A REVIEW ON THE CYCLES OF THE HOUSING STARTS IN THE SHORT-RUN

By Sang Kook Jung*

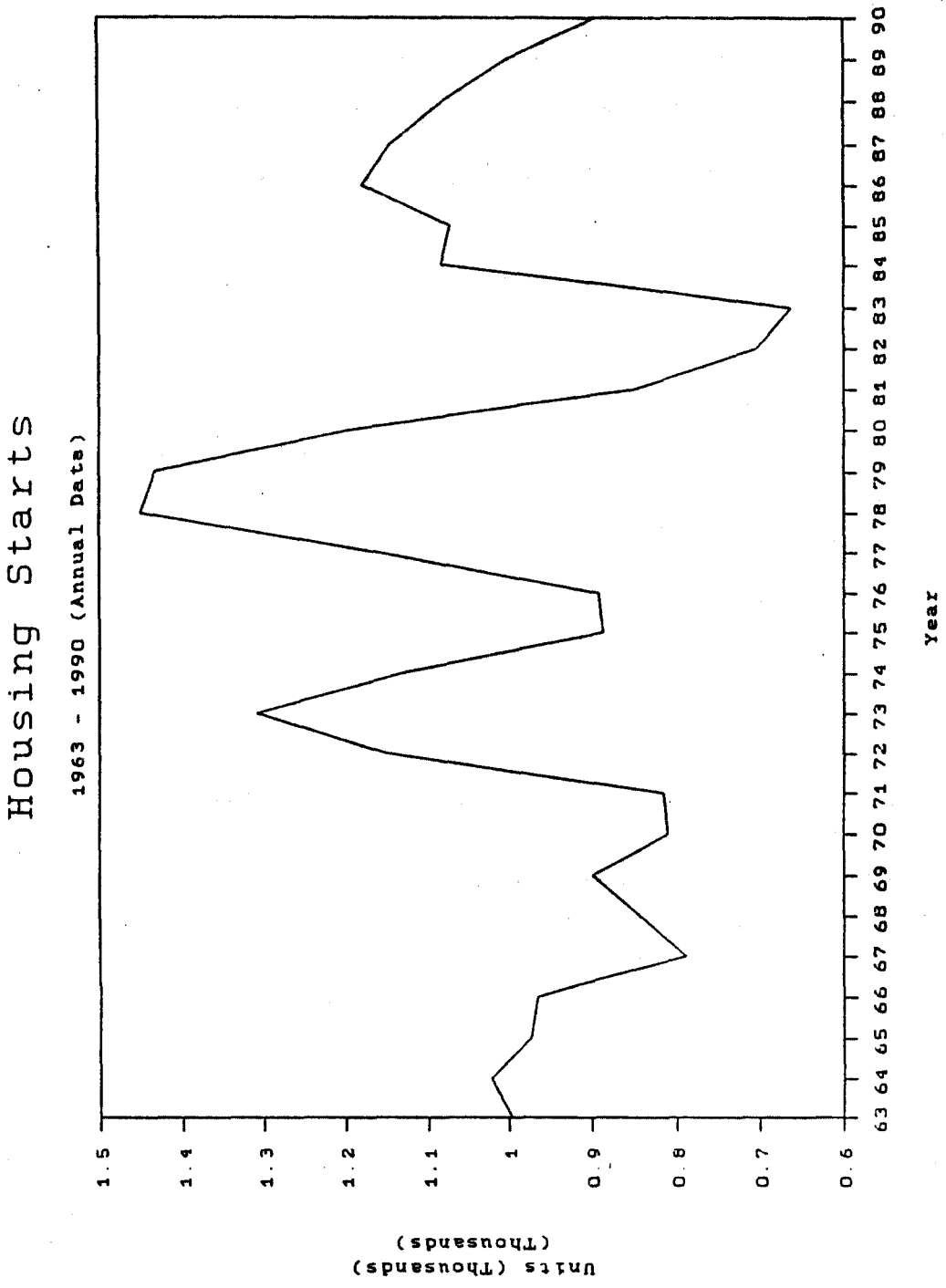
Ⅰ. Studies on the Cycles of Housing Starts

Shifts in housing construction starts have an impact on both employment and values of production, and much data on housing starts show increasingly severe fluctuations in home-building activity.

