrtco	0	1	1	0	0	0	1	0	0.0190292	−7.37729	10.37	4.37	1.08	1.79	2.05	15.25	−0.31
gvatrrtcu	0	0	0	1	1	0	1	0	0.0195051	−7.59187	12.65	3.12	−1.05	1.42	0.015	16.69	1.18
gvatcsco	0	0	0	1	1	0	1	0	0.0195062	−7.75986	13.37	0.393	0.165	−0.61	1.28	15.74	−0.86
gvatcscu	0	0	0	1	0	0	1	1	0.0287609	−6.98329	14.67	1.36	0.391	−1.10	0.030	22.33	−0.86
gvatcstsco	0	1	1	0	1	0	1	0	0.0165654	−7.97698	18.60	6.05	−1.72	1.76	0.115	21.87	0.857
gvatcstscu	0	0	0	1	0	0	1	1	0.0408137	−6.34018	18.21	15.5	2.33	3.17	0.620	11.00	1.42
gvatcscomco	0	0	0	1	1	0	1	0	0.0288476	−6.92080	11.91	0.270	0.400	−0.33	0.732	8.635	0.867
gvatcscomcu	0	0	0	1	1	0	1	0	0.0297927	−6.85633	10.35	1.61	−0.51	−1.16	0.0	9.354	−0.29

Appendix C. SEATS Models Summary Results for Quarterly National Accounts Statistics

Time Series	Pre-adjusted	Model Changed	Approx. to NA	New Model							SD(a)	Spectrum Factor	Check on ACF	Check on CCF	Deterministic			
				m	*p*	*d*	*q*	*P*	*D*	*Q*					TC	S	U	Trans
gnppceco	Y	N	N	0	3	1	0	0	1	0	.1272E-01	0	0	0	Y	N	Y	N
gnppcecu	Y	Y	Y	0	0	1	2	0	1	0	.1790E-01	0	0	0	Y	N	Y	N
gnpgceco	Y	N	N	1	0	0	1	0	1	0	.5721E-01	0	0	0	Y	N	N	N
gnpgcecu	Y	N	N	0	0	1	1	0	1	1	.4563E-01	0	0	0	Y	N	Y	N
gnpcfco	Y	N	N	0	0	1	1	0	1	1	4881.	0	0	0	Y	N	N	N
gnpcfcu	Y	N	N	0	0	1	1	1	1	1	.9961E-01	0	0	0	N	N	Y	N
gnpcffcco	Y	Y	N	0	1	1	0	0	1	1	3876.	0	0	0	Y	Y	Y	N
gnpcffccu	Y	N	N	1	1	1	0	1	0	0	.9959E-01	0	0	0	N	N	N	N
gnpcffccon~o	Y	N	N	0	0	1	1	0	1	0	2681.	0	0	0	Y	N	Y	N
gnpcffccon~u	Y	N	N	0	0	1	1	0	1	1	.1183	0	0	0	N	Y	Y	N
gnpcffcdeco	Y	N	N	0	0	1	1	0	1	1	1921.	0	0	0	Y	N	Y	N
gnpcffcdecu	Y	Y	N	1	0	1	1	0	0	0	.1095	0	0	0	N	N	N	N
gnpcffcbso~o	Y	N	N	1	0	0	0	1	1	0	.3554E-01	0	0	0	Y	N	Y	N
gnpcffcbso~u	Y	Y	Y	0	0	1	1	0	1	1	.5454E-01	0	0	0	Y	N	Y	N
gnpcfcisco	Y	N	N	0	0	0	1	0	1	1	2575.	0	0	0	N	N	Y	N
gnpcfciscu	Y	N	N	0	0	0	0	0	1	1	5944.	0	0	0	N	N	Y	N
gnpexco	Y	N	N	1	1	0	0	0	1	1	.7677E-01	0	0	0	Y	N	Y	N
gnpexcu	Y	N	N	0	0	1	0	0	1	1	.6759E-01	0	0	0	Y	N	Y	N
