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Development of Leading Indicators for Housing Starts in Tremonton, Utah

Douglas I. Ward
Utah State University

DEVELOPMENT OF LEADING INDICATORS FOR HOUSING STARTS IN TREMONTON, UTAH

by

Douglas I. Ward

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TABLE OF CONTENTS

	Page
INTRODUCTION	1
Objectives	1
Development	1
Background	3
Methods	4
PROCEDURES	6
Data accumulation	6
Dependent variable	6
Independent variable	7
Analysis	8
Dependent variable	8
Independent variable	10
Data synthesis	10
Application	10
Alternative	12
RESULTS	13
Dependent variable	13
Deriving the variable	13
Alternative methods	13
Independent variable	15
Thiokol employment	15
Thiokol contracts	18
Trust deeds and mortgages in Box Elder County	23
Gas meters	24
Comment on scope	26
DISCUSSION	28
Findings	28
Implications	28
Limitations of the study	31

TABLE OF CONTENTS (continued)

	Page
CONCLUSIONS	34
Leading indicator	34
Bestway closure	34
APPENDIX	37
Appendix A	38
Appendix B	41
Appendix C	43
Appendix D	49
Appendix E	50
Appendix F	54
LITERATURE CITED	56
VITA	57

LIST OF TABLES

Table		Page
1.	Calculation of dependent variable	14
2.	Employment levels at Thiokol	16
3.	Rate of change in Thiokol employment	19
4.	Contracts awarded to Thiokol	20
5.	Moving average of Thiokol contracts	22
6.	Mortgages and trust deeds for Box Elder County	23
7.	Gas meter hookups in Tremonton, Utah	26
8.	New homes in Tremonton completed and occupied	30
9.	Calculation of simple moving average	41
10.	Data for calculating coefficient of determination and standard error of estimate	46
11.	Population effect of the accelerator	51

LIST OF FIGURES

Figure		Page
1.	Deriving a dependent variable	9
2.	Employment levels and rate of change in employment at Thiokol plotted with dependent variable	17
3.	Moving average of Thiokol contracts and dependent variable	21
4.	Mortgage and gas meter data plotted against dependent variable	25
5.	Application of freehand regression lines	44
6.	The accelerator principle effect	53
7.	Leading indicator relationship	55

ABSTRACT

Development of Leading Indicators for

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by

Douglas I. Ward

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Major Professor: Dr. Scott Durdan
Department: Business Administration

The possibility of developing leading economic indicators of housing starts, on a localized basis, was studied in Tremonton, Utah, for the period from 1958 to 1965. Data on any economic variable which might show a leading relationship to housing starts was gathered and synthesized to ascertain any predicting tendencies.

Several of the variables researched, particularly contracts awarded to Thiokol and Thiokol employment, showed a high positive correlation to housing starts; however, none showed any consistent leading pattern.

An accelerator relationship was found to exist between the average rate of change in Thiokol employment and housing starts. This finding, though not directly applicable to the study, resulted in the most economically rational explanation for the absence of a leading indicator.

(63 pages)

INTRODUCTION

Objectives

This study proposes to examine the dynamic economic conditions in the Tremonton, Utah, area with special emphasis on their effect on the demand for building materials. The central objective of this study will be to ascertain if any indicator was available that might have been used by businessmen, building suppliers in particular, to predict changes in residential construction prior to the occurrence of actual changes. If any "predicting indicator" is found, it will be used to revise the historical financial statements of Bestway Lumber Company of Tremonton to determine the plausibility of using such an indicator for planning inventory levels, manpower requirements, or for making any other operating decision.

The time period covered by the study will be from 1958 to 1965. The significance of these dates, the historical setting, and procedures will be outlined in the following pages of the Introduction and explained in detail in ensuing sections.

Development

Prior to 1958 the predominant employers in and around Tremonton, Utah, were agricultural or agricultural-related operations. Tremonton itself was a typical small town with most of its business coming from smaller outlying towns within a fifteen to twenty mile radius.

In 1958 construction was started on Thiokol Chemical Corporation's Minuteman Missle Plant ten miles west of town on the north shore of the

Great Salt Lake. Almost from inception the plant carried on an aggressive recruiting program, causing a rapidly increasing influx of people into the area. This influx continuted until mid-1962 when Thiokol reached peak employment. The 1962 employment level was maintained until late in 1963 when a systematic layoff program was undertaken. The rapidly increasing population in the upswing period had economic repercussions not only in Tremonton, but extending to the surrounding areas as well. Especially acute to the Tremonton region was the severe strain on suitable housing for incoming employees. The influx had a "vacuum effect" which stimulated residential development to the point of causing a boom for the next four to five years.

During this period of rapid development, two major building suppliers were operating in Tremonton, one being Bestway Lumber Yard, and the other, Anderson Lumber Company. Both of these yards are branches of important regional retail chains. The Anderson yard is currently operating as the sole building supplier in Tremonton and the immediate market area. Bestway Lumber, on the other hand, was closed in mid-summer of 1965 as a result of "losing money every year due to poor management." (Hansen, 1966.)

In connection with the above statement, there is some indication that the demand for building supplies fell somewhat below the pre-expansion level after 1965. However, sufficient data is not available to accurately determine demand, either immediately before or after the expansion. Therefore, the assumption has been made that demand essentially returned to the pre-1958 level when both yards were operating profitably.

The first objective of this paper, then, will be to present the results of the study covering the possibility of developing some "predicting indicator" of the eventual downturn in housing construction, hereafter referred to as a local leading indicator of housing construction or just a leading indicator. In the event such a leading indicator can be derived, it will be used as a "historical planning device" to adjust the inventory levels, major expenses, and other financial statement items to determine the possibility of using such an indicator as a tool in making operating decisions.

Background

The following brief historical review should be helpful in setting the background for the study and indicating some of the rapidly changing economic conditions in Tremonton during the time period covered by this report. In addition, data will be presented regarding the housing situation as it existed at the time of the study.

Prior to 1958, construction around Tremonton could most appropriately have been described as from slow to moderate with most new construction being farm structures (grade A dairy farming was growing rapidly at this time) and a few new homes.

Simultaneous with the population increase resulting from Thiokol recruiting was the establishment of six rather distinct subdivisions in and around Tremonton which eventually were expanded to include a total of 336 new homes. By 1962 the seasonally adjusted level of housing construction reached its peak; and by 1965, when Thiokol slowed employment cutbacks, major construction of the type experienced during

the expansion was virtually nonexistent.

In December, 1966, there were approximately 112 new homes vacant in the six subdivisions mentioned; many of these never had been occupied and a considerable number had not been completed. There are still several new houses being built each year; most of these are in the $25,000 to $40,000 range. These homes are generally build by permanent residents of the area who evidently find the subdivision homes unsuitable.

