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New Directions in Latin American Macroeconometrics

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Abstract

This paper provides a brief overview of modeling and forecasting methodologies for price trends and other macroeconomic variables in developing countries. Five different approaches are reviewed within the time series and econometric traditions from which they have been selected. Each methodology offers a means for understanding different aspects of inflationary and other macroeconomic variable movements in Latin American economies. A brief list of publications that illustrate examples of how to implement each modeling strategy is included in the bibliography. There may be situations in which one approach is more useful than alternative techniques, but no methodology should be regarded as uniquely superior to the others.

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Introduction

Econometric forecasting analysis began developing as a field of research with the initial endeavors of Jan Tinbergen and others in the 1930s (Dhane and Barten, 1989). These relatively small macroeconometric models of the Dutch economy were developed using annual data. Research on business cycles in the United States began replicating and extending the Dutch modeling examples in the 1940s. Increasing interest in short-term economic fluctuations eventually led to the development of quarterly forecasting models (Barger and Klein, 1954). Although directed toward better understanding of national economic behavior over time, these early efforts influenced nearly all areas of international macroeconometric analysis which developed subsequently.

Along with the expansion of structural econometric modeling and research in the realms of forecasting and policy analysis, time series statistics also became increasingly sophisticated in the realm of predictive modeling. Most of these efforts occurred with respect to high frequency monthly data, especially univariate autoregressive moving average ARIMA models (Box and Jenkins, 1976). While often regarded as competitors, time series models are frequently utilized as complements to econometric equation sets and can also be imbedded within a variety of forecasting systems (Clemen, 1989; Fullerton, 1989; Zellner, 1994).

Latin American macroeconomic forecasting models began to appear in the 1960s (Beltrán del Río, 1991). Similar to the first models for the Netherlands and the United States, the early Latin American models utilized systems of simultaneous equations designed around national income and product account (NIPA) data. Unlike most industrialized economies, however, NIPA data in Latin America during this period tended to be published only at an annual frequency. This constraint precluded the development of Latin American quarterly forecasting models in a manner analogous to what occurred in many industrialized economies, a problem that long frustrated policy modeling efforts with respect to "southern-hemisphere" countries (Sawyer and Sprinkle, 1987).

Although quarterly forecasting models have not been widely disseminated in Latin America, large-scale forecasting models built using annual NIPA data abound. Representative examples include the CIEMEX-WEFA model for Mexico (Beltrán del Río, 1991), the CIEPLAN model for Chile (Vial, 1988), the Metroeconómica model for Venezuela (Palma and Fontiveros, 1988), and the WEFA models for Colombia and Ecuador (Fullerton, 1993a, 1993b). Among the most salient characteristics shared by these models are continuous maintenance and enhancement over sustained periods of time. All of the aforementioned studies provide detailed references to the history of macroeconometric modeling in the region. Econometric forecasting analysis using annual data in Latin America has a distinguished history and track record that is well-documented.

Given the volatile behaviors of the majority of the economies in Latin America in the 1980s, the absence of quarterly forecasting tools hampered business planning efforts. Forecasting conferences sponsored by commercial entities such as Wharton Econometrics during the late 1980s utilized simulation output from annual structural models for Latin American countries of interest. Client questions at these meetings were generally directed toward the first year of the forecast period, largely ignoring outer period extrapolation results (for example, see Fullerton, 1993a).

This is not to imply that the traditional macroeconometric Latin American models are regarded as useless. Most analyses of international indebtedness typically rely on annual data in order to examine the consequences of changes in regional balance of payment factors. Not surprisingly, significant effort was put forth in recent years to enhance the current account-capital account linkages and simulation performances in Latin American macroeconomic models (Fullerton, 1993a). The relative lack of forecasting models estimated with higher frequency data, nevertheless, continues to pose an obstacle to corporate, public sector, and multilateral agency planners and economists.