gnpextmeco	Y	Y	Y	1	0	0	0	0	1	0	.8926E-01	0	E	0	N	N	Y	N
gnpextmecu	Y	Y	N	1	1	0	0	0	1	1	.7215E-01	0	0	0	Y	N	N	N
gnpexnfsco	Y	N	N	1	1	0	0	0	0	0	.8359E-01	0	0	0	Y	N	Y	N
gnpexnfscu	Y	N	N	1	0	1	0	0	0	0	.1095	0	0	0	Y	N	N	N
gnpmco	Y	N	N	0	1	1	0	0	1	1	.5826E-01	0	0	0	Y	Y	Y	N
gnpmcu	Y	N	N	1	0	1	1	0	0	0	.8870E-01	0	0	0	Y	N	N	N
gnpmtmico	Y	N	N	1	1	0	0	0	1	1	.7377E-01	0	0	0	N	N	Y	N
gnpmtmicu	Y	N	N	1	2	1	0	0	0	0	.8714E-01	0	0	0	N	N	N	N
gnpmnfsco	Y	N	N	0	0	1	1	0	1	1	.1385	0	0	0	Y	N	Y	N
gnpmnfscu	Y	N	N	1	1	0	0	1	0	0	.1208	0	0	0	N	N	Y	N
gnpsdco	Y	N	N	0	0	1	1	0	1	0	7962.	0	0	0	Y	N	Y	N

Appendix C continued...

Time Series	Pre-adjusted	Model Changed	Approx to NA	New model							SD(a)	Spectrum Factor	Check on ACF	Check on CCF	Deterministic			
				m	p	d	q	P	D	Q					TC	S	U	Trans
gnpsdcu	Y	Y	Y	0	0	1	1	0	1	1	.1453E+05	0	E	0	Y	N	Y	N
gnpmitglci~o	Y	N	N	0	1	0	0	1	0	0	6827.	0	0	0	Y	N	Y	N
gnpmignico	Y	N	N	0	2	0	0	0	1	0	.3943E-01	0	0	0	Y	N	Y	N
gdpexpco	Y	N	N	0	1	1	1	0	1	0	.2719E-01	0	0	0	N	N	Y	N
gdpexpcu	Y	N	N	0	0	1	0	0	1	1	.1764E-01	0	0	0	Y	N	Y	N
nfiaexpco	Y	N	N	0	1	1	0	0	1	1	1967.	0	0	0	N	N	Y	N
nfiaexpcu	Y	N	N	0	1	1	0	0	1	0	5408.	0	0	0	Y	N	Y	N
gnpexpco	Y	N	N	0	1	1	0	0	1	0	.2515E-01	0	0	0	Y	Y	Y	N
gnpexpcu	Y	N	N	0	0	1	0	0	1	1	.2152E-01	0	0	0	Y	N	Y	N
gnpaffco	Y	N	N	0	0	1	1	0	1	0	1348.	0	0	0	Y	N	Y	N
gnpaffcu	Y	N	N	1	1	0	0	0	1	1	.5029E-01	0	0	0	Y	N	Y	N
gnpisco	Y	N	N	0	1	0	0	0	1	0	.3533E-01	0	0	0	N	Y	Y	N
gnpiscu	Y	N	N	0	1	1	1	0	1	1	.3789E-01	0	0	0	Y	N	Y	N
gnpssco	Y	Y	Y	1	0	1	1	0	1	1	.1301E-01	0	E	0	Y	N	Y	N
gnpsscu	Y	N	N	0	1	1	0	0	1	0	.1200E-01	0	0	0	Y	N	Y	N
gnpindgdpco	Y	N	N	1	1	0	0	0	1	0	.1507E-01	0	0	0	Y	Y	Y	N
gnpindgdpcu	Y	N	N	0	0	1	0	0	1	1	.1764E-01	0	0	0	Y	N	Y	N
gnpindnfiaco	Y	Y	Y	1	2	1	1	0	1	1	1696.	0	0	0	Y	N	Y	N
gnpindnfiacu	Y	N	N	0	1	1	0	0	1	0	5408.	0	0	0	Y	N	Y	N
gnpindco	Y	N	N	0	0	1	1	0	1	0	.2053E-01	0	0	0	Y	Y	Y	N
gnpindcu	Y	N	N	0	0	1	0	0	1	1	.2152E-01	0	0	0	Y	N	Y	N