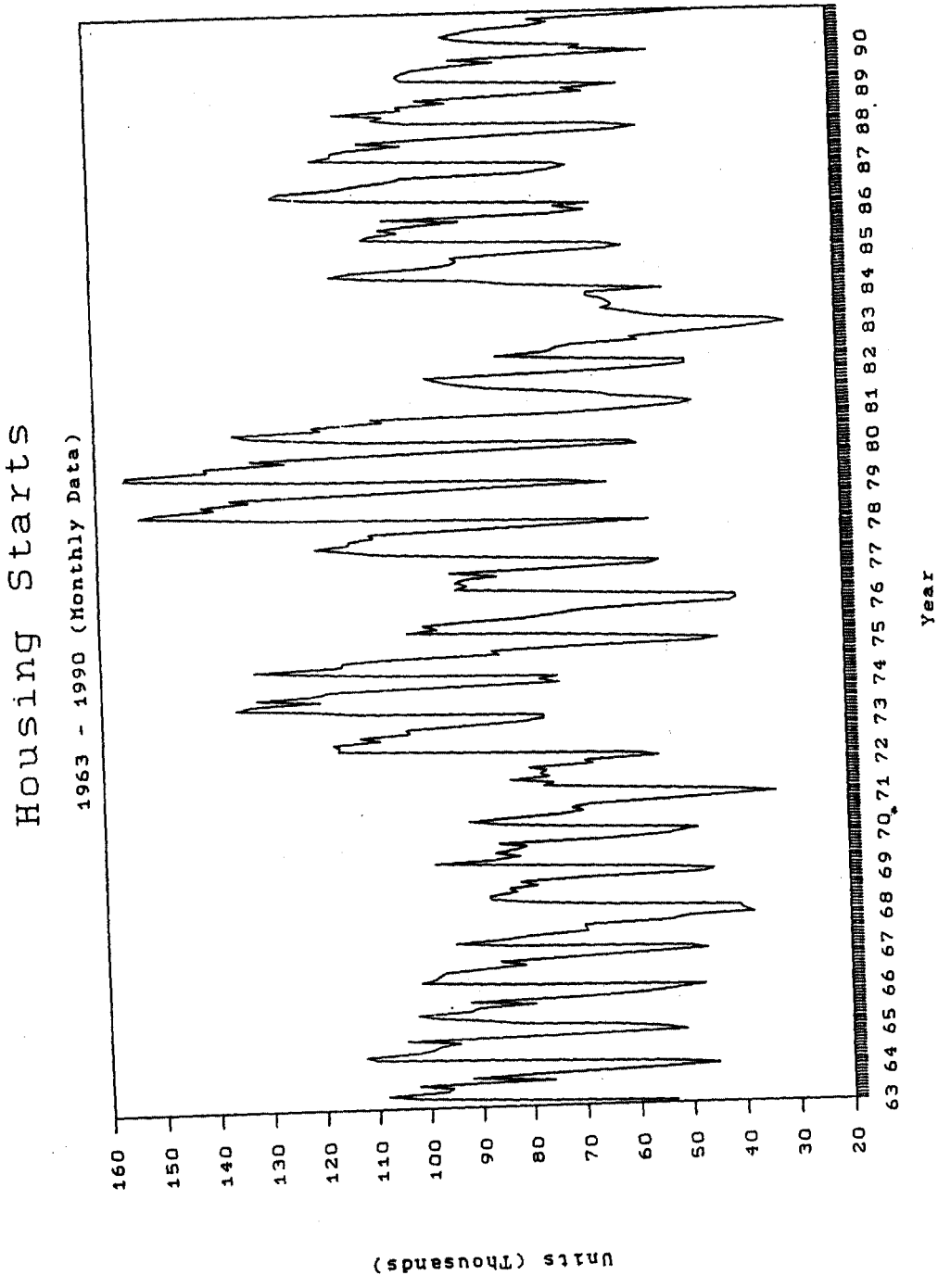
Figures 1 and 2 illustrate this point. Figure 1 plots the cyclical movement of housing starts with annual data. Figure 2 shows the fluctuations of the housing starts with monthly data. Monthly data provide evidence that extreme cyclical fluctuations exist in the short-run and have been chosen for this study in order to account for the fluctuations.[1] Consequently, concerns over the structure and performance of the residential construction sector have increased due to its extreme cyclical volatility in the short-run.

* 본학회 정회원, 대구대학교 강사

1) The literature defines long-run as more than 10years and short-run as less than five years



〈Figure 1〉 Housing Starts : 1963 - 1990 (annual Data)



〈Figure 2〉 Housing Starts : 1963 - 1990 (monthly Data)

The studies on the cycles of housing starts in the short-run can be classified into two types. The first type emphasizes mortgage credit and consumer demand as the key factors responsible for postwar instability in housing construction. This kind of study has been done by Guttentag (1961) and Alberts (1962) who both attribute the short-run instability in housing construction primarily to the flow of mortgage credit in and out of the housing market. However, their analyses assume that housing demand fluctuates in response to the availability and/or terms of mortgage credit. Thus, the basic determinants of the level of new construction are found on thedemand side.