Although quarterly national income and product account data are still not widely available to researchers in Latin America, monthly time series for many economic variables do exist. Examples of the latter include inflation indices, money supply measures, currency exchange rates, commodity export prices, and international reserves. Those data, plus the development of low cost microcomputing hardware and econometric software, has encouraged macroeconometric analysis throughout the region to become more time series oriented in recent years (Fullerton, 1992). Accompanying this trend has been the application of increasingly sophisticated econometric methodologies that yield new insights with respect to economic performance in Latin America. Given the adoption of market-oriented adjustment packages that erase many of the short-run relative price rigidities (see Ize and Salas, 1985), the latter class of information analysis is of central importance to policy advisors throughout the region.

This article provides an overview of new directions in Latin American macroeconometric research. Because there is a huge volume of work occurring in this regard, the research contained herein serves as a suggestive survey designed to familiarize readers with some of the promising developments that have emerged in recent years. As an organizational strategy, inflationary modeling research is utilized as the common unifying theme about which each topic is referenced. Additional topics are included where appropriate or of interest, but inflation provides a convenient vantage point from which to develop the framework in an organized manner. Subsequent sections of the paper include discussions of univariate ARIMA time series analysis, multi-input ARIMA transfer function modeling, single-equation econometric modeling, structural model systems of equations econometric analysis, and vector autoregressive multi-series endogeneity approaches.

Univariate ARIMA Time Series Analysis

Univariate ARIMA modeling has been increasingly applied to a wide variety of economic applications in Latin America and other regions of the world. This form of time series analysis attempts to characterize the behavior of an individual variable by utilizing the information contained in its own historical movements. These movements are broken down into stationary components involving autoregressive and moving average sub-components, where the latter are comprised by estimated residuals. Differencing and transformation of the data series are frequently required to induce stationarity in the various moments, generally the mean and variance, associated with the series of interest (Pankratz, 1983).

The basic form of an ARIMA (p,d,q) equation may be expressed as follows:

$$1. \qquad P_t = a_0 + a_1 * P_{t-1} + \ldots + a_p * P_{t-p} + b_1 * U_{t-1} + \ldots + b_q * U_{t-q} + U_t,$$

where t = 1,2,...,T, P is the stationary working series for a dependent variable such as a price index, and U is a random error term. The above representation is for a time series process of autoregressive order p and moving average order q, reflecting the respective number of lags for each type of parameter. The degree of differencing necessary to induce trend stationarity is indicated by the value taken on by the d term in the parentheses. A differenced series is referred to as integrated of order d.

Four basic steps are taken with respect to this type of statistical analysis: identification, estimation, diagnostic checking, and forecasting. Identification is usually accomplished via graphical analysis of the autocorrelation and partial autocorrelation functions. When moving average parameters appear in an ARIMA model, estimation must be accomplished using iterative procedures because the resulting equation is nonlinear. Standard coefficient t-tests, residual chi-square statistics, and goodness-of-fit log-likelihood ratios are used for diagnostic checking. Extrapolation exercises, over history and out-of-sample, provide an idea of the simulation capabilities with any estimated equation. Good diagnostics do not always guarantee forecast accuracy. Still growing in popularity with respect to Latin American macroeconomics, an interesting range of applications has emerged over the course of the past two decades. Two examples are discussed below.

In one of the earliest time series studies developed for an economy in Latin America, Cabrera and Montes (1978) utilize univariate ARIMA techniques to model the consumer price index (CPI) in Colombia. Logarithmic transformation, plus regular and seasonal differencing of the monthly CPI series are used to induce stationarity. An equation containing an autoregressive term at lag 1 and a seasonal moving average term at lag 12 yields statistically significant parameter estimates. While simple in structure, the model exhibits good statistical traits and is found to simulate historical movements of the CPI successfully. Empirical evidence is provided that Colombian inflation, although high relative to that observed in many industrial economies such as Japan and the United States, is stable enough to be modeled and predicted with a fair degree of accuracy.