It is interesting to note that in the first of the subdivisions undertaken in Tremonton, the homes were built by competent local contractors and of the 100 homes built in the subdivision all but five were occupied on December 22, 1966. Representative of the other subdivisions was one in which 61 houses were built on two or three standard floor plans. On the same date only ten of these homes were occupied. It had been rumored that as of mid-1966 the Federal Housing Administration was the largest real estate owner in Box Elder County, which encompasses the Tremonton area.

It is hoped that the above background material will give some indication of the extremely dynamic conditions in Tremonton from 1958 to 1965 and some insight into the effect these changing conditions had on the demand for building materials.

Methods

The steps followed in arriving at the objectives of this study were:

1) To gather selected data on homes completed per quarter for the purpose of estimating approximate housing starts.

2) To obtain data on homes being occupied per quarter, employment levels at Thiokol, interest rates, and other data which might be used in determining a suitable leading indicator of the eventual downturn in home construction.

3) To use any indicator derived as a historical planning device; and, by using the financial statements of the Bestway yard, to determine if such an indicator could have been used in planning operations; and, if so, to revise the statements accordingly.

4) Finally, in developing an indicator it should be kept in mind that in order to be useful to the type of businessman being considered in this study, the data would have to be readily available and easily interpreted. It should be realized that these businessmen are not likely to have the statistical tools necessary to do any complex analysis of the data.

PROCEDURES

Data accumulation

Dependent variable. The first data needed before actual analysis could be undertaken was information which could be synthesized to arrive at the dependent variable, houses started per quarter, applicable to this study. In researching the possible sources for the data needed, it was found that electrical power meters were installed in newly completed homes just prior to their being approved by the Federal Housing Administration. Therefore, it was concluded that, since all but a few of the homes were FHA approved, the data on meter installations would be an appropriate indicator of house completions and could be readily converted to reflect housing starts.

The information on meter installations was taken directly from the work orders of the Utah Power and Light Company, the sole suppliers of electrical power in the Tremonton area. It was found that the contractor contacts the power company at the time the house is completed and orders a meter installed. According to the Utah Power and Light Company, the meter would be installed one to five days after the request is received. During the construction period, power is supplied to the contractor by means of a temporary meter installed near the construction site. Data on temporary installations was not included in the study.

From the electrical company work order, it was readily apparent what type of structure was involved in the installation. Therefore, in going through the work orders from 1958 to 1965, all installations

could be omitted except those involving new homes. In order to insure the maximum validity possible, each work order for the entire time period was carefully examined and recorded immediately.

Independent variable. In researching possible independent variables, the objective was to find any data which, in either raw or statistically adjusted form, showed any determinable leading relationship to the dependent variable. Data was obtained from Thiokol Chemical Corporation on cumulative employment levels at the local plant, from Mountain Fuel Supply Company on gas meters installed per quarter, from Security Title Company on trust deeds and mortgages recorded per quarter, and from Thiokol on contracts awarded. The data obtained was graphed on time continuums with the dependent variable to determine if any leading relationships could be observed.

In cases where the raw data exhibited erratic or widely fluctuating characteristics, the application of standard statistical methods was used to derive a trend line of the raw data curve. Statistical methods used and implications of their application will be explained later in the text. In all cases the data was obtained either directly by the researcher from original sources or from employees within the cooperating firm who researched and supplied the information under explicit instructions from the author.

The criterion used in selecting possible independent variables was that they must have some rational relationship to the dependent variable. The rationale for selecting each of the independent variables mentioned is given below:

1) The cumulative employment level at Thiokol was chosen because it was the influx of employees which initiated the impetus to housing construction. It was felt that the cumulative level of employment may actually turn down ahead of the downturn in housing starts. This same data was used to derive a rate of employment increase on the premise that the reversal in the rate of employment may have led the housing downturn.

2) The data on the gas meters installed was obtained in order to see if this data, which purported to show houses being occupied per quarter, would show any tendency to lead the dependent variable.

3) The data on trust deeds and mortgages was obtained because this information must be recorded before construction can begin; therefore, it would seem intuitively logical that this variable should lead the downturn in housing starts.

4) The contract data from Thiokol might show a relationship to housing starts because it was the failure to obtain new contracts which caused Thiokol to initiate employment cutbacks.

Analysis

Dependent variable. As can be seen from examining Figure 1, the raw data for houses completed per quarter exhibited a widely fluctuating but not a seasonally consistent pattern. In an effort to adjust the data to a smooth trend line of approximate housing starts, a reversed moving average computation was applied to the data. (Appendix A.)

The revised data now is the approximate indicator of housing starts per quarter (Figure 1). The effect of the reversed moving average