gdcfdemspico	Y	N	N	0	1	0	0	0	1	0	.7892E-01	0	0	0	Y	Y	Y	N
gdcfdemspicu	Y	Y	N	1	1	0	0	0	1	1	.9577E-01	0	0	0	N	N	Y	N
gdcfdegimeco	Y	N	N	1	1	0	0	1	0	0	.1241	0	0	0	N	N	Y	N
gdcfdegimecu	Y	N	N	0	0	0	2	0	1	0	.1505	0	0	0	N	N	N	N
gdcfdeteco	Y	N	N	0	0	1	1	0	1	1	.2370	0	0	0	Y	N	N	N
gdcfdetecu	Y	N	N	0	0	1	1	1	0	0	.2194	0	0	0	Y	N	Y	N
gdcfdemeco	Y	N	N	1	3	0	1	0	1	1	.1040	0	0	0	Y	N	Y	N
gdcfdemecu	Y	N	N	1	1	0	0	1	0	0	.1218	0	0	0	N	N	N	N

Time Series	Pre-adjusted	Model Changed	Approx. to NA	New Model							SD(a)	Spectrum Factor	Check on ACF	Check on CCF	Deterministic			
				m	*p*	*d*	*q*	*P*	*D*	*Q*					TC	S	U	Trans
pceco	Y	N	N	0	1	1	0	0	1	0	.5437E-02	0	0	0	N	N	Y	N
pcecu	Y	N	N	0	1	1	0	0	1	0	.1286E-01	0	0	0	N	N	Y	N
pcecfco	Y	N	N	1	0	0	0	0	1	0	.2189E-01	0	0	0	Y	Y	Y	N
pcecfcu	Y	N	N	1	0	0	0	0	1	0	.2353E-01	0	0	0	Y	Y	Y	N
pcebevco	Y	Y	Y	0	0	1	1	0	1	1	.1599E-01	0	0	0	N	N	Y	N
pcebevcu	Y	N	N	0	0	1	1	0	1	0	.2354E-01	0	0	0	N	N	Y	N
pcefco	Y	N	N	0	1	1	0	0	1	0	.7067E-02	0	0	0	N	N	Y	N
pcefcu	Y	N	N	0	1	1	0	0	1	0	.1700E-01	0	0	0	N	N	Y	N
pceflwco	Y	N	N	0	0	1	1	0	1	0	.2078E-01	0	0	0	Y	Y	Y	N
pceflwcu	Y	N	N	0	1	1	0	0	1	1	.2588E-01	0	0	0	Y	N	Y	N
pcehhfco	Y	Y	Y	0	0	1	1	0	1	1	.3482E-01	0	E	0	Y	N	Y	N
pcehhfcu	Y	Y	Y	0	0	1	1	0	1	1	.5226E-01	0	0	0	Y	N	Y	N
pcehhoco	Y	N	N	0	2	1	0	0	1	0	74.44	0	0	0	N	N	Y	N
pcehhocu	Y	N	N	0	0	1	1	0	1	0	.6431E-02	0	0	0	N	N	Y	N
pcetobco	Y	Y	Y	1	0	0	1	0	1	0	.4002E-01	0	0	0	Y	N	Y	N
pcetobcu	Y	N	N	1	0	0	0	0	1	0	.3168E-01	0	0	0	N	N	Y	N
pcetcco	Y	N	N	0	0	1	0	0	1	1	.1861E-01	0	0	0	N	Y	N	N
pcetccu	Y	N	N	0	0	1	1	0	1	1	.3675E-01	0	0	0	N	N	Y	N
pcemiscco	Y	N	N	0	0	1	0	0	1	1	.1302E-01	0	0	0	N	Y	N	N
pcemisccu	Y	N	N	0	0	1	1	0	1	0	.1346E-01	0	0	0	Y	N	Y	N
gvaaffco	Y	N	N	1	1	0	0	0	1	1	1758.	0	0	0	N	N	N	N
gvaaffcu	Y	N	N	1	1	0	0	0	1	1	.3288E-01	0	0	0	Y	N	Y	N
gvaindaico	Y	N	N	1	0	0	2	0	1	0	.2798E-01	0	0	0	N	N	Y	N
gvaindaicu	Y	N	N	1	1	0	0	0	1	1	.3305E-01	0	0	0	Y	N	Y	N