Interestingly, this early model specification withstood the test of time in an impressive manner in later research on price trends in Colombia (Fullerton, 1993c).

Of course, univariate ARIMA modeling can be applied to many other areas of macroeconomic analysis. One example is provided with respect to the behavior of money multipliers in South America (Fullerton and Kapur, 1991). While monetary aggregates in developing economies are generally subject to high degrees of volatility, evidence is provided that the relationships between monetary bases and money supply measures are stable enough to be modeled and forecast. The analysis indicates that results comparable to those observed for industrial economies such as the United States and the Netherlands are attainable. As such, the article partially refutes the old adage that standard economic hypothesis testing is not applicable to developing economies because they are somehow "different."

Transfer Function ARIMA Analysis

As shown by Box and Jenkins (1976), it is a relatively straightforward and natural progression to move beyond the narrow, but valuable, focus associated with univariate ARIMA modeling. Transfer functions incorporate new information via input series to augment what is already provided in a single variable time series equation. Further utilizing the consumer price index example provided above, the basic form of an ARIMA transfer function can be expressed as follows:

$$2. \quad P_t = a_0 + a_1*P_{t-1} + ... + a_p*P_{t-p} + b_1*U_{t-1} + ... + b_q*U_{t-q} + c_i*M_{t-i} + d_j*X_{t-j} + ... + U_t,$$

where i = 1,...,k, j = 1,...,l, M is the stationary component of a money supply measure such as M1, and X is the stationary component of an exchange rate series or import cost index. Obviously, different input variables will be selected as the nature of the process under consideration determines.

The procedure followed when estimating a transfer ARIMA model is similar to that utilized for univariate time series analysis. In the two-input series case like that depicted in Equation 2, individual univariate ARIMA equations are developed for the dependent varaible P and the independent regressors, M and X, under the four basic steps discussed above. Cross-correlation functions (CCFs) are then estimated using the individual residual series calculated for each of the three univariate models. The CCFs indicate which, if any, lagged observations of M and X are of use in predicting current values of P.

Estimation of the transfer equation for P is then conducted by specifying it as follows. All of the univariate autoregressive and moving average parameters appearing in Equation 1 are incorporated into the initial model. Lags of the input series are included based on the results obtained from the CCFs. Once model parameters have been

calculated, diagnostic testing and equation simulation exercises are conducted to test the overall reliability of the equation. Again, the latter steps are very similar to those conducted for univariate ARIMA specifications.

Fullerton (1993c) utilizes a transfer function autoregressive integrated moving average (transfer ARIMA) modeling framework to analyze movements in consumer prices in Colombia. Forecasting experiments are conducted with the resulting model to shed light on potential impacts associated with an anti-inflationary program enacted by the central bank. Results indicate that this class of time series modeling can provide useful insights with respect to macroeconomic trends and potential policy results in Latin American countries.

This class of time series model has also proven helpful in gauging the impact of currency movements on commuter flows between Mexico and the United States (Fullerton, 1997). Macroeconomic policy changes and business cycle developments of this nature have substantial impacts on regional economic performance and commercial trends. Transfer function analysis conducted for the El Paso, Texas - Ciudad Juarez, Chihuahua international metropolitan area indicates that northbound bridge traffic is impacted by curency devaluations in a manner analogous to the well-known J-curve effects observed for merchandise trade (for examples, see Tegene, 1989, and Demirden and Pastine, 1995). For the 1979 - 1988 sample period, commuter flows between Mexico and the United States are found to respond to real changes in the peso/dollar exchange rate within an eight-month time frame.

