ECONOMETRIC APPROACH TO FORECASTING HOUSING TRENDS

Remarks of

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I was asked to discuss an econometric approach to forecasting housing trends. For this purpose, I want to touch briefly on three related points: (1) an exposition of the econometric model I have used to forecast housing starts; (2) a projection of starts for this year based upon the model; and (3) the record of the model in the recent past.

A Model for Forecasting Housing Starts

Figure 1 lists two closely related, statistically estimated equations for housing starts. These equations follow the nearly identical form of a model of the housing market which I developed six years ago and which was discussed at length in the June 1963 American Economic Review.

The equations clearly meet the normal statistical tests of goodness of fit as well as of significance for the specific independent variables. The F-ratios for the individual variables range from 15 to 30. The equations also show a significant Durban-Watson coefficient. It is recognized, however, that because of the inclusion of lagged values of the dependent variable, this is not a necessary proof of lack of autocorrelation. The coefficient values are of the same order of magnitude as in previously published versions of this model. They differ somewhat, however, because rather massive corrections have occurred in the underlying data and because one variable (household formation) now appears in the model only indirectly through its influence on vacancies.

The AER article describes the logic of this model at some length, but we can briefly restate it. In effect, this model stresses the existence of large scale inventory swings around a more stable level of final demand. It holds that the level of housing starts is determined by four factors:

(1) First is the general level of final housing demand. This depends upon the rate of household formation and the rate at which houses are removed from the existing housing stock.

(2) The rate of construction also depends upon the level of available vacancies. When units are completed at a faster rate than the increases in final demand, a backlog of vacancies is built up. The available vacancies depress the rate of starts.

(3) The rate of inventory accumulation fluctuates widely with builders' expectations and desires to build houses. The desire to build is influenced by current interest rates, as well as by the relationship between rents and costs. As these cause builders' expectations and profits to change, starts vary.

(4) There is a technical relationship between the rate of starts and the number of units in the pipeline under construction. The inventory under construction does not move in a simple manner with starts. Rather the relationship takes a form which can be expressed as a difference equation. The relationship between changes in the inventory under construction and the rate of change in starts tends to follow a fluctuating form.

Figure 1 also shows the expected elasticities or reactions of starts to changes in the independent variables. Two elasticities are given. The first shows the immediate impact on starts of changes whether in vacancies, interest rates, or relative costs. The second takes into account their total impacts including their influence on the inventory under construction.

By the end of a year a one-percent increase in vacancies lowers the level of starts by about four-tenths of a percent. A one-percent increase in costs relative to rents would decrease the level of starts by about two percent. A one-percent increase in the mortgage interest rate would also cause a similar two-percent fall in starts, but its impact would take a half-year longer to be fully effective.

From the actual coefficients, we see that if there are 100,000 additional vacancies, the level of starts in the following year will be reduced by about 40,000. Other things being equal, this reduces future vacancies. As a result, the excess in vacancies and its depressing impact on starts virtually disappear over a two- to three-year period. Alterations between strength and weakness from vacancies have been typical of the markets.

When mortgage interest rates vary, each ten basis points movement, according to the model, causes starts to alter by from 35 to 50,000 a year. The interest variable averages rates for nine months. On the average, the model estimates that it takes a change in interest rates three-quarters of a year to influence starts. From top to bottom of an interest rate move, the equations show an impact on starts of 200 to 300,000 units at an annual rate.

The data underlying the rent-cost indexes are among the most suspect of all. Changes in this relationship over a cyclical period have ranged from two and one-half to five percent. Thus, their estimated impact on starts is shown to have influenced the level of starts by from 50 to 100,000 with the changes occurring over a two-year period.

Figures 2 and 3 are charts which show the estimated impact of each of the independent variables on housing starts since 1950. They also show the relationship of the estimated totals to the actual.

The charts indicate that the total impact of movements in each of the individual variables has normally ranged between plus and minus 150,000 starts. It usually takes several years for an individual variable to alter by that much. On the other hand, as several variables have moved together, the annual rate of starts has varied rapidly. There have been at least four major fluctuations in starts since 1950.