gvaindaiag~o	Y	N	N	1	0	0	0	0	1	1	1151.	0	0	0	N	N	Y	N
gvaindaiag~u	Y	N	N	1	1	0	0	0	1	1	.3626E-01	0	0	0	Y	N	Y	N
gvaindaifi~o	Y	N	N	0	0	1	1	0	1	0	.3565E-01	0	0	0	N	N	Y	N
gvaindaifi~u	Y	N	N	1	3	1	1	0	0	0	.3730E-01	0	0	0	N	N	Y	N
gvaindfico	Y	N	N	1	0	0	0	1	0	0	.3619	0	0	0	N	N	Y	N

Appendix C continued...

Time Series	Pre-adjusted	Model Changed	Approx. to NA	New Model							SD(a)	Spectrum Factor	Check on ACF	Check on CCF	Deterministic			
				m	p	d	q	P	D	Q					TC	S	U	Trans
gvaindficu	Y	N	N	0	1	0	0	0	1	0	.3957	0	0	0	N	N	Y	N
gvconsco	Y	N	N	0	1	0	0	0	1	1	.7126E-01	0	0	0	Y	N	Y	N
gvconscu	Y	N	N	1	1	0	0	0	1	1	.7002E-01	0	0	0	Y	N	Y	N
gvconsgv~bco	Y	N	N	0	1	0	0	0	1	0	.1650	0	0	0	N	N	Y	N
gvconsgv~bcu	Y	N	N	0	0	1	1	0	1	1	.1855	0	0	0	N	N	Y	N
gvconsgv~vco	Y	N	N	1	0	1	1	0	1	1	.8220E-01	0	0	0	N	N	N	N
gvconsgv~vcu	Y	N	N	1	0	1	1	0	1	1	.7757E-01	0	0	0	N	N	N	N
gvaconsco	Y	N	N	0	1	0	0	0	1	0	.8430E-01	0	0	0	Y	N	Y	N
gvaconscu	Y	N	N	1	1	0	0	0	1	1	.7218E-01	0	0	0	Y	N	Y	N
gvamfgco	Y	Y	Y	0	0	1	1	0	1	1	.1903E-01	0	0	0	N	N	Y	N
gvamfgcu	Y	N	N	1	2	0	0	0	1	0	.2830E-01	0	0	0	Y	N	Y	N
gvamfgfmco	Y	N	N	1	0	0	1	0	1	0	.2990E-01	0	0	0	N	N	Y	N
gvamfgfmcu	Y	Y	Y	1	1	0	1	0	1	0	.3441E-01	0	0	0	Y	N	Y	N
gvamfgbico	Y	N	N	1	1	0	0	0	1	1	.6153E-01	0	0	0	N	N	Y	N
gvamfgbicu	Y	N	N	1	1	0	0	0	1	1	.6833E-01	0	0	0	N	N	N	N
gvamfgtomco	Y	N	N	0	1	0	0	0	1	0	.1048	0	0	0	Y	N	Y	N
gvamfgtomcu	Y	N	N	0	1	0	0	0	1	0	.1097	0	0	0	Y	N	Y	N
gvamfgtemco	Y	N	N	0	1	0	0	0	1	0	.1007	0	0	0	N	N	N	N
gvamfgtemcu	Y	N	N	0	1	0	0	0	1	0	.9475E-01	0	0	0	N	N	N	N
gvamfgfwaco	Y	N	N	0	1	0	0	0	1	0	.1096	0	0	0	N	Y	N	N
gvamfgfwacu	Y	N	N	0	1	0	0	0	1	0	.1052	0	0	0	N	N	N	N
gvamfgwcpco	Y	N	N	0	1	0	0	0	1	0	.1360	0	0	0	N	N	Y	N
gvamfgwcpcu	Y	N	N	0	1	0	0	0	1	0	.1048	0	0	0	N	N	Y	N
gvamfgffco	Y	N	N	1	1	0	0	0	1	0	.9185E-01	0	0	0	Y	N	Y	N
gvamfgffcu	Y	N	N	0	0	1	1	0	1	1	.1114	0	0	0	N	N	N	N
gvamfgpppco	Y	N	N	0	1	0	0	0	1	1	.7721E-01	0	0	0	N	N	N	N