A closely related class of ARIMA models that has yet to be widely applied in the context of Latin American macroeconometric analysis is known as intervention analysis (Box and Tiao, 1975). Because of its ability to clarify the effects of major policy changes, this methodology is particularly well-suited to analyzing developments that have taken place over the last 15 years of widespread structural adjustment efforts throughout the region. Prime examples of the latter include the elimination of retail price controls, multi-tiered exchange rate systems, and nontariff import barriers in several important economies such as Venezuela and Ecuador. Intervention modeling techniques may also prove useful in examining the financial consequences of natural disasters such as earthquakes and hurricanes that periodically affect Latin America and the Caribbean (see Lenze, 1997). Similar to the other ARIMA model examples, policy analysis in the region will likely benefit from the dynamic aspects of the intervention framework for quantitative estimation and simulation efforts.

Single Equation Econometric Models

As discussed in the previous section, time series analysis can directly incorporate variables suggested by standard economic hypotheses. Economic theory can also be used to suggest the functional forms of equations to be estimated. Under this more traditional approach, the equation reflects a theoretically specified relationship between movements in the regressor variables and changes in the dependent variable. A wide variety of both

static and simple dynamic examples of this type of model can be found in econometric textbooks (for example, see Pindyck and Rubinfeld, 1991). Straightforward model specifications provide valuable starting points and have been found to withstand the test of time in a robust manner for a wide variety of applications (Christ, 1993; Fullerton, 1993a). A common area of endeavor utilizing this approach for Latin America has been in the realm of macroeconomic growth performance (Edwards, 1993).

Recent work utilizing a single equation econometric approach has been completed with respect to short-term policy impacts and forecasting issues regarding consumer price movements (Fullerton, 1995). Consumer prices in Ecuador are modeled using an econometric framework that incorporates domestic monetary factors and international input costs. Because serial correlation is present in the model residuals, parameter estimation is accomplished with a nonlinear procedure that provides sufficient flexibility to handle even mixed error structures. Simulation exercises are also utilized to examine possible consequences associated with a price stabilization program implemented by the central bank. A simplified version of the reduced form model for Ecuadorian consumer prices is summarized in Equation 3:

$$3. \qquad P_t = e_0 + e_1 * M_{t-i} + e_2 * V_{t-j} + e_3 * X_{t-k} + U_t,$$

where V represents the velocity of circulation.

As alluded to above, the hypothesized equations will frequently not account for all variation in the dependent variable. Nonrandom movements still present in the residuals may be modeled as exogenous time series processes. A nonlinear methodology suggested by Pagan (1974) has proven helpful in several Latin American modeling applications in recent years. This option is especially helpful when data constraints preclude further expansion of the initial specification. Equation 4 illustrates a general ARMAX specification for the previous equation:

$$4. \qquad P_t = e_0 + e_1 * M_{t-i} + e_2 * V_{t-j} + e_3 * X_{t-k} + f_i U_{t-l} + g_j W_{t-m} + W_t,$$

where f_i are autoregressive parameters, g_j are moving average coefficients, and W_t is a white noise component for U_t, where the latter represents the disturbance term appearing in Equation 3. One question which naturally arises with respect to single equation models is how to account for movements in variables other than those appearing on the left-hand side. The latter is feasible via systems of equations modeling and, as discussed in the introductory remarks, represents one of the most valuable areas in Latin American macroeconometric research during the late 1980s and early 1990s.

There is another class of single-equation econometric models that have become widespread in the analysis of advanced industrial macroeconomies. The latter are generally referred to as error-correction models and were introduced by Davidson, Hendry, Srba, and Yeo (1978). A principal feature of this category of econometric models is the simultaneous incorporation of long-term structural trends and short-term

dynamic movements in the variables being modeled (Hamilton, 1994). Simulation properties associated with error-correction models resemble those of partial adjustment equations (Wallis and Whitley, 1991). It is likely that a large volume of Latin American research will be conducted in the coming years using this technique. With regard to other recent modeling advances, macroeconomic and financial studies in the region have already begun to utilize unit root-cointegration methodologies (Arellano, 1993). It should be noted that error-correction models and cointegration techniques can fall within the category of single-equation specifications. They can also be utilized in conjunction with the next topic of this paper, systems of simultaneous equations.