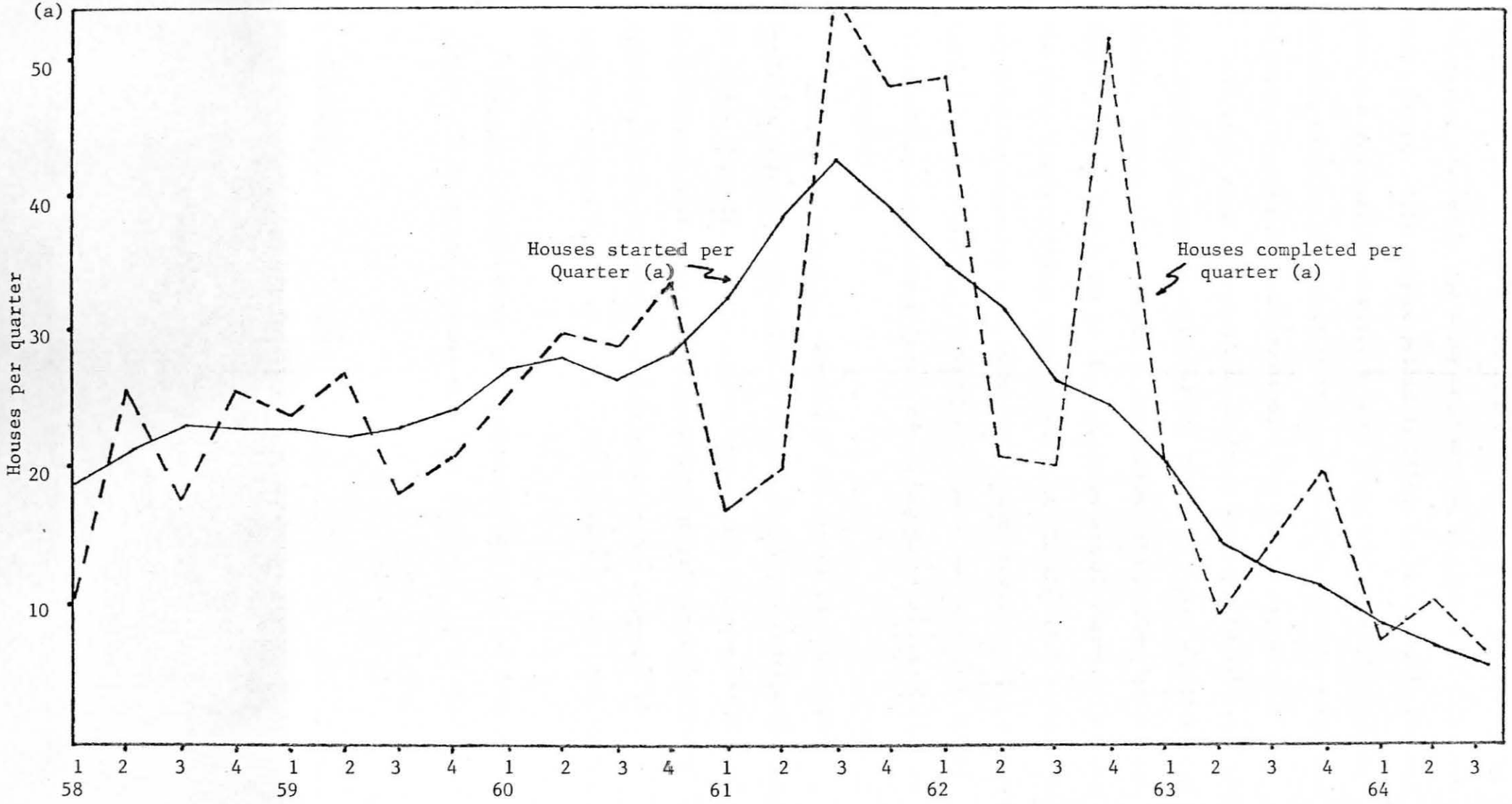

Figure 1. Deriving the dependent variable of estimated housing starts per quarter.

calculation is to move the same curve that would be found by standard moving average methods to the left three quarters. In essence, this is saying that the average houses completed in any given quarter during the period covered by the study were started an average of three quarters earlier. This elapsed period is likely to be closer to the maximum time required to complete a house than to the mean time lapse; however, owing to the nature of this study, it is probably preferable to having a parameter which approaches the minimum lapsed time.

It might also be argued that shifting the curve to reflect a maximum lapsed time may actually reflect levels of future expected housing starts. Within the framework of the current study, expectations for future housing starts are as significant as actual starts. Therefore, the three quarters lapsed time reflected in the dependent variable curve may actually represent some compromise between actual housing starts and expected housing starts. However, the lack of any objective method for measuring expectations leaves one at the point of postulating on this possibility.

Independent variable. Several of the curves for independent variables required application of statistical moving average methods to derive trend lines. However, in these cases the data was plotted in accordance with generally accepted statistical procedures which specify plotting the moving average point in the mid-point of the interval covered by the average. (See Appendix B for moving average calculation.)

Data synthesis. After the independent variable had been plotted against the dependent variable on a time continuum, those dependent-

independent pairs showing usable relationships were plotted against one another on semi-logarithmic paper. (Figure 5.) (Semi-log paper was used because it consistently plotted the most linear relationships.)

In all cases plotted, there was found to be two separate trend relationships. One represents the upswing part of the dependent-independent relationship, and the other represents the downswing relationship. To these two groupings of plots were fitted freehand regression lines for which coefficients of determination and standard errors of estimate were calculated. (See Appendix B.)

The coefficient of determination shows the proportion of variations in the dependent variable which can be explained by the independent variable. The standard error of estimate shows the range within which there is a 68.3 per cent probability of observing the actual value of the dependent variable for any given corresponding independent variable value.

However, the significant point to be kept in mind is that even though the results of the regression analysis are very favorable, if the independent variable shows no leading relationship to the dependent variable on the continuum, the objective of deriving a leading indicator has not been achieved. This does not relieve the necessity of calculating regression lines, coefficients of determination, and the standard errors of estimate, because in the event no leading relationship is found, the nature of the existing relationships must be explained.

Application. In compliance with the second major objective of this study, any leading indicator derived will be used as a historical planning device on the financial statements of Bestway Lumber Yard in

an effort to determine the usefulness of the indicator.

Financial statements were chosen from the Bestway Lumber Company because Bestway was directly involved in supplying material for residential construction during the entire cycle and also because they were forced out of business by excessive losses following the downswing in new home construction.

Alternative. In the event no leading indicator is found, the conclusion and summary section will consider possible reasons for not finding a leading relationship. In addition, the discussion section will be altered to evaluate the nature and implications of the actual relationships that were found.

RESULTS

Dependent variable

Deriving the variable. The first step in the analysis of the data accumulated was to derive an appropriate trend line for the dependent variable, which was the approximate number of houses completed per quarter. In the synthesis of the dependent variable, the data obtained from the Utah Power and Light Company on houses completed per quarter was ranked according to corresponding quarters and the reversed ratio-to-moving average calculation was used to derive the approximate line for housing starts. (Appendix A.)

Figure 1 shows the results obtained by graphing the original data, shown by the broken line, and the trend line obtained by application of the reversed ratio-to-moving average calculation to the data and shown by the heavy black line. It is the heavy black line which was used as the dependent variable in this study. What the graphed dependent variable shows, then, is the approximate housing starts per quarter plus an allowance for expectations of housing starts in the next four quarters. Table 1 shows the calculation of the dependent variable.

Alternative methods. Several other methods of analysis were applied to the data on house completions before the decision was made to use the reversed ratio-to-moving average method on the data. Before proceeding further, it might be enlightening to explain the other methods tried and the reasons why they were abandoned.

The first method applied was the forward ratio-to-moving average

Table 1. Calculation of reversed ratio-to-moving average for house completions in Tremonton, Utah.

Year	Quarter	Original data	Moving total	Moving four quarter average	Second quarter moving total	Centered four quarter average
1958	1	12			20.50	20.50
	2	26	82	20.50	44.00	22.00
	3	18	94	23.50	47.75	23.62
	4	26	95	23.75	47.50	23.75
1959	1	24	95	23.75	46.25	23.12
	2	27	90	22.50	45.25	22.62
	3	18	91	22.75	46.25	23.12
	4	21	94	23.50	49.75	24.87
1960	1	25	105	26.25	55.75	27.87
	2	30	118	29.50	57.00	28.50
	3	29	110	27.50	52.50	26.25
	4	34	100	25.00	56.50	28.25
1961	1	17	126	31.50	66.50	33.25
	2	20	140	35.00	78.00	39.00
	3	55	172	43.00	86.25	43.12
	4	48	173	43.25	77.75	38.87
1962	1	49	138	34.50	70.00	35.00
	2	21	142	35.50	64.00	32.00
	3	20	114	28.50	54.00	27.00
	4	52	102	25.50	49.75	24.87
1963	1	21	97	24.25	40.50	20.25
	2	9	65	16.25	29.00	14.50
	3	15	51	12.75	25.75	12.87
	4	20	52	13.00	23.75	11.87
1964	1	7	43	10.75	18.50	9.25
	2	10	31	7.75	14.25	7.12
	3	6	26	6.50	11.25	5.62
	4	8	19	4.75	8.00	4.00
1965	1	2	13	3.25	4.50	2.25
	2	3	5	1.25	2.00	1.00
			3	.75		

Author's note: Data was available to the end of 1965, thereby making it possible to calculate the moving average to the second quarter of 1965.