A review of the charts gives us some pause in making too literal an interpretation of the coefficients. We note the erratic quarterly movements in the reported series. There is some indication that the calculated totals may be more reliable than the reported in many periods. On the other hand, the sharp differences between the movements of vacancies and the interest rate between the early and late 1950's caused concern. Some of the estimated elasticities may reflect a movement in trends and not in the short-run variations.

A Projection for 1966

Based on the model and current forecasts of the independent variables, I estimate that private starts in 1966 will be approximately 1.4 million. This is roughly 100,000 less than last year. This projection is based on an averaging of several different forms of the model. Each individual equation gives a slightly different result.

What leads to this expected drop? Basic demand from household formation and net removals would be expected to increase this year's starts over last by approximately 40,000 units. On the other hand, a fairly rapid rise in costs related to rents is expected to decrease starts by a similar 40,000. Increasing interest rates also will, according to the model, depress starts by about 40,000. The higher level of vacancies carrying over as a result of the large number of starts in 1963 and early '64 has a negative impact of

about 30,000. These are the initial decreases. Since falling starts require fewer units in the construction pipeline, the inventory under construction is expected to fall by roughly 30,000. The total of these diverse movements leads to the expected decrease of approximately 100,000 units.

When this model was run at the end of October, it projected 1,460,000 starts for the year. Thus, the projected level of starts has fallen by 60,000 over the past five months. This is true even though the actual level of starts is as yet running close to the November projection. The expected deterioration later this year occurs because it is now assumed that interest rates and relative costs will both reach higher levels than were predicted for our initial run last fall.

The Record of the Econometric Forecasts

Since this is a meeting of the American Statistical Association dedicated to the improvement of our statistical techniques, it appears proper for us to consider the record and problems of economic projections of this type.

Since developing this model, I have as a matter of principle attempted to go on record with my forecasts. I believe that the best way to test a forecasting model is to see how it works.

Figure 4 contains information on forecasts made from this model in four previous years. In two of these years, the initial forecast was revised after a month as additional information became available.

I have also included for each of these years published estimates from the Business and Defense Services Administration of the Department of Commerce. I have selected their projections simply because they are easily available in published form. I have no idea whether their record is better or worse than that of other forecasters. I do note, however, that in the last four years their projections have called for minimum changes of 1/2 to 1-1/2 percent a year.

Looking at the record, I come to no firm conclusion as to whether or not the econometric model is doing well. In two years the projections were very close; one was moderately off; and one was very bad. In three of the four years, the direction of change was correct. This is a considerably better record than Commerce's whose direction was wrong in three of the four years. The comparisons show a standoff comparing percentage errors by years--each was better twice. The average percentage error for the four years was 4.8 percent for Commerce and 5.4 per cent for this model, or a plus in favor of the non-econometric model.

Frankly, I have no way of determining whether an average mean error of 5.4 percent for a fairly volatile series such as housing starts is good or not. The median error at 3.5 per cent is considerably better. I would judge that if the median performance stayed at this level, the record of this forecasting procedure could be considered more than satisfactory.

The reasons for the variance are fairly clear. In the first place, it should be recognized that some variance is to be expected. The standard error of forecast for the current model is 17,900 starts per quarter. Assuming that it has been roughly the same in the past periods, the actual forecast fell within the standard error on an annual basis in two years and was very close in one.

Another major source of error in the forecasts is the poor underlying data. They have undergone several major revisions. The first two forecasts were made from data prior to their revisions. It is not clear how much of the error came from this fact. Perhaps one should be surprised that the model did as well as it did, given the basic changes in the data.

Another point to recognize is that in use, this particular model requires that several items be projected. Thus for this year, we have to project the mortgage interest rate and the cost elements through the third quarter. Errors in projecting these exogenous variables end up as part of the total variance in the final forecast.

Conclusion

My general feeling about the model, outside of a normal pride of authorship, is that it has been a useful exercise in model-building and forecasting. As a result of this particular model, we have a much better concept of how the housing market works than we

had before its development. Others are building upon this foundation. We can expect that over time considerable improvements will be made.

Even in its present state, however, I find it worth while to go through and recalculate the model each time a forecast is required. Given the size of the standard error of forecast and the other difficulties with our information, I believe that the model must still be used as part of a coordinated, over-all analysis of the housing market rather than as a unique estimate. For example, if for policy purposes I required a specific estimate at this time, I might adjust this year's projection up somewhat.