Structural Model Systems of Equations

Of course, independent variables such as the money supply and exchange rate regressors that appear in Equations 2, 3, and 4 are also functions of economic processes and can be modeled as such. Inflation models can be, and frequently are, readily expanded into systems of simultaneous equations, with individual component specifications determined by theories of how the economy works. Different sectors of each model can affect the simulation behavior of other variables depending on model structure and forecast asumptions regarding exogenous variables such as international consumer price movements. This general modeling approach has proven its worth in numerous research, policy simulation, and business condition forecasting exercises for Latin America during the better part of the past three decades.

Building upon the basic inflationary macroeconometric framework outlined thus far, the general model form for a small structural system of equations is presented immediately below:

5. $P_t = f_0 + f_1*M_t + f_2*X_t + U_t$

6. $M_t = g_0 + g_1*MB_t + W_t$

7. $X_t = h_0 + h_1*PF_t/P_t + h_2*BOP_t + Z_t,$

where MB is the monetary base (implying that the g_1 regression coefficient is an M1 or M2 money multiplier), PF is an international inflation index, and BOP is a balance of payments international reserves variable. From these well-known and relatively intuitive specifications, it is easy to see that such a structural model can handle multiple factors that may potentially alter the inflationary outlook for an economy (for actual forecasting results associated with this approach, see Fullerton, 1993a, 1993b).

In addition to the research listed in the first section of the paper, several other examples within this model category are worth mentioning. Standard modeling frameworks are set forth in Haque, Lahiri, and Montiel (1990) and in Vaez-Zadeh (1989). Montes and Candelo (1983) utilize a monetary theory framework to analyze balance of payments performance in Colombia. Given the many different components, categories,

and global influences affecting international trade and financial flows, the systems of equations model and estimator utilized in that paper yields interesting insights to changes that periodically surface in international reserves positions. In more recent work, Torres (1991) models the supply side value-added categories for Colombian gross domestic product in a simultaneous equations framework. That study represents one of the early efforts to forecast Latin American output in a disaggregated format, something Vial (1988) had indicated as a necessary step in order to bring macroeconometric analysis in the region up to par with research developments in industrialized economies.

Many of the controversial issues arising from the liquidity crisis and the balance of payment imbalances of the 1980s can also be analyzed within a structural equation context, even when they involve multiple countries. Secondary market trades involving sovereign debt certificates became widespread following the outbreak of the international debt crisis in 1982. Fullerton (1993d) employs a three-stage least squares modeling strategy to study the predictability of short-run movements in secondary market debt prices in Colombia, Ecuador, and Venezuela. Selection of the estimator was motivated by the opportunity to take advantage of the information content in cross-country contemporaneously correlated individual equation residual strings. Doing so improved the parameter estimation results. The simulation tests also met with some success and additional experimentation with alternative estimators and larger sample sizes is recommended.

Vector Autoregression Equation Systems

It is sometimes argued that structural systems of equations are inadequate vehicles for modeling any given economy or market. Economic theory, it is rightly claimed, will provide only a partial explanation of what takes place at any point in time. It is further stated that no economic variable can truly be regarded as completely exogenous. Consequently, all variables in any model should be regarded as functions of previous lags of themselves and all other variables (see Hamilton, 1994). Implementation of this severe interpretation of economic modeling gives rise to a series of identically specified vector autoregressive (VAR) equations.

Further expansion of the theoretical inflation model that has been developed in earlier sections of this article yields the basic form of a VAR model:

8. $P_t = a_0 + a_i*P_{t-i} + a_j*M_{t-j} + a_k*X_{t-k} + U_t$

9. $M_t = b_0 + b_i*P_{t-i} + b_j*M_{t-j} + b_k*X_{t-k} + W_t$

10. $X_t = c_0 + c_i*P_{t-i} + c_j*M_{t-j} + c_k*X_{t-k} + Z_t,$

wherein each of the dependent variables are specified as functions of their own lagged observations and those of each other.