Source: Records of the Utah Power and Light Company, Tremonton, Utah.

method. This method would be averaging the same four figures as the reversed method except in a different sequence; therefore, the trend line derived would be identical to the reversed line with the exception of being shifted three quarters to the right. It can immediately be seen that this line would be unsatisfactory because it indicated nothing about the estimated housing starts; therefore, it lacked one of the essential criterion of the dependent variable.

A second method tried was the simple moving average method explained in Appendix B. While this method resulted in a trend line that fit the original data very well, it also failed to give any indication of estimated housing starts. The final attempt was the least squares trend line method which, while fitting the best trend line, also failed to indicate anything about housing starts. It was concluded, therefore, that the reversed ratio-to-moving average calculation yielded the most straightforward and most dependable trend line.

Independent variable

Thiokol employment. It was felt that since it was the influx of Thiokol employees into Tremonton which caused the housing boom, cumulative employment levels might yield the leading indicator desired. Through the cooperation of the personnel department of Thiokol Chemical Corporation's Wasatch Division, the cumulative employment data for the years 1958 to 1966 was obtained (Table 2).

Two separate types of analysis were applied to this data. First, the original data was plotted on the time continuum with the dependent

variable, housing starts, to determine if any leading relationship could be observed. In order for a leading relationship to occur, the line for the independent variable must consistently lead the upswings and downswings in the dependent variable. The result of the first plot is shown in Figure 2 where the independent variable, cumulative employment levels, is plotted as an alternating dot-dash line and the dependent variable, housing starts, as a solid black line.

Table 2. Cumulative employment levels at Thiokol Wasatch Division; 1958 through 1965.

Month	Year							
	1958	1959	1960	1961	1962	1963	1964	1965
January	156	1276	3104	4079	5319	5929	5273	2753
April	243	1858	2923	4600	5876	5948	4377	2701
July	429	2407	3279	4824	6241	5971	3642	
October	813	2876	3667	4999	5856	5672	2958	

Source: Personnel department of Thiokol Chemical Corporation's Wasatch Division.

From observing the line for this first independent variable, it can be seen that there is no leading relationship between the independent and dependent variables. In fact, the reverse is true; the dependent variable actually leads the independent. As a supplementary calculation, regression lines were run on the data and coefficients of determination and standard errors of estimate were derived. (Appendix C.)

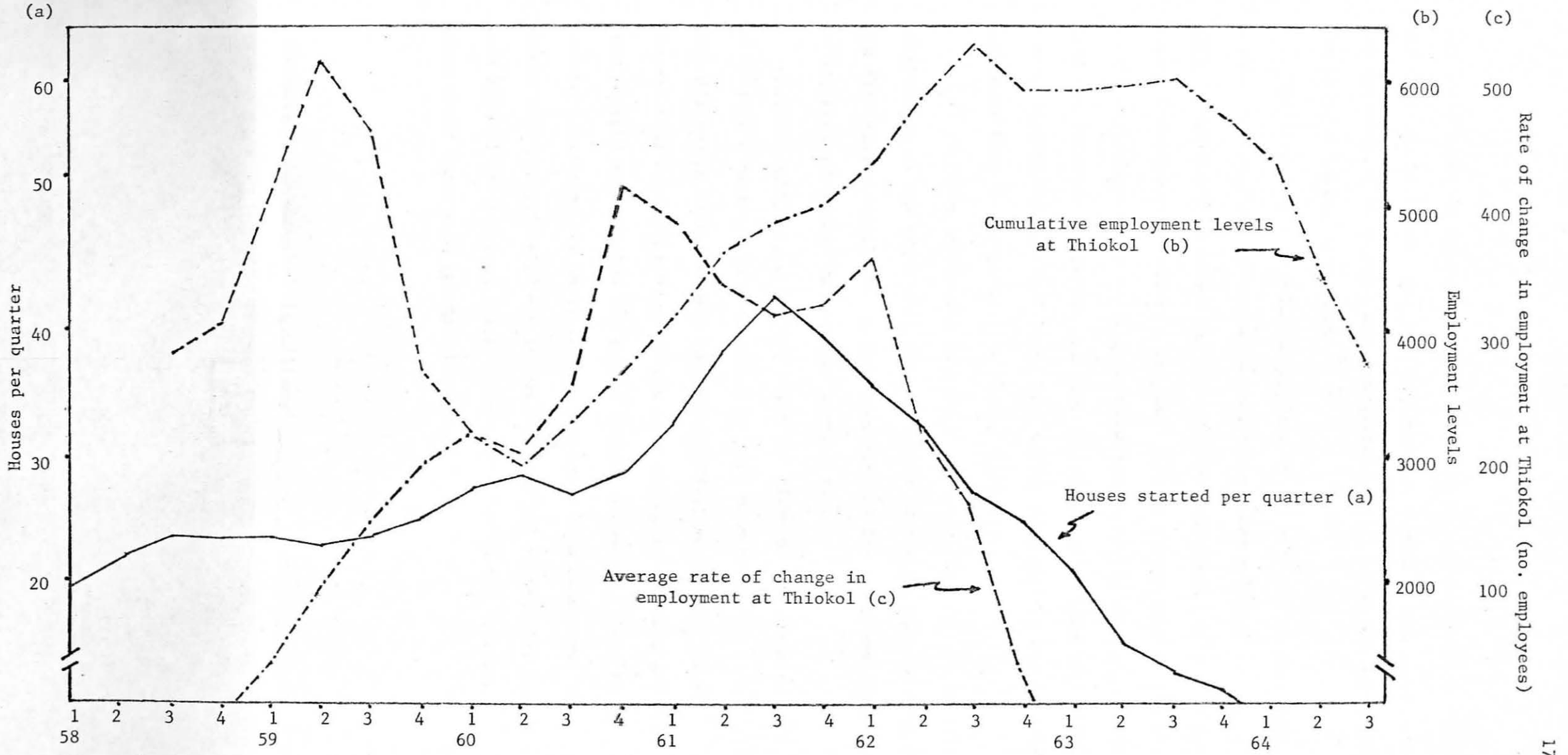

Figure 2. Employment levels and rate of change in employment and Thiokol plotted against the dependent variable housing starts.