On the other hand, because a specific model exists, we do have some ideas of the orders of magnitude of impacts on starts that can be expected as a result of changes in costs, interest rates, or vacancies. Without a model of this sort, it is extremely difficult to give any numerical content to the idea that these movements in these variables will alter the rate of housing starts. While I do not place a high reliability on the specific numbers involved in estimating the effects of changes in these variables, I do feel that as long as the model continues to forecast fairly well, we must place some confidence in the specific numbers that it throws out.

Figure 1

ALTERNATIVE HOUSING STARTS EQUATIONS

$$St_o = 152.7 - .7698 \frac{1}{3}\sum_{-4}^{-2} int._{-j} - .0690\ V_{-1} + .5363\ St_{-1} - .2754\ St_{-3} + .6100 \left(\frac{R}{C}\right)_{-1} + 2.467\ T_o$$

(.1542) (.0126) (.1001) (.0715) (.1196) (.4465)

$R^2 = .869$ $\quad \bar{S}_u = 17.46$

* * * * * *

$$St_o = 138.3 - 1.0027 \frac{1}{3}\sum_{-4}^{-2} int._{-j} - .0858\ Vs_{-1} + .5336\ St_{-1} - .3148\ St_{-3} + .5956 \left(\frac{R}{C}\right)_{-1} + 3.166\ Rem_o$$

(.2039) (.0153) (.1025) (.0732) (.1201) (.6534)

$R^2 = .866$ $\quad \bar{S}_u = 17.65$

* * * * * *

ELASTICITIES OF STARTS IN RELATION TO INDEPENDENT VARIABLES

Variable	Mean	First Period		Long Run	
		coeff.	elasticity	coeff.	elasticity
V_{-1}	1383.3	- .086	- .322	- .110	- .412
$\left(\frac{R}{C}\right)_{-1}$	980.3	.596	1.582	.763	2.026
$Int._{-3}$	552.0	-1.003	-1.499	-1.284	-1.919

* * * * * *

St_o = Private housing starts, quarterly totals in thousands, seasonally adjusted, U. S. Bureau of the Census, Construction Reports--Housing Starts, Series C-20.

V_{-1} = Available vacancies derived endogenously from base of available vacancies in 1960 census. U. S. Bureau of the Census. For Vs, total available vacancies are reduced by 4 percent of the accumulated change in households since 1950.

$\left(\frac{R}{C}\right)_{-1}$ = Residential rent component of the consumer price index (1957-59 = 100). U. S. Bureau of Labor Statistics.

C_{-1} = Cost of residential construction--GNP implicit price deflator residential construction (1958 = 100).

$Int._{-j}$ = Contract interest on conventional first mortgages for the purchase of new, one-family, nonfarm houses. Federal Home Loan Bank Board.

T_o = Time

Rem_o = Net removals. 17,500 plus .180 percent of dwelling units available at beginning of quarter.