Following their adaptation from the impulse response class of multi-equation ARMA models in the early 1980s, VAR models have become very popular for studying dynamic reactions to changes in regional economic and/or macroeconomic business conditions. They require, however, large numbers of sample observations because estimating so many regression parameters causes an inordinate number of degrees of freedom to be lost. In fact, the profligate loss of degrees of freedom imposed by this modeling approach has led some to criticize it in a fairly strenuous manner (Lutkepohl, 1990). This aspect of the VAR technique, a sharp departure from the principle of parsimony that guides traditional time series statistics and econometrics, represents an especially heavy burden for Latin American data sets that generally contain relatively few observations. Because of this shortcoming, Latin American VARs, including the Bayesian variety wherein (0,1) priors are set in advance of coefficient estimation, are likely to contain only a handful of equations at most for the foreseeable future.

Another criticism of VAR analysis is its complete lack of structure (Runkle, 1987). Given the perhaps excessive simplicity embodied in most mathematical economic models, VAR practitioners view its unstructured specification as a prime virtue of the approach. Others point out, however, that otherwise useful insights to the behavior of the variables in question are masked by the overabundance of lagged coefficient estimates. In spite of these shortcomings, small-scale VAR modeling and policy analysis has been applied on a variety of occasions to the arena of Latin American macroeconometrics.

Leiderman (1984) utilizes vector autoregressions to analyze inflation in Colombia and Mexico. In the case of Colombia, the results indicate that variations in the rate of change of M1 systematically affect the CPI, but not the converse. From a policy perspective, this implies that Colombian monetary authorities do not engage in "accommodative" measures in response to production and inflationary shocks, a result later confirmed by Fullerton (1993c). Not surprisingly, this observation regarding Colombian monetary policy actions was not found to hold for the higher inflationary economy that existed in Mexico during the waning days of its inward-looking development strategies.

Arellano and González (1993) examine inflationary dynamics under the heterodox nominal anchor exchange rate policy during the initial phase of the export diversification, market-oriented reform period of the Salinas administration in Mexico. Separately, Kamas (1995) analyzes Colombian inflationary dynamics under the “crawling peg” exchange rate era in that economy. The latter paper uncovers empirical support for several, but not all, of the conclusions reached in Leiderman (1984) and Fullerton (1993c). It also provides evidence that Colombian inflation contains a substantial inertial component, and will be difficult to lower below its recent historical range of 20 to 23 percent per year.

Conclusion

There has been a rapid acceleration in macroeconometric research taking place in Latin America in recent years. Much of this applications-oriented investigation followed the aftermath of the international debt crisis and the ensuing market-oriented structural reform measures that governments throughout the region adopted. With the debt crisis, it became necessary to understand seemingly out-of-control inflationary processes as well as year-to-year balance of payment variations and external obligations performances. Market-oriented reforms reduced the role of government planning agencies in the economy, increasing the need for systematic analysis of general macroeconomic performance such as that which has occurred on a continual basis in industrial economies since the pioneering work of Tinbergen in the 1930s.

While a large volume of insightful research has already been completed, much work remains to be done. Two slightly separate strands of empirical analysis are likely to emerge in future years as a reflection of the current state-of-the-art. It is still necessary in many Latin American economies to engage in basic hypothesis testing that examines the applicability of standard modeling techniques and macroeconomic constructs that have proven useful in advanced northern hemisphere countries. This class of investigation will prove especially helpful in the context of the steadily growing fields of fiscal, monetary, and financial market policy analysis.

The second category of empirical analysis will probably emerge just as quickly as the former. In large measure, Latin American researchers enjoy access to data sets of sufficient quality to permit the testing and potential adoption of nearly all newly developed econometric methodologies. Given this, it will not be uncommon to find theoretical advances being spurred onward by results associated with southern hemispheric modeling questions. Obviously, this symbiotic relationship between theory and application has been in existence in a limited form for many years. The rapid expansion of financial markets and data information systems will serve to expand the scale of this relationship in Latin America to one that resembles what already exists in Europe, Japan, and North America.