The second type of study emphasizes the builders' supply as the key factor for fluctuations in housing starts. In a study of this type, Maisel (1963) argues that instability in housing starts comes about primarily through the optimism and pessimism of builders who carry out their inventory policy with a time lag. Maisel (1963) further believes that the cost and availability of mortgage credit or construction loans play a significant role in influencing the builders' ability to alter their inventories.

Ⅱ. Theme of the Study

The roles played by the demand and supply variables in the explanation of construction activity require some scrutiny. If one is interested in analyzing the long-run aspects of the housing market, concentration on the demand-determinant factors may be justified by the argument that the supply of new housing units at a given price is relatively elastic (Muth, 1960). Thus, the factors affecting demand are more capable of explaining the level of construction activity. If, however, one's interest is in short-run fluctuation on a monthly or quarterly basis, it may be argued thatdemand variables, such as demographic characteristics and taste, change relatively little vis-a-vis the variation in variables suchas mortgage credit factors on the demand side and constructionfinancing, builders' expectations and

inventories on the supplyside.

Three groups are important in the study of housing starts: builders, buyers,and lenders. The makeup of each group substantially differs from each other, so each must be characterized by a different behavioral function.

Specification and identification of these functions become quite essential in understanding how key variables impact upon market participants to determine construction activity. Although sufficient work has been done on understanding buyers, housing, and mortgage markets, much research is needed to understand the behavior of builders.

Prior to Maisel's study (1963), virtually all of the research on residential construction activity emphasizes the role played by housing demand. That is, basic demand factors have been considered to be the principal determinants of the volume of residential building, while supply-side factors have been accorded a relatively minor role. Maisel, on the other hand, calls attention to the importance of the supply side in determining the level of construction, suggesting that the housing fluctuations are the result of inventory adjustments made by speculative builders and developers. This study focuses on the causes of short-run fluctuations in residential construction, paying primary attention to the behavior of builders rather than focusing solely on consumer demand based theory.

Ⅲ. Principal Theory of the Housing Cycle

The most influential theory of the housing cycle is put forth by Sherman Maisel (1963), who argues that the cycle leads to fluctuations in the inventories of residential building suppliers, similar to the kinds of inventory cycles that are experienced in manufacturing. Thus, Maisel advances his theory from the perspective of the builder. Maisel argues that information about the level of the inventory in the market at any given time motivates the builder to decide whether to increase or decrease the number of houses to be constructed. Thus, the

periodic fluctuation of residential construction is rarely determined by a shift in demand: rather, the fluctuation of residential construction is determined by the builders' expectations of a shift in inventories. Although Maisel recognizes that shifts in demand can have an impact on the level of home-building activity, he maintains that the forces necessary for such reactions (e.g., heavy declines in income) have not been important factors in the postwar market. Like most housing economists, Maisel accepts the view that both the interest rate and noninterest terms on mortgage credit are strategic variables influencing the volume of construction. He points out, however, that since credit factors do not appear to have a significant impact on the rate of household formation, it is unlikely that credit influences the consumer demand for housing space.[2] From his perspective, credit helps to determine the volume of residential construction by influencing the behavior of speculative residential builders rather than the behavior of consumers.

According to Maisel, the typical housing cycle is generated in the following manner. When the market for new construction exists in equilibrium, builders start exactly enough dwelling units to maintain a desired inventory of units under construction. These inventories are necessary, he claims, because of the lag between starts and completions. The inventory size is determined by (a) the length of the production process and (b) a feedback mechanism which relates both starts and completions to final sales. Under equilibrium conditions, the outflow of completed units equals final demand, defined by household formation plus removals and perhaps a normal increase in the number of units held vacant.

If one assumes a shift in some variable that influences the level of inventories which builders want to hold, such as a change in credit terms or the rate of housing sales, then, in Maisel's opinion, the response of builders is to adjust the rate of construction to bring inventories back into equilibrium (i.e., a normal level coinciding with final demand). This readjustment process is expected to be

2) In a subsequent article, Maisel(1966) notes that credit can have an impact on tenture choice (i.e, whether to own or rent). For example, as the cost of credit changes, particilar parts of the housing stock (o.e, owner-occupied units)may appear to be a better buy. As a result, a movement of housrholds could occur from rental to owner-occupied housing units, or vice versa.

sluggish, however, due to a number of factors which adversely affect the efficiency of the home-building industry. In particular, Maisel notes that builders have an inclination to either over-build or under-build because of the important role which market expectations play in forming their decisions. These expectations are destabilizing, he suggests, because they are characterized by wave-like surges of optimism and pessimism. Moreover, he emphasizes that builders may feel only slight pressure to change their production plans when a rise in inventories is mainly in units under construction. In Maisel's opinion, therefore, the instability of the residential sector is caused by factors relating to the construction process itself —namely,lags, poor information, and acceleration effect.[3] Thus, the housing cycles represent a periodic disequilibrium in the inventories of speculative builders rather than fundamental shifts in consumer demand.