FIGURE 2

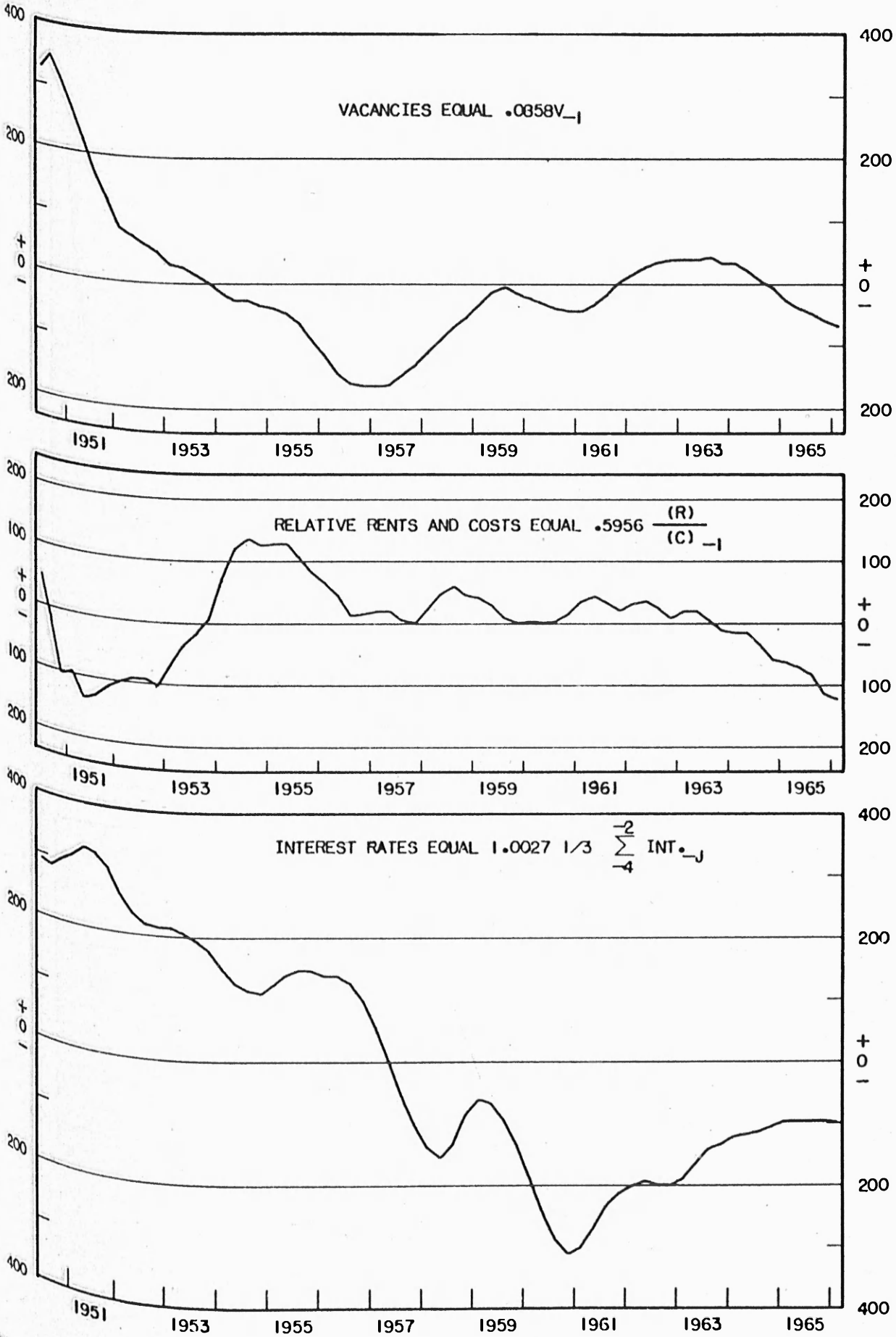
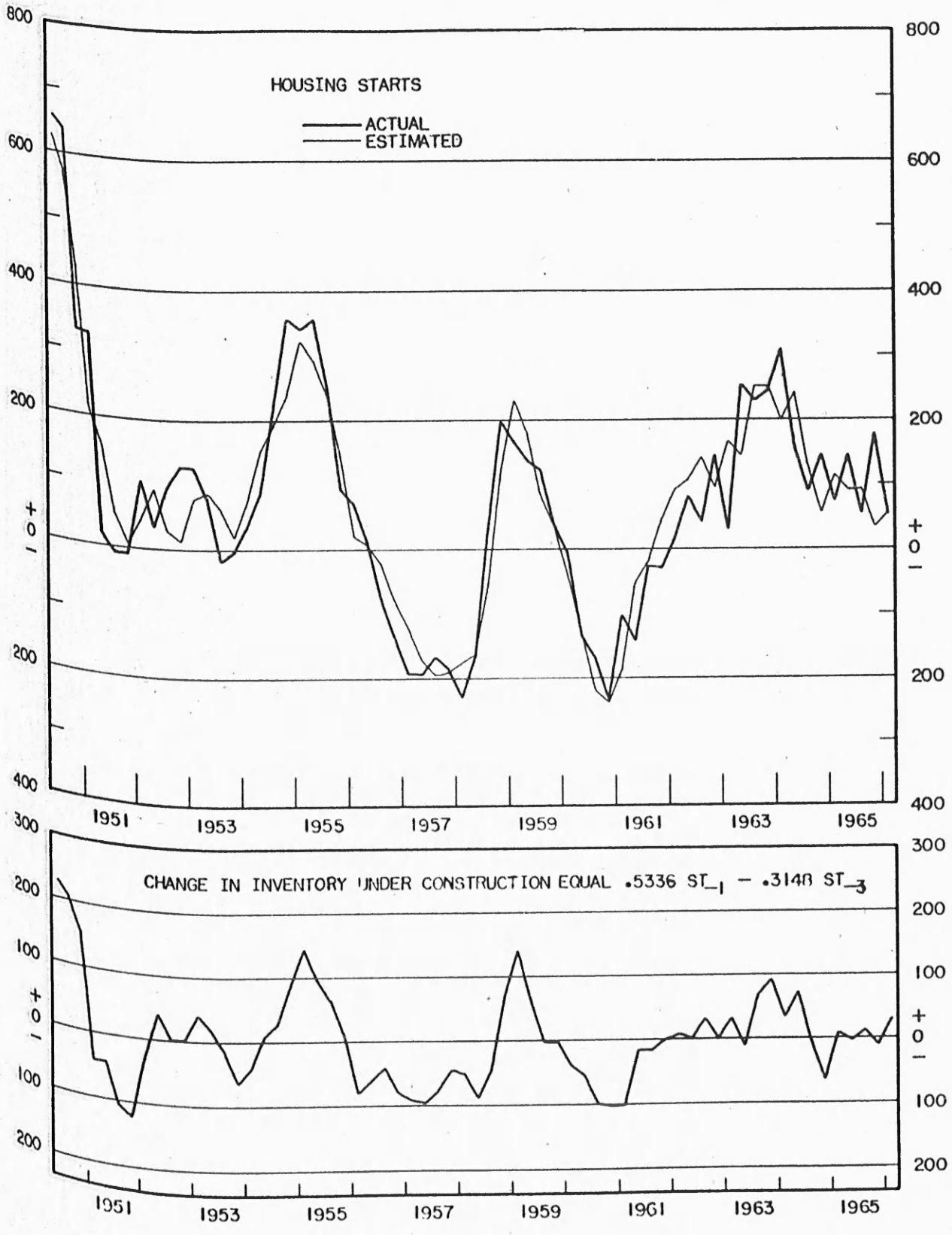