No matter what actually transpires in Latin American macroeconometric modeling and research in the future, it will probably take place within the context of serious policy and planning analytic questions. As such, research for this important area of the global economy will be scrutinized and supported to a much greater extent than was previously the case. Given this, it is undeniably an exciting and fulfilling time to be involved in this line of research and analysis. It is also very possible that what is currently taking place in Latin American macroeconometrics is a precursor to what will also occur in Africa, the Middle East, and major parts of Southern Asia, where market-oriented economic reforms are only now beginning to be introduced.

References

Rogelio Arellano Cadena, 1993, "Relación de Largo Plazo del Mercado Bursátil Mexicano con el Estadounidense," **El Trimestre Económico** 60, 91-112.

Rogelio Arellano Cadena and Eduardo González Castañon, 1993, "Dinámica de la Inflación: Un Análisis del Ajuste Heterodoxo Mexicano," **Estudios Económicos** 8, 249-261.

Harold Barger and Lawrence R. Klein, 1954, "A Quarterly Model for the United States Economy," **Journal of the American Statistical Association** 49, 413-437.

Abel Beltrán del Río, 1991, "Macroeconometric Model-Building of Latin American Countries, 1965-1985," Chapter 12 in **A History of Macroeconometric Model Building**, Edited by Ronald G. Bodkin, Lawrence R. Klein, and Kantah Marwah, Brookfield, VT: Edward Elgar Publishing Company.

George E.P. Box and Gwilym M. Jenkins, 1976, **Time Series Analysis, Forecasting, and Control**, Second Edition, San Francisco, CA: Holden Day.

George E.P. Box and G.C. Tiao, 1975, "Intervention Analysis with Applications to Economic and Environmental Problems," **Journal of the American Statistical Association** 70, 70-79.

Mauricio Cabrera and Fernando Montes, 1978, "La Dinámica de las Series de Tiempo: El Caso del Indice Nacional de Precios al Consumidor-Empleados," **Revista del Banco de la República** 51, 1122-1142.

Carl F. Christ, 1993, "Assessing Applied Econometric Results," Federal Reserve Bank of St. Louis **Review** 75, (March/April) 71-94.

Robert T. Clemen, 1989, "Combining Forecasts: A Review and Annotated Bibliography," **International Journal of Forecasting** 5, 559-583.

James Davidson, David Hendry, Frank Srba, and Stephen Yeo, 1978, "Econometric Modelling of the Aggregate Time-Series Relationship between Consumers' Expenditures and Income in the United Kingdom," **Economic Journal** 88, 661-692.

Tuvana Demirden and Ivan Pastine, 1995, "Flexible Exchange Rates and the J-Curve," **Economics Letters** 48, 373-377.

George Dhane and Anton B. Barten, 1989, "When it all Began: The 1936 Tinbergen Model Revisited," **Economic Modelling**, 6, 203-219.

Sebastian Edwards, 1993, "Openness, Trade Liberalization, and Growth in Developing Countries," **Journal of Economic Literature** 31, 31-52.

Thomas M. Fullerton, Jr., 1989, "A Composite Approach to Forecasting State Government Revenues," **International Journal of Forecasting**, 5, 373-380.

Thomas M. Fullerton, Jr., 1992, "Confessions of an International Forecaster," **Business Economics** 27, (April) 61-65.

Thomas M. Fullerton, Jr., 1993a, "Un Modelo Macroeconométrico para Pronosticar la Economía Colombiana," **Ensayos Sobre Política Económica** 24, 101-136.

Thomas M. Fullerton, Jr., 1993b, "Un Modelo Macroeconométrico para Pronosticar la Economía Ecuatoriana," **Cuestiones Económicas**, 20, 59-100.