Ⅳ. Empirical Models of the Residential Construction Sector

1. General Housing Construction Models

The empirical study of the residential construction sector may be separated into two periods. The first period dates from the mid-1930s, when the first quantitative studies appeared, through 1960. The second period includes the work that has been done between 1961 and the present. During the first period, most of the research on the housing sector addresses long-term residential capital formation. The empirical models of this period have been typically estimated with annual data extending back to World War I. Basic demand variables, such as disposable

3) The acceleration effect means that an increase in consumer demand induces a magified expansion in investment because a larger capital stock is necessary to produce a higher level of output. In other words, when final demand changes, starts must increase by still more in order to raise the inventory level to that required for higher output. This result means rhat current starts are related to previous inventory levels.

personal income, employment, and household formation, have been used to explain the movements in building activity. A notable feature of most of the models has been the absence of a variable to capture the impact of changes in credit conditions. In the few cases where a credit variable has been used, it has usually proven to be statistically insignificant.

An extensive, critical review of the empirical work during this period has been conducted by Grebler and Maisel (1963) on the basis of the following four criteria: (a) the observed structure of the housing market and the consistency of the observations, (b) the predictive ability of the model, (c) procedural and statistical difficulties, and (d) the adequacy of the data employed. In order to accomplish this task, they take the unusual step of recomputing the published equations for each model and then comparing the results.

With respect to the first criterion, Grebler and Maisel find all of the models to be highly specious and unreliable. First of all, they note that in each case the selection of the variables has not been guided by an acceptable theory of the housing market. Thus, the models cannot be said to be very useful. Secondly, they find that in recomputing the equations with improved data the stability of the coefficients has been extremely poor. Their evaluation is similar with respect to the other three criteria. They find that all of the models exhibit poor predictive ability, fail to meet the basic requirements worked out in statistical theory for obtaining unbiased estimates of coefficients, and utilize data suffering from severe deficiencies.

Grebler and Maisel maintain that none of the empirical models which they examine are able to provide a consistent and accurate framework that allows a theory of the housing market to be tested. In their opinion, the only value of these models is in the leads they offer for future works.

The second period in the empirical analysis of the residential construction sector begins in the early 1960s with the appearance of George Break's study, "The Sensitivity of Housing Demand to Changes in Mortgage Credit Terms" (1961). This study marks an important departure from previous works for two reasons. First of all, Break makes the initial attempt to isolate and provide an economic analysis of residential building activity in the post-World War II period. Secondly, his study is

the first to offer convincing evidence that credit factors have a significant impact on the behavior of the residential sector.

Break's empirical model is formulated as an aggregate household demand function for new houses. The explanatory variables he employs include the following: (a) disposable personal income, (b)house prices relative to all other prices, (c) the rate of family formation, (d) the total stock of residential wealth, and (e) the terms on mortgage credit. The key innovation is in his use of a new systematic time series of mortgage interest rates, maturities, and loan-to-value ratios that had just become available. Apart from the credit variable, his model is merely a collection of the various independent variables, which other investigators have found to be significantly related to the level of housing construction.

The major finding of Break's study is that the role which credit plays in determining the volume of construction has changed significantly during the postwar period. Before World War II, residential construction was apparently not sensitive to changes in the terms on mortgage credit. During the postwar period, however, Break finds that housing has become considerably more sensitive to these terms. Furthermore, he observes that the role of the nonfinancial variable has also undergone a change: the postwar elasticities for these variables are substantially less than the corresponding prewar values, which indicates that the nonfinancial factors have become less influential on the residential sector. As Break points out, prior to his study the quantitative impact of changes in mortgage credit terms on housing had been an intriguing but elusive mystery. The next empirical analysis of residential construction to appear is Maisel's (1963). Like Break, Maisel concentrates on the post-World War II period and the particular role which credit plays in determining the volume of construction. However, he also advances the empirical study of the residential sector by making two significant contributions of his own. He is the first to develop a time series which is used to analyze home-building activity on a quarterly basis. This is a major innovation because it not only increases the number of observations for the purposes of estimation, but also makes it possible to track the behavior of the residential sector in the short-run more effectively.

In addition, Maisel is also responsible for developing a new theory of how the

market for new housing units operates. Prior to his study, virtually all of the research on residential construction activity had emphasized the role played by housing demand. That is, basic demand factors were considered to be the principal determinants of the volume of residential building, while supply-side factors were accorded a relatively minor role. Maisel, on the other hand, has called attention to the importance of the supply side in determining the level of construction, suggesting that the housing fluctuations are the result of inventory adjustments made by speculative builders and developers.