VACANCIES EQUAL .0858V_1
RELATIVE RENTS AND COSTS EQUAL .5956 (R)/(C)_1
INTEREST RATES EQUAL 1.0027 1/3 Σ_{-4}^{-2} INT._J
400
200
+
0
−
200
400
1951
1953
1955
1957
1959
1961
1963
1965

FIGURE 3



(THOUSANDS OF STARTS—SEASONALLY ADJUSTED ANNUAL RATES DEVIATIONS FROM MEANS)

Figure 4

SUMMARY OF PRIOR FORECASTS
(In thousands at annual rates)

Projection					Actual change		Error		
Date	For year	Amount	Change* Amount	Change* Percent	Amount	Percent	Amount	Percent	Direction
Jan.61	1961	1300	+ 78	+ 6.0	+ 82	+ 6.3	- 4	- 0.3	correct
Nov.60	1961	1350	+ 97	+ 7.7	+ 51	+ 3.9	+ 46	+ 3.5	correct
Nov.62	1963	1296	-178	-12.1	+115	+ 7.2	-293	-18.4	wrong
Dec.62	1963	1359	- 97	- 6.7	+133	+ 8.4	-230	-14.5	wrong
Nov.62	1963	1459	- 15	- 1.0	+115	+ 7.2	-130	- 8.2	wrong
Feb.64	1964	1450	-165	-10.2	- 69	- 4.5	- 86	- 5.6	correct
Nov.63	1964	1605	+ 16	+ 1.0	- 45	- 2.9	+ 61	+ 4.0	wrong
Nov.64	1965	1420	-117	- 7.6	- 34	- 2.3	- 83	- 5.5	correct
Dec.64	1965	1480	- 27	- 1.8	- 4	- 0.3	- 23	- 1.5	correct
Nov.64	1965	1552	+ 11	+ 0.7	- 38	- 2.5	+ 49	+ 3.3	wrong
Nov.65	1966	1460	- 32	- 2.1					
Apr.66	1966	1398	-144	- 9.3					
Nov.65	1966	1515	+ 22	+ 1.5					

*Annual rate in last six months' data available at time of forecast.