gvamfgpppcu	Y	N	N	1	1	0	0	0	1	1	.8121E-01	0	0	0	N	N	N	N
gvamfgppco	Y	N	N	0	1	0	0	0	1	0	.6719E-01	0	0	0	N	N	Y	N
gvamfgppcu	Y	N	N	1	1	0	0	0	1	0	.7421E-01	0	0	0	N	N	Y	N

Time Series	Pre-adjusted	Model Changed	Approx. to NA	New Model							SD(a)	Spectrum Factor	Check on ACF	Check on CCF	Deterministic			
				m	*p*	*d*	*q*	*P*	*D*	*Q*					TC	S	U	Trans
gvamfgllpco	Y	N	N	0	0	0	1	0	1	0	.2678	0	0	0	Y	N	Y	N
gvamfgllpcu	Y	N	N	0	2	0	1	0	1	0	.2084	0	0	0	Y	N	Y	N
gvamfgrpco	Y	N	N	0	1	0	0	0	1	1	.7267E-01	0	0	0	Y	N	Y	N
gvamfgrpcu	Y	Y	Y	1	1	0	1	0	1	0	.1045	0	0	0	Y	N	N	N
gvamfgccpco	Y	N	N	0	0	1	1	0	1	1	.6321E-01	0	0	0	N	N	N	N
gvamfgccpcu	Y	N	N	1	1	0	0	0	1	1	.5789E-01	0	0	0	N	N	Y	N
gvamfgppcco	Y	Y	N	1	0	0	1	0	1	1	738.4	0	0	0	Y	N	Y	N
gvamfgppccu	Y	Y	N	1	1	0	1	0	1	1	.1241	0	0	0	N	N	Y	N
gvamfgnmmpco	Y	N	N	1	0	1	1	0	1	1	.9915E-01	0	0	0	N	N	N	N
gvamfgnmmpcu	Y	N	N	1	1	0	0	0	1	0	753.4	0	0	0	N	N	N	N
gvamfgbmico	Y	N	N	0	1	0	0	0	1	0	.1406	0	0	0	Y	N	N	N
gvamfgbmicu	Y	N	N	1	1	0	0	0	1	0	.1532	0	0	0	Y	N	N	N
gvamfgmico	Y	N	N	1	0	0	2	0	1	0	.7436E-01	0	0	0	Y	N	Y	N
gvamfgmicu	Y	N	N	0	0	1	1	0	1	0	.6133E-01	0	0	0	Y	N	N	N
gvamfgmeeco	Y	Y	N	1	2	0	0	0	0	0	.1421	0	0	0	N	N	N	N
gvamfgmeecu	Y	Y	N	0	0	1	1	0	0	0	.1495	0	0	0	N	N	N	N
gvamfgemco	Y	N	N	0	0	1	1	0	1	1	.1055	0	0	0	Y	N	N	N
gvamfgemcu	Y	N	N	1	1	0	0	1	0	0	.1175	0	0	0	N	N	N	N
gvamfgteco	Y	N	N	0	1	0	0	0	1	1	.1333	0	0	0	N	N	N	N
gvamfgtecu	Y	N	N	1	1	0	0	0	1	1	.1136	0	0	0	N	N	N	N
gvamfgmmco	Y	N	N	1	0	0	2	0	1	0	.6662E-01	0	0	0	N	N	N	N
gvamfgmmcu	Y	N	N	1	1	0	0	1	0	0	.6713E-01	0	0	0	Y	N	N	N
gvamqco	Y	N	N	0	0	1	1	0	1	1	.1258	0	0	0	Y	N	N	N
gvamqcu	Y	N	N	1	3	1	0	0	0	0	.7773E-01	0	0	0	Y	N	Y	N
gvamqcmco	Y	N	N	0	1	0	0	0	1	0	.2052	0	0	0	Y	N	Y	N
gvamqcmcu	Y	Y	N	0	0	1	1	0	0	0	.3656	0	0	0	N	Y	N	N
gvamqgmco	Y	N	N	0	0	1	1	0	1	1	167.2	0	0	0	N	N	N	N
gvamqgmcu	Y	N	N	0	0	1	1	0	1	1	.1666	0	0	0	N	N	N	N
gvamqchmco	Y	N	N	1	1	0	0	1	0	0	3.074	0	0	0	N	Y	Y	N

Appendix C continued...