The purpose of Maisel's empirical model is to provide an empirical test of his theory of the short-run housing cycle. The Maisel model of the housing market consists of a single equation which is specified in five slightly different ways. Four separate equations attempt to explain the quarterly level of private housing starts using independent variables for the cost of mortgage financing, the availability of such financing, inventory factors, the relationship between the returns and costs of building or owning houses, and household income. The fifth equation attempts to predict the change in starts using a similar set of variables. The variables in the model include the following: (a) the housing vacancy rate, (b) the ratio of a rent index to a construction cost index, (c) an estimate of new removals from the housing stock, (d) household formation, (e) the interest rate on three-month Treasury bills, and (f) the number of lagged construction starts. According to Maisel, the results of estimating the model provide support for his thesis concerning the role of the supply-side factors in the cycle. His results confirm Break's findings that credit is a key variable influencing the housing sector in the postwar period. In contrast with Break, he claims that credit affects the behavior of speculative builders rather than that of consumers.

However, the empirical evidence of his model fails to be fully convincing for two reasons. First, although his model involves a set of relationships that jointly explain the behavior of certain variables, he separately examines each link in the proposed model. The evidence at each link is suggestive of the proposed relationship between variables at that link. However, his equation by equation estimation procedure may be inappropriate for what is essentially a system of equations. Because error terms across equations are likely to be correlated, the

ordinary least squares estimates could result in biased parameter estimates, although it is unbiased in a single equation.

Second, although his findings are based on the proposed direction of the relationship between dependent and independent variables in estimating each link in the proposed models, he imposes this structural model on the data, rather than allowing the data to determine the existence and direction of any relationship. Although the estimates of his model appear reasonable, the methodology does not have the power to identify the appropriate direction of the relationship between dependent and independent variables and to determine the accurate lag structure. In the decade following the appearance of the Maisel study, a large number of econometric models of the residential sector have been developed. Much of the work has been done in connection with building large-scale, complete-system models of the U.S. economy, such as the Brookings model, the FRB-MIT-Penn model, the Wharton models, and the Data Resources Incorporated model. Other notable studies concerned with the new housing market have been done by Sparks (1967), Huang (1969), Fair (1971), Brady (1973), and Arcelus and Meltzer (1973).[4]

Most of the models of this period may be viewed as simple extensions and modifications of the ones done by Break and Maisel. However, there are two areas in which a serious attempt has been made to improve on earlier models. First of all, much attention has been given to disaggregating the residential sector into its principal submarkets (e.g., single-family, multiple-family and mobile-type housing).

Secondly, a considerable amount of effort has gone into refining the empirical specification of the credit factors influencing the housing market.

The housing models developed during the 1964-1978 period have been critically reviewed by Kalchbrenner (1972), Fromm (1973), and Fredland and Macrae (1978). On the whole, their evaluations of these models have been quite negative. They find them to be still relatively primitive, incomplete, and highly unreliable for forecasting purposes. In particular, both Kalchbrenner and Fromm stress that the

4) The Key variables and time lags of each model are presented in Table 1.

models provide little insight into the structure of the market for new houses and how it actually operates. They argue that the specification of the demand and supply functions is extremely vague and "adhoc." Moreover, as Fromm has noted, virtually all of the models have been estimated with the ordinary least squares technique, a method which could be expected to result in biased parameter estimates when it is used in the system of simultaneous equations as opposed to using a single equation.

Between 1979 and the present, c0onsiderably less attention has been given to the empirical analysis of the residential construction sector. During this period no new complete econometric models of the residential sector have been published in recognized journals. Also, while some refinements have been made in the housing sector of the complete-system models of the U.S. economy, there appear to have been no fundamental changes in the way this sector has been empirically specified.

There has been a resurgence of interest in the performance of this residential sector. New empirical studies of housing construction activity have been done by Jaffe and Rosen (1979) and Hendershott (1980) in an effort to provide more insight into the behavior of the residential sector during the 1970s.

Grebler and Burns (1982) offer a comprehensive analysis of construction cycles since World War II by using quarterly data from 1950 to 1978. They contrast the characteristics of public versus private and nonresidential versus residential cycles. However, they do not address the performance of specific housing submarkets. They point out that the heterogeneity of residential construction places limits on their analysis. Their findings elucidate the relationships between cycles in total construction and their components and between construction and GNP cycles. Grebler and Burns show increasing volatility of private construction over time and substantial inter-sector differences in average volatility.