Thomas M. Fullerton, Jr., 1993c, "Inflationary Trends in Colombia," **Journal of Policy Modeling** 15, 463-468.

Thomas M. Fullerton, Jr., 1993d, "Predictability of Developing Country Secondary Market Debt Prices," **Applied Economics** 25, 1365-1371.

Thomas M. Fullerton, Jr., 2000, "Short-Run Price Movements in Ecuador," **Southwestern Journal of Economics**, 3 (August), 45-60.

Thomas M. Fullerton, Jr., 2000, "Currency Movements and International Border Crossings," **International Journal of Public Administration** 23, 1113-1123.

Thomas M. Fullerton, Jr. and Ajay Kapur, 1991, "Predicción de Multiplicadores Monetarios en Colombia, Ecuador, y Venezuela," **Lecturas de Economía** 35, 53-86.

James D. Hamilton, 1994, **Time Series Analysis**, Princeton, NJ: Princeton University Press.

Nadeem Ul Haque, Kajal Lahiri, and Peter J. Montiel, 1990, "A Macroeconometric Model for Developing Countries," **IMF Staff Papers** 37, 537-559.

Alain Ize and Javier Salas, 1985, "Pricing and Output in the Mexican Economy: Empirical Testing of Alternative Hypotheses," **Journal Development Economics** 17, 175-199.

Linda Kamas, 1995, "Monetary Policy and Inflation under the Crawling Peg: Some Evidence from VARs for Colombia," **Journal of Development Economics** 46, 145-161.

Leonardo Leiderman, 1984, "On the Monetary-Macro Dynamics of Colombia and Mexico," **Journal of Development Economics** 14, 183-201.

David G. Lenze, 1997, "Dynamic and Spatial Aspects of the Recovery from a Natural Disaster," **Review of Regional Studies** (forthcoming).

Helmut Lutkepohl, 1990, "Assymptotic Distributions of Impulse Response Functions and Forecast Error Variance Decompositions of Vector Autoregressive Models," **Review of Economics and Statistics** 72, 116-125.

Gabriel Montes and Ricardo Candelo, 1983, "El Enfoque Monetario de la Balanza de Pagos: El Caso de Colombia, 1968-1980," **Revista de Planeación** 15, 11-40.

Pedro Palma and Domingo Fontiveros, 1988, "A Comparative Sensitivity Analysis of the MODVEN VII Macroeconomic Model for Venezuela," **Economic Modelling** 5, 286-345.

Alan Pankratz, 1983, **Forecasting with Univariate Box-Jenkins Models**, New York, NY: John Wiley and Sons.

Robert S. Pindyck and Daniel L. Rubinfeld, 1991, **Econometric Models and Economic Forecasts**, Third Edition, New York: McGraw Hill.

David Runkle, 1987, "Vector Autoregressions and Reality," **Journal of Business and Economic Statistics** 5, 437-442.

W. Charles Sprinkle and Richard L. Sprinkle, 1987, "Contractionary Effects of Devaluation in Mexico," **Social Science Quarterly** 68, 885-893.

Ricardo Torres, 1991, "Un Modelo de Ecuaciones Simultáneas para Proyección del Producto Interno Bruto," **Universitas Económica** 7, 47-71.

Reza Vaez-Zadeh, 1989, "Oil Wealth and Economic Behavior: The Case of Venezuela, 1965-1981," **IMF Staff Papers** 36, 343-384.

Joaquín Vial, 1988, "Comparación de Modelos Macroeconométricos Latinoamericanos," **Colección Estudios CIEPLAN** 24, 145-181.

Kenneth F. Wallis and John D. Whitley, 1991, "Large-Scale Econometric Models of National Economies," **Scandinavian Journal of Economics** 93, 283-296.

Arnold Zellner, 1994, "Time Series Analysis, Forecasting, and Econometric Modeling: The Structural Econometric Modeling, Time Series Analysis (SEMSTA) Approach," **Journal of Forecasting** 13, 215-233.