Time Series	Pre-adjusted	Model Changed	Approx. to NA	New Model							SD(a)	Spectrum Factor	Check on ACF	Check on CCF	Deterministic			
				m	*p*	*d*	*q*	*P*	*D*	*Q*					TC	S	U	Trans
gvamqchmcu	Y	N	N	0	0	1	1	0	1	1	7.006	0	0	0	N	Y	N	N
gvamqnmco	Y	N	N	0	1	0	0	0	1	1	.4644	0	0	0	N	Y	Y	N
gvamqnmcu	Y	N	N	0	1	0	0	0	1	1	.7069	0	0	0	N	N	N	N
gvamqommco	Y	Y	N	1	2	0	0	0	1	1	.4466	0	0	0	N	Y	N	N
gvamqommcu	Y	N	N	0	0	1	1	0	0	0	.3817	0	0	0	N	N	N	N
gvamqcoco	Y	N	N	0	0	1	1	0	1	1	.2845	0	0	0	Y	N	N	N
gvamqcocu	Y	N	N	1	1	0	0	0	0	0	.2673	0	0	0	Y	N	Y	N
gvamqsqcsco	Y	N	N	0	0	1	1	0	1	0	62.49	0	0	0	Y	N	Y	N
gvamqsqcscu	Y	N	N	0	1	0	0	0	1	0	182.6	0	0	0	N	N	Y	N
gvamqonmco	Y	N	N	1	0	0	0	0	1	1	.1874	0	0	0	N	N	Y	N
gvamqonmcu	Y	Y	N	1	0	1	1	0	1	1	.1828	0	0	0	Y	N	Y	N
gvaosco	Y	Y	Y	1	0	1	1	0	1	1	.1036E-01	0	0	0	Y	N	N	N
gvaoscu	Y	Y	Y	1	0	1	1	0	1	1	.1495E-01	0	0	0	N	Y	N	N
gvaosgovtco	Y	N	N	0	0	1	1	0	1	0	.2229E-01	0	0	0	Y	N	N	N
gvaosgovtcu	Y	N	N	1	3	1	1	0	0	0	.3743E-01	0	E	0	N	N	N	N
gvaosprivco	Y	N	N	0	0	1	0	0	1	0	.8537E-02	0	0	0	Y	N	Y	N
gvaosprivcu	Y	N	N	1	0	1	0	0	1	1	.1262E-01	0	0	0	Y	N	Y	N
gvaosprivb~o	Y	N	N	0	0	1	1	0	1	0	.2318E-01	0	0	0	Y	N	Y	N
gvaosprivb~u	Y	N	N	0	0	1	1	0	1	0	.2726E-01	0	0	0	Y	N	Y	N
gvaosprive~o	Y	N	N	1	1	0	0	0	1	0	.1565E-01	0	0	0	N	N	Y	N
gvaosprive~u	Y	N	N	1	0	1	1	0	1	0	.1921E-01	0	0	0	N	Y	N	N
gvaosprivh~o	Y	N	N	1	1	0	0	0	1	0	.2221E-01	0	0	0	N	N	N	N
gvaosprivh~u	Y	N	N	1	1	0	0	0	1	0	.2546E-01	0	0	0	N	Y	N	N
gvaosprivm~o	Y	N	N	0	0	1	1	0	1	1	.1887E-01	0	0	0	Y	N	Y	N
gvaosprivm~u	Y	N	N	1	3	1	0	0	1	1	.1114E-01	0	0	0	Y	N	Y	N