Nevertheless, these three studies suffer from the same critical defect which Kalchbrenner (1972), Fromm (1973), and Fredland and Macrae (1978) note in the models of the 1964-1978 period. Moreover, virtually all of the models do not have the power to identify the appropriate direction of the relationship between dependent and independent variables and to determine the accurate lag structure.

If the model has been properly specified and if sufficient data covering the proper periods are available, problems could still arise in the statistical estimation of the economic relationships. As Fromm (1973) has noted, most of the models have been estimated with the ordinary least squares technique, a method which could be expected to result in biased parameter estimates since error terms across equations are likely to be correlated. Since most variables are jointly determined, the application of simultaneous estimation techniques is appropriate and desirable.

Multivariate Time Series (MTS) analysis is one answer for these problems (Tiao & Box, 1984) because MTS (a) provides simultaneous estimation and (b) includes cross-time correlation between variables. Simultaneous Transfer Function (STF) analysis is a form of MTS analysis and seems to be most appropriate in resolving these problems because it considers both autocorrelation and moving average. The STF model is viewed in this study as a set of reduced form equations associated with a simultaneous system of linear structural equations.

2. Univariate Time Series Models

Although many researchers have used the regression method to study the housing market, cross-sectional analysis between variables over time should not be investigated with the regression method because of serial correlation. In view of this problem, a few researchers (Vandale, 1983; Abraham & Ledolter, 1983) use the iterative Box-Jenkins univariate Autoregressive Integrated Moving Average (ARIMA) procedures to study housing construction over time.[5)]

Vandale (1983) finds that ARIMA(1,1,1)(1,1,1)12 fits the U. S. residential construction data covering the period from January 1947 to December 1970. One step ahead forecasts generated by this model using updated parameters are accurate. Abraham and Ledolter (1983) find that ARIMA(0,1,1)(0,1,1)12 fits the monthly U.S. housing starts of single family structures for the period of January

5) The iterative Box-Jenkins univariate Autoregressive Integrated Moving Average (ARIMA) procedure for analyzing time series data consist of extracting the predictable movements from observed data.

1965 to December 1974.

The empirical evidence of the above research offered in support of their theory is not fully convincing because they consider a univariate time series model which consists of just one variable and uses only current and past data on one variable. With a univariate time series analysis, the set of relationships that jointly explains the behavior of certain variables cannot be investigated.

Therefore, in order to accurately understand housing construction activity, a multivariate time series analysis should be considered as an alternative.

3. Multivariate Time Series Models

The next logical step is to examine simultaneously the directional links connecting the variables. One can investigate the relationships among these variables using a simultaneous transfer function (STF) model. A STF model can be viewed as a set of reduced form equations associated with a simultaneous system of linear structural equations. Importantly, the procedure does not preclude any causal structure a priori, since it allows feedback among variables. Thus, the STF approach allows existing directional relationships to emerge from the data.

Hilmer and Tiao (1979) develop a multiple time series model for single family housing starts and houses sold. In addition to the two housing series, Wang and Ma (1981) add the mortgage interest rate. They use a multiple time series (three-variable time series model) to predict the mortgage interest rate from housing starts and houses sold. They show that the mortgage rate plays an important role in housing construction. Furthermore, Wang and Ma point out that the mortgage rate depends not only on its own past but also on both housing variables. In other words, the past level of the housing starts and houses sold affects the current level of the mortgage interest rate. This result is a feedback effect which has been neglected by previous studies which indicate that mortgage interest rate affects the housing starts. Thom (1985) uses housing starts, long-term government bonds, mortgage interest rate, and credit availability. A four-variable multivariate time series model is run to examine the effect of the credit

availability. Thom (1985) finds some evidence that variations in credit availability affect housing starts. The conclusion is that the role of credit availability is not greater than that played by mortgage interest rates. McGarvey and Meador (1991) use housing starts, ten-year Treasury bond yield, mortgage rate, and credit availability. A multivariate time series (four-variable time series model) is run to investigate the effect of credit availability. This study shows that the mortgage rate contributes to long-term movements in housing starts while credit availability contributes to short-term movements in housing starts.

The studies of Hilmer and Tiao (1979) and Wang and Ma (1981) consider time series properties of housing construction and mortgage interest rates. Thom (1985) and McGarvey and Meador (1991) consider time series properties of housing starts, mortgage interest rates, and credit availability. However, as implied in previous studies and illustrated in Table 1, other macroeconomic variables such as disposable personal income, cost, and the average house price are shown to be significant variables.

Ⅴ. Summary

This study provides an overview of previous research studies concerned with the residential construction sector. The objective here is to evaluate the earlier empirical models of this sector in order to indicate the areas in which they are deficient. The focus of attention is on two particular types of analysis. First, the principal theory regarding causes of the residential building fluctuations which cause a housing cycle is reviewed. Furthermore, aspects of the theory of the post war housing cycles are also discussed in detail. Second, empirical models of the residential construction sector which account for specific changes in the volume of construction are analyzed. These reviews in turn provide a brief historical survey of the previous econometric models of residential construction.