The coefficient of determination for the upswing was found to be 73.02 per cent and 81.43 per cent for the downswing sector of the curve. While the correlation is significant, the variable still lacks the criterion for being a leading indicator.

The second type of analysis applied to the data was to calculate a rate of change in employment on the premise that a change in the rate of employment may have led the dependent variable. To derive this second independent variable, a marginal line of change between quarters in the employment curve was figured, and then a moving average of that line was derived. (Appendix D.) The rationale behind this calculation was to find an average rate trend line which would yield a more stable indicator than the marginal line alone. (Table 3.)

This variable is plotted as a broken line in Figure 2. A casual observation of the graph will show that this variable lacks the criterion for being a consistent leading indicator of the dependent variable. No regression analysis was applied to this data.

Thiokol contracts. Table 4 shows the value of contracts awarded to Thiokol's Wasatch Division plant for each year from 1958 to 1965. From discussion with contract control personnel at Thiokol, it was learned that a simple moving average line fitted to the data per year very closely approximated the actual contracts awarded. This is so because in many of the years showing extremely high contracts, the figure also includes what are called Supplemental Agreements, which were awarded for previous years but not included in the contract tally until funds were received.

Table 3. Calculation of average rate of change in employment at Thiokol's Wasacth Division.

Year	Quarter	Original data	Marginal	Four quarter moving total of marginal	Four quarter moving average of marginal
1958	1	156			
	2	243	87		
	3	429	186		280.0
	4	813	384		403.8
1959	1	1276	463	1120	494.5
	2	1858	582	1615	515.8
	3	2407	549	1978	457.0
	4	2876	469	2063	266.2
1960	1	3104	228	1828	218.8
	2	2923	(181)	1065	197.8
	3	3279	356	875	248.8
	4	3667	388	791	419.2
1961	1	4079	412	975	388.2
	2	4600	521	1677	333.0
	3	4824	224	1545	310.0
	4	4999	175	1332	319.0
1962	1	5319	320	1240	354.2
	2	5876	557	1276	214.2
	3	6241	365	1417	152.5
	4	5856	(385)	857	18.0
1963	1	5929	73	610	(67.5)
	2	5948	19	72	(21.0)
	3	5971	23	(270)	(164.0)
	4	5672	(299)	(84)	(392.8)
1964	1	5273	(399)	(656)	(582.2)
	2	4377	(896)	(1571)	(678.5)
	3	3642	(735)	(2329)	(555.0)
	4	2958	(684)	(2714)	(344.0)
1965	1	2753	(205)	(2220)	
	2	2701	(52)	(1376)	

Source: Original data from the Personnel Department, Thiokol Chemical Corporation, Wasatch Division.

Table 4. Value of contracts received by Thiokol's Wasatch Division for 1958 through 1965.

Year	Values of contracts received (in millions)
1958	$ 17.5
1959	110.0
1960	48.5
1961	242.0
1962	228.0
1963	30.0
1964	171.0
1965	96.0

Author's note: Total contracts for 1965 include $45 million of government assets administration contracts.

Source: MINUTEMAN Contracts Division of Thiokol Chemical Corporation's Wasatch Division.

Table 5 shows the calculation of the simple moving average of contracts awarded to Thiokol using methods explained in Appendix B. By plotting the simple moving average of contracts awarded onto a time continuum with the dependent variable, it can be seen whether any leading relationship exists (Figure 3). While the two variables have a high degree of continuity, it will be observed that the independent variable fails to lead the dependent variable.

However, because of the continuity that appeared between the curves, the author was interested in ascertaining the actual strength of the relationship. By applying the regression analysis explained in Appendix C, it was found that the upswing relationship had a coefficient of determination of 90.12 per cent and the downswing sector of 68.70 per cent. Here again, while the relationship is significant,