gvaosprivr~o	Y	N	N	0	0	1	0	0	1	1	.2373E-01	0	0	0	Y	N	Y	N
gvaosprivr~u	Y	N	N	0	0	1	0	0	1	0	.2742E-01	0	0	0	Y	N	Y	N
gvaosprivp~o	Y	N	N	0	0	1	1	0	1	0	.1533E-01	0	0	0	Y	N	Y	N
gvaosprivp~u	Y	N	N	0	0	1	1	0	1	0	.2398E-01	0	0	0	N	N	Y	N

Time Series	Pre-adjusted	Model Changed	Approx. to NA	New Model							SD(a)	Spectrum Factor	Check on ACF	Check on CCF	Deterministic			
				m	*p*	*d*	*q*	*P*	*D*	*Q*					TC	S	U	Trans
gvaosprivo~o	Y	N	N	0	0	1	1	0	1	0	.1286E-01	0	0	0	Y	N	Y	N
gvaosprivo~u	Y	N	N	0	0	1	1	0	1	0	.1951E-01	0	0	0	Y	N	Y	N
gvaodreco	Y	N	N	0	0	1	1	0	1	1	.1430E-01	0	0	0	Y	N	N	N
gvaodrecu	Y	N	N	0	0	1	0	0	1	1	.1335E-01	0	0	0	Y	N	N	N
gvaodrereco	Y	N	N	0	0	1	0	1	0	0	.6793E-01	0	0	0	N	Y	N	N
gvaodrerecu	Y	N	N	0	0	1	0	0	1	1	.5753E-01	0	0	0	Y	Y	N	N
gvaodreodco	Y	Y	Y	1	0	1	1	0	1	1	27.41	0	0	0	Y	N	Y	N
gvaodreodcu	Y	Y	Y	1	1	1	2	0	1	0	369.7	0	0	0	Y	N	N	N
gvatrco	Y	N	N	0	2	0	0	0	1	0	.2495E-01	0	0	0	N	N	Y	N
gvatrcu	Y	N	N	0	0	1	1	0	1	1	.1632E-01	0	0	0	Y	N	Y	N
gvatrwsco	Y	N	N	0	0	1	1	0	1	0	.1855E-01	0	0	0	Y	N	Y	N
gvatrwscu	Y	N	N	0	0	1	0	0	1	1	.3637E-01	0	0	0	Y	N	Y	N
gvatrrtco	Y	N	N	1	1	0	0	0	1	0	.1765E-01	0	0	0	Y	N	Y	N
gvatrrtcu	Y	N	N	0	0	1	1	0	1	0	.1871E-01	0	0	0	Y	N	Y	N
gvatcsco	Y	N	N	0	0	1	1	0	1	0	.1931E-01	0	0	0	N	Y	N	N
gvatcscu	Y	N	N	0	0	1	0	0	1	1	.2847E-01	0	0	0	N	Y	N	N
gvatcstsco	Y	N	N	1	1	0	1	0	1	0	.1655E-01	0	0	0	N	N	Y	N
gvatcstscu	Y	N	N	0	0	1	0	0	1	1	.4081E-01	0	0	0	N	N	N	N
gvatcscomco	Y	N	N	0	0	1	1	0	1	0	.2826E-01	0	0	0	Y	Y	N	N
gvatcscomcu	Y	N	N	0	0	1	1	0	1	0	.2919E-01	0	0	0	Y	Y	N	N