A general housing construction model and a multivariate time series model have

their valid points. However, there are deficiencies. Multivariate time series models fail to consider other existing variables, thereby failing to adequately clarify pertinent issues. Futher, a general housing construction model fails to accurately determine the direction of any relationship, thereby rendering it less effective. Thus, there are a number of important issues which could be clarified by a more adequate model such as multivariate time series(MTS) model with more existing variables of the housing construction sector.

〈Table 1〉 Empirical Models of Residential Construction Sector

Name	Key Variable	Time lag
General Housing Construction Models		
Break (1961)		(Annual)
	Disposable personal income	0
	House price relative to other prices	0
	Rate of family formation	0
	Total stock of residential wealth	0
	Ratio of ioan to value	0
	Maturities of loans	0
		(Quarterly)
	Household formation	0
	Housing starts	1,3
	Ratio of a rent index to a construction cost index	1
	Estimated number of removals	0
	Housing vacancy rate	1
	Rate on three-month tresury bills	2,3,4
Sparks (1967)		(Quartely)
	Net household formation	0
	Disposable personal income	0
	Credit availability	0
	Ratio of a rent index to a construction cost index	1
	Rate on 9-12 month U.S.government notes and bonds	0
	Coperate bond rate	0
Huang (1969)		(Quarterly)
	Housing starts	1,2
	Excess supply of new single-family housing units	0
	Estimated average price index	0
	Rate on 4-6 month commercial paper	1
	Credit availability	2
Huang (1973)		(Quarterly)
	Household	1,2
	Ratio of a estimated price index to a construction cost index	0
	Short-term interest rate	1
	Credit availability	2
	Estimated number of vacancies	1
Fair (1971)		(Quarterly)
	FHA mortgage rate series	1
	Number of working days in a month	0
	FHLB advance to S&L	1
	Savings capital of S&L and mutual savings bank	2
Brady (1973)		(Quarterly)
	Nominal interest rate	0
	Construction cost index	0
	Loan to value ratio	0
	Net FHLB advances	0
Arcelus &Meltzer (1973)		(Quarterly)
	Sales price	0
	Rent index	0
	Real income	0
	Real stock of base money	0
	Real stock of government debt outstanding	0
	Market rate of interest	0
	Labor cost	0

〈Table 1〉 (Continued)

General Housing Construction Models		
Jaffe &Rosen (1979)	Number of existing units Number of owner occupied units Mortgage interest rate Housing price index Credit availability	(Quarterly) 1 0 0 0 0
Hendersh ott (1980)	Housing starts Real income Mortgage payment Real user cost Credit availability variables Change in homeownership variables	(Quarterly) 1 0 0 0 0 0
Grebler& Burns (1982)	Gross national product	(Quarterly) 1.2.4
Univariate Time Series Models		
Vandale (1983)	Housing Starts	(monthly) 1.2.3&seasonal factors
Abraham & Ledolter (1983)	Housing Starts	(monthly) 1.2.3&seasonal factors
Multivariate Time Series Models		
Hilmer& Tiao (1979)	Housing Starts Houses sold	(Monthly) 1&seasonal factor 1
Wang&Ma (1981)	Housing Starts House sold Mortgage interest rate	(Monthly) 1.2.3.4&seasonal factor 1.2.3 1.2.3.4
Thom (1985)[a]	Housing Starts Rate on government bonds Mortgage interest rate Credit availability	(Monthly) 1 to 4 1 to 4 1 to 4 1 to 4
McGarvey &Meador (1991)[b]	Housinig Starts Ten-year treasury bond yield Mortgage nterest rate Credit availability	(Monthly) 1 to 12 1 to 12 1 to 12 1 to 12