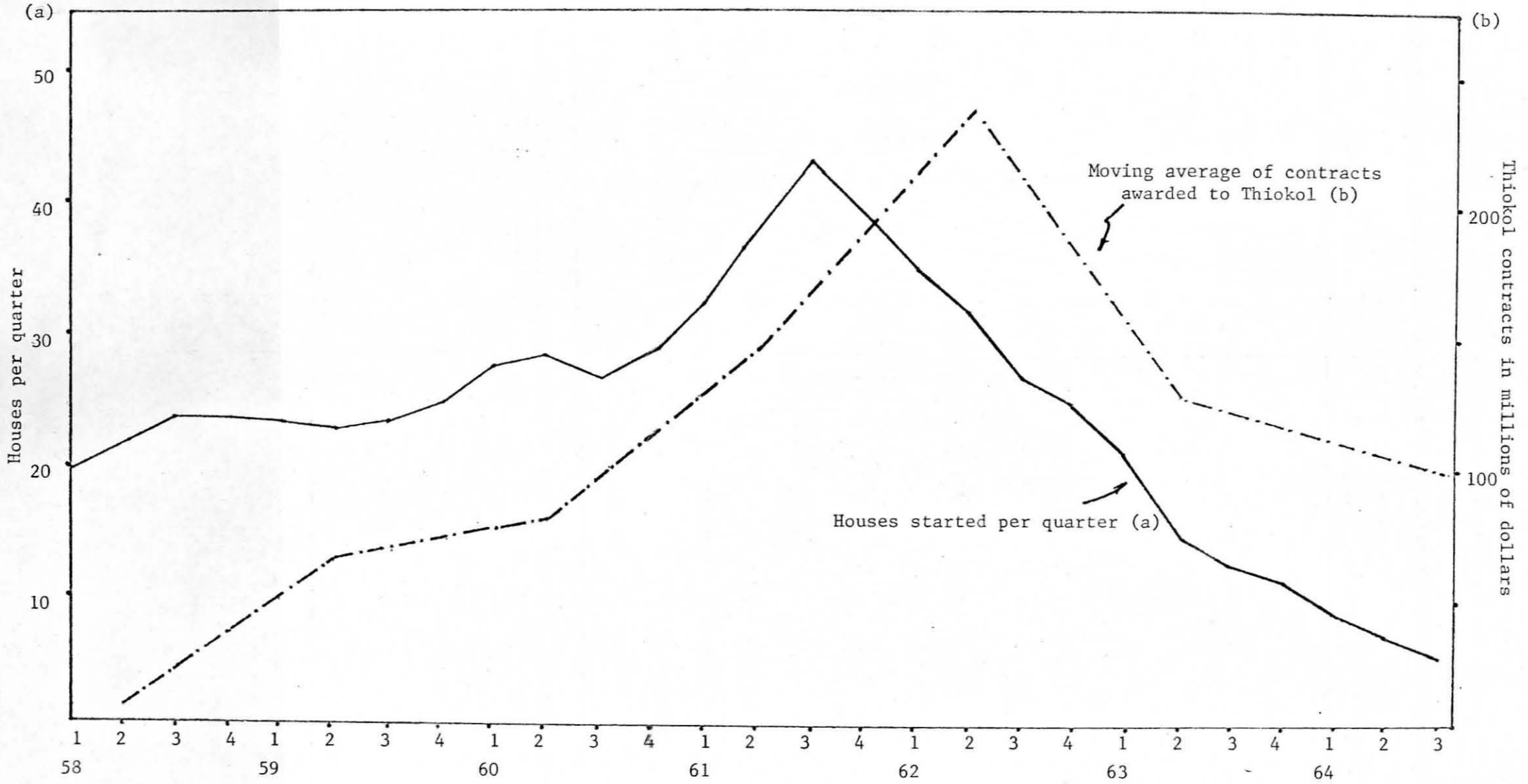

Figure 3. Moving average of contracts awarded to Thiokol plotted against the dependent variable housing starts.

Table 5. Calculation of simple moving average of total yearly contracts awarded to Thiokol (in millions).

Year	Quarter	Original data	Moving total	Two year moving average
1958	1			
	2			8.25
	3			
	4	17.50	17.50	
1959	1			
	2			63.75
	3			
	4	110.00	127.50	
1960	1			
	2			79.25
	3			
	4	48.50	158.50	
1961	1			
	2			145.25
	3			
	4	242.00	290.50	
1962	1			
	2			235.00
	3			
	4	228.00	470.00	
1963	1			
	2			129.00
	3			
	4	30.00	258.00	
1964	1			
	2			105.00
	3			
	4	171.00	210.00	
1965	1			
	2			81.00
	3			
	4	91.00	162.00	

Source: MINUTEMAN Contracts Division of Thiokol Chemical Corporations's Wasatch Division.

it fails to compensate for the lack of a leading tendency.

Trust deeds and mortgages in Box Elder County. Table 6 shows the quarter by quarter totals of trust deeds and mortgages issued in Box Elder County from 1958 to the second quarter of 1965.

Table 6. Quarter by quarter total of mortgages and trust deeds recorded for Box Elder County.

Year	Quarter	Quarter totals of trust deeds and mortgages
1957		
1958		not available
1959		
1960	1	$3,662,442
	2	3,380,445
	3	3,529,662
	4	4,095,441
1961	1	4,056,719
	2	4,297,364
	3	4,521,978
	4	5,004,897
1962	1	5,789,165
	2	4,132,616
	3	3,841,858
	4	4,097,149
1963	1	3,772,162
	2	3,522,305
	3	4,062,103
	4	2,182,397
1964	1	2,072,148
	2	2,101,264
	3	2,385,243
	4	2,675,686
1965	1	2,283,501
	2	2,653,960

Author's note: Figure imputed for data missing in August, 1963.

Source: Security Title Company.

It was felt, since a mortgage is recorded before construction is started, that a downturn in this variable may have preceded a downturn in the dependent variable. However, one fallacy immediately becomes apparent; Box Elder County encompasses not only Tremonton but the much larger population center of Brigham City. Therefore, records on mortgages and trust deeds applicable to Box Elder County included not only Tremonton but Brigham City.

To attempt, then, to assert a relationship between total mortgages and trust deeds for Box Elder County to Tremonton only, may be conjecturing an unwarranted relationship. An attempt was made to obtain mortgage data for Tremonton only, but such information was not available.

In spite of these limitations, the quarter by quarter totals of mortgages and trust deeds recorded were plotted against the dependent variable (see broken line in Figure 4). Note that from 1960, when data was first available, no leading relationship is shown.

Gas Meters. Gas meter "hookups" were chosen for consideration as an independent variable because it was felt that since the meter is not "hooked up" until the house is used, presumably when moved into, it may indicate something about the rate at which newly built houses were being occupied. A leading indicator would exist if the rate of occupation declined before the downturn in housing starts. Table 7 gives the data on "hookups" per quarter. The data from Table 7 is plotted as a dotted line in Figure 4.