note : a) Restricted at lag 4

b) Assumed at lag 12

〈REFERENCES〉

1. Abraham, B., & Ledolter, J., ***Statistical methods for forecasting,*** New York: John Wiley & Sons. 1983.
2. Alberts, W. W., "Business cycles, residential construction cycles and the mortgage market". ***Journal of Political Economy,*** 70(3), 263-281. 1962.
3. Arcelus, F., & Meltzer, A. "The markets for housing and housing services". ***Journal of Money, Credit, and Banking,*** 5(1), 78-99. 1973.
4. Arcelus, F., & Meltzer, A. "A reply to Craig Swan". ***Journal of Money, Credit, and Banking,*** 5(4), 973-978. 1973.
5. Brady, E. A. "An econometric analysis of the U.S. residential housing market". In R. B.Ricks (Ed.), ***National housing models: Application of econometric techniques to problems of housing*** 1973. research, Lexington, MA: D. C. Heath and Co.
6. Break, G. F. ***The economic impact of federal loan insurance.*** Washington, DC: National Planning Association.1961, pp. 1-4.
7. Cambell, B. O. "Long swing in residential construction: The postwar experience ". ***American Economic Review***, Papers and Proceedings, 53(2), 508-529. 1963.
8. Fair, R. C. ***A short-run forecasting model of the United States economy.*** Lexington, MA: D.C. Heath and Co.,1971.
9. Fredland, E. J., & Macrae, D. C. ***Econometric models of the housing sector: A policy-oriented survey.*** Washington, DC: The Urban Institute. 1978.
10. Fromm, G. "Econometric models of residential construction: A comparison". In R. B. Ricks (Ed.), ***National housing models: Application of econometric techniques to problems of housing research,*** Lexington, MA: D.C. Heath and Co., 1973. pp. 125-134.
11. Grebler, L., & Maisel, S. "Determinants of residential construction: A review of present knowledge". In ***Commission on Money and Credit, Impacts of monetary policy,*** Englewood Cliffs, N J: Prentice Hall. 1963. pp. 475-620.
12. Grebler, L., & Burns, L. "Construction cycles in the United States since World

War Ⅱ". ***Journal of American Real Estate and Urban Economics Association***, 10, 1982. pp.123-151.

13. Griffiths, W., Hill, R., & Judge, G. ***Learning and practicing econometrics***. New York: John Wiley & Sons. 1993.
14. Guttentag, J. M. "The short cycle in residential construction, 1946-1959". ***American Economic Review***, 51(3), 1961. pp.275-298.
15. Hendershott, P. H. "Real user costs and the demand for single family housing ". ***Brookings Papers on Economic Activity***, 1980. pp.2, 401-444.
16. Hilmer, S. C., & Tiao, G. C. Likelihood function of stationary multiple autoregressive moving average models". ***Journal of American Statistical Association***, 1979. pp.74, 652-660.
17. Huang, D. S. "A study of the market for new housing units". ***Journal of the American Statistical Association***, Proceedings of Business and Economic Statistics Section, 1969. pp.702-712.
18. Huang, D. S. "Short-run instability in single-family housing starts". ***Journal of the American*** Statistical Association, 1973. pp.68, 788-92.
19. Jaffe, D., & Rosen, K. "Mortgage credit availability and residential construction". ***Brookings Papers on Economic Activity***, 1979. pp.2, 333-376.
20. Kalchbrenner, J. H. "Theoretical and empirical specifications of the housing sector". In ***Federal Reserve Staff Study***, Ways to moderate fluctuations in housing construction. Washington, DC: Board of Governors of Federal Reserve System., 1972. pp.235-274.
21. Maisel, S. "A theory of fluctuations in residential construction starts". ***American Economic Review***, 1963. pp.53, 359-383.
22. Maisel, S. "The relationship of residential financing and expenditures on residential construction". In M. Ketchum & N. Strunk (Eds.), ***Conference on Savings Residential Financing, 1965 Proceedings***. Chicago: The U.S. Savings and Loan League. 1966.
23. McGarvey, M. G., & Meador, M. "Mortgage credit availability, housing starts and the integration of mortgage and capital market: New evidence using linear feedback". ***American Real Estate and Urban Economics Association***,

19(1), 1991. pp.25-40

23. Muth, R. F. "The demand for nonfarm housing". In A. C. Harberger (Ed.), ***The Demand for Durable Goods***, Chicago: University of Chicago Press. 1960. pp.29-96.

24 Sparks, G. R. "An econometric analysis of the role of financial intermediaries in the postwar residential building cycles". In R. Ferber (Ed.),***Determinants of investment behavior***, New York: Columbia University Press. 1967. pp. 301-331.

25. Swan, C. "The markets for housing and housing services: A comment". ***Journal of Money, Credit, and Banking***, 5(4),1973. pp.960-972.

26. Thom, R. "The relationship between housing starts and mortgage availability". ***Review of Economics and Statistics***, 57(4),1985. pp.693-696.

27. Tiao, G. C., & Box, G. E. "Modeling multiple time series with application". ***Journal of American Statistical Association***, 1984. pp.75, 35-48

28. Vandale, W. ***Applied time series and Box-Jenkins models***. New York : Academic Press Inc. 1983.

29. Wang, M., & Ma, H. "Multiple time series models for housing and the mortgage rate". ***Journal of the American Statistical Association***, Proceedings of Business and Economic Statistics Section Proceedings, 1981. pp.418-423.