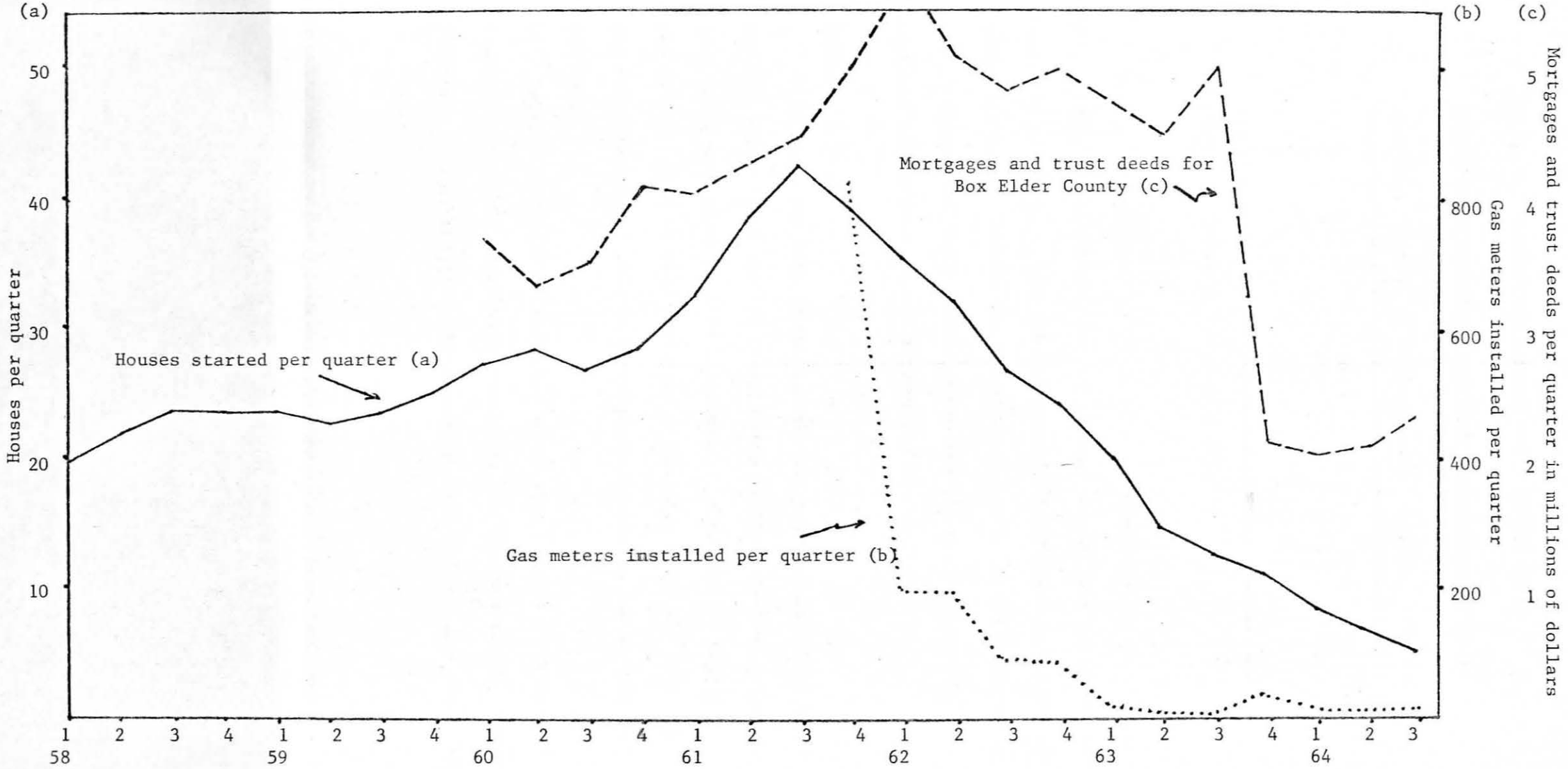

Figure 4. Gas meters installed per quarter and mortgages and trust deeds per quarter plotted against housing starts per quarter.

Table 7. Quarter by quarter total of gas meter "hookups" for Tremonton, Utah.

Quarter	Year 1961	1962	1963	1964	1965
1		209	39	23	12
2		208	27	14	36
3		107	22	23	
4	835	105	54	25	

Source: Mountain Fuel Supply Company.

Natural gas was not available in Tremonton until the fourth quarter of 1961, which accounts for the absence of any data prior to that time. In addition, it was learned that the contractors often had the meter "hooked up" before the house was occupied, so the house would be warm enough for winter work. These two factors account for the apparent lack of correlation between the two variables.

Comment of scope

No attempt was made to exhaust all the possible variables which may have exhibited a leading relationship to the dependent variable; time would not permit such an undertaking. However, the objective was to first list as many variables as possible which may have had any rational relationship to the dependent variable and to research each one.

Many of the possibilities were eliminated because no data was available; this was especially true where the data was needed from city records. Of the remaining possibilities, some yielded data which had

no coherent relationship to the dependent variable, and, therefore they were not applicable to this study. In two of the most important possibilities, namely lumber and fixture sales, it was found that suppliers were unwilling to release that data needed to synthesize an independent variable. Therefore, the five explained in this section were those left after the above elimination process.

DISCUSSION

Findings

The objective of this study, as stated in the Introduction, was to research the possibility of deriving a predicting indicator of housing starts in Tremonton, Utah, and to study the possible uses of such an indicator. In addition, one of the major criteria of the indicator would be that it was readily available to local businessmen.

In the preceding sections, the steps taken in attempting to derive the desired indicator have been explained and the results of the findings presented. The purpose of the present section is to conjecture on the possible reasons for not finding a leading indicator and to examine limitations of the study.

Implications

There appear to be three possible explanations for not finding a leading indicator of housing starts. First, there is the possibility that the reversed ratio-to-moving average method used in deriving the dependent variable is unrealistic and has shifted the dependent variable curve so far to the left that variables which actually lead the downturn in housing starts did not show up on the graphs. However, this seems unlikely for the following reasons:

1) None of the independent variables derived exhibited any consistent pattern of leading any change in the dependent variable. Therefore, it appears unlikely to expect a purposed predicting variable

to lead the major downturn when it was not anticipating minor fluctuations.

2) While it is true that the reversed ratio-to-moving average for estimated housing starts was shifted three quarters to the left of the ratio-to-moving average curve for house completions, it is unlikely that this involved any significant error. Note that even though a house may be completed in less than three quarters, nine months, the actual plans and arrangements to build must be made in advance of the start. By making this extra allowance, the curve is allowing for what was earlier called the average estimated starts plus expectations. Hence, the curve for the dependent variable is allowing an average of nine months to obtain the plans, arrange the financing, and complete the house. When considered in this light, three quarters lead time does not appear unreasonable.

A second possible reason for not finding a leading indicator may have been that the building contractors were sufficiently adept at anticipating the economic fluctuations in the fortunes of Thiokol, so that they could halt construction ahead of an actual reverse and consequently before any leading indicators reversed. While there could be an element of truth in this contention, it is unlikely that builders' anticipations caused the halt in housing starts, but rather it resulted from an overexpansion in the early stages of the period which pushed the number of houses to an early saturation point. The number of houses empty, which have never been occupied, would tend to support this argument (Table 8). This point will be expanded in the following section on the accelerator.

Table 8. Houses in subdivisions in and around Tremonton, Utah: number completed and occupied (new homes since 1958).

Subdivision	Houses	Occupied
Melody Park	61	10
Sandalwood Acres	94	52
Country Estates	14	8
Bessinger Subdivision	100	95
From Garland to Tremonton	67	59
Total	336	224

Source: Data obtained by actual count on December 22, 1966.

Table 8 shows the number of houses completed and the number occupied in each of the subdivisions in and around Tremonton. As was mentioned above, many of the empty houses had never been occupied.

The third possibility offers the most rational explanation of the phenomenon that occurred in Tremonton and yields a satisfactory answer to the question of why no leading indicators were found. This explanation is centered around the economic principle of the accelerator.

The accelerator principle explains the effect of a change in spending, population, or consumption on investment. For example, in some industries it has been found that a two million dollar increase in sales may induce a six or seven million dollar increase in investment immediately following the consumption increase.

Applying the accelerator to the present context, it is possible to arrive at a rationale similar to the following. In 1958 there was an autonomous 18 million dollar increase in spending for construction of the Thiokol Chemical Corporation plant. Simultaneously, there was an influx of Thiokol employees and construction workers into the area.

These two factors in combination with the expectations of quick profits from real estate developments caused the accelerator to go into effect. Housing starts likely exceeded existing demand and, indeed, even eventual need. When contractors and funding institutions realized homes were not being sold, housing starts were halted even though employment was still growing at Thiokol. In conversations with contractors in Tremonton, it was found that most expected the area surrounding Tremonton to absorb more of the employee influx than it actually did. Most contractors expressed surprise that the employees were willing to drive 30 or 40 miles in order to live in a larger population area.

Herein, then, lies the most rational explanation of the absence of a leading indicator. Action of the accelerator plus over optimistic expectations caused the level of housing starts to rise, then fall more rapidly than would normally be the case. Therefore, the time period covered by the cycle did not allow sufficient time for those economic variables which would generally lead the dependent variable to reflect a leading relationship.

Limitations of the study

As mentioned previously, there are several limitations in the study

which make it impossible to conclude that no factor existed which might have led the dependent variable. Among the limitations, the following appear to be the most significant:

1) There apparently was a high degree of autocorrelation between those factors researched as possible independent variables. Or, in other words, there was an overriding interrelationship between the variables, with the exception of housing starts, which caused them to be closely tied to the economic fortunes of Thiokol.

In addition, it might be conjectured that because of the action of the accelerator principle, the residential construction factor acted independently of any other overriding economic factor after it received the original stimulus from Thiokol construction in 1958 and 1959. If this was the case, then those variables researched; Thiokol employment, Thiokol contracts, and so on; would be so highly intercorrelated that if one did not lead the dependent variable, the others likely would not exhibit any leading tendencies.

2) The second factor has to do with the actual data collection. Probably the most significant limiting factor here was the lack of appropriate data. Many of the most promising possibilities had to be abandoned because the data was either not available or those who had the data did not wish to release it.

In addition, there were several cases where the extensive research required to derive the data could not be undertaken because of time limitations involved. A whole new avenue of research could have been possible in analysis of the data and synthesis of the variables in some of these cases.

3) The third major limitation has to do with the original recording of the data. It is possible that there might have been a lag between the occurrence of the actual economic phenomenon and the time it was recorded. For example, in the case of the data on mortgages and trust deeds, construction may have commenced before the parties concerned had the mortgage or trust deed recorded, thereby building an automatic lag in this data.

4) Finally, there is the matter of the type of statistical analysis applied to the data. As mentioned in the text, the application of these methods often involved some rather tenuous assumptions; in the event the assumptions are invalid, the variable may also be invalid. For example, note the calculation of the curve for the dependent variable, estimated housing starts. An attempt was made to be as economically rational as possible in making statistical assumptions; however, in the absence of any empirical method of validating the data, it can only be assumed that the assumptions were valid.

CONCLUSIONS

Leading indicator

On the basis of the research done for this study, it is concluded that no leading indicator of housing starts was available which fit the criterion explained in the Introduction. However, there were two supplemental findings, which, while not applicable to the main objective of this study, were significant enough to deserve further explanation. These are:

1) The results which tend to support the economic proposition of the accelerator principle are highly significant and will be examined further in Appendix E.

2) A very notable leading relationship was found to exist between the rate of employment at Thiokol and the moving average of contracts awarded to Thiokol. This relationship will be examined in Appendix F.

Bestway closure

A final comment should be made regarding the closing of Bestway Lumber Company's yard in Tremonton, Utah. The apparent consideration is who should accept the responsibility for the losses sustained and the eventual closing of the yard. This writer is of the opinion that no one person or level of management should be held solely responsible for the failure. Consider the following circumstances:

1) The Tremonton yard, with the approval of upper management, initiated an expansion program early in 1962 which resulted in an increase in the annual lease payments. This is particularly interesting

since the branch manager had budgeted a ten per cent decrease in net sales and gross profit. It appears, therefore, that either a mistake in judgement was made or that plans had proceeded to the point where it would have been impossible to change courses.

2) The local manager had anticipated a significant decline in sales late in 1961, yet no attempt was made to cut either inventories or expenses. As a result, inventory turnover dropped from three times per year to one and one half times per year and expenses increased 700 dollars.

3) In 1960 the ratio of discounts taken to gross sales was 5.34 per cent; by 1962 this had steadily declined to 3.53 per cent. This would indicate to the astute manager that customers were experiencing difficulties in meeting payments. In addition, bad debts increased 400 per cent.

4) Interest paid by the yard on accounts receiveable and merchandise consistently accounted for eleven to twelve per cent of total expenses. This would indicate a lax policy in meeting payments on accounts payable. (Rudisile, 1966.)

5) Finally, there apparently was some conflict between the local and area managers, which may have resulted in some additional problems.

While this list does not exhaust the problems that existed, it does give some of the symptoms of more basic problem areas through all levels of management. For example, there appeared to be a lack of communication between the management levels, thereby eliminating one of the important sources of information and advice flows to the local manager.

Boise Cascade had initiated a streamlining program in the Utah area and possible the extremely depressed conditions in the Tremonton area made this yard a logical candidate for closure. However, this author would conclude that had there been an open flow of information and advice both to and from the local manager, in addition, had the local manager planned inventories and expenses more carefully, the Tremonton Yard could have been operated at a profit even after the downturn in housing starts. (Lierz, 1966.)

APPENDIXES

Appendix A

In calculating the statistically adjusted curve for the houses completed per quarter, the ratio-to-moving average method of calculation was chosen to smooth the variations in the original data. This method was used because of the tendency of the calculation to remove the influences of seasonal and irregular variations in the data, leaving only the trend and cyclical components of the curve.

In addition, the averaging process in the calculation was reversed in an attempt to convert the data to an approximate houses started per quarter curve. The considerations and implications of this adjustment were explained in the text and would be redundant if repeated here.

The procedure involved in the reversed moving average calculation can easily be explained by presenting a portion of Table 1 from the body of the text.

Table 1. Calculation of reversed ratio-to-moving average for house completions in Tremonton, Utah.

Year	Quarter	(1) Original data	(2) Moving total	(3) Moving four quarter average	(4) Second quarter moving total	(5) Centered four quarter average
1963	1	21			40.50	20.25
	2	9	65	16.25	29.00	14.50
	3	15	51	12.75	25.75	12.87
	4	20	52	13.00	23.75	11.87
1964	1	7	43	10.75	18.50	9.25
	2	10	31	7.75	14.25	7.12
	3	6	26	6.50	11.25	5.62
	4	8	19	4.75		
1965	1	2				
	2	3				

Column 1 is merely the original data obtained from Utah Power and Light Company on approximate houses completed per quarter.

To derive Column 2, a cumulative addition procedure is started from the bottom of Column 1 with the first four original data figures added and the total being entered on the line between the third and fourth quarters of 1964. The next four figures are then totaled, starting with the data for the first quarter of 1965; the total for these figures is entered on the line between the second and third quarters of 1964. This procedure is continued up through the first quarter of 1957.

To derive the figures shown in Column 3, the figures in Column 2 were divided by four, representing the number of quarters in the total. This calculation results in a non-centered four quarter moving average.

Columns 4 and 5 show the procedures involved in shifting the non-centered moving average curve to a centered moving average basis. To achieve this calculation, the same totaling procedure is followed as was used in Column 2, except now only two of the figures are added and the total is placed on the line with the corresponding quarter. These totals are then divided by two and placed on the same line in Column 5, resulting in the approximate curve for housing starts to be used as the dependent variable.

This procedure can be found in most elementary statistics texts. Possibly one of the most straightforward is Yamane's Statistics, An Introductory Analysis (1964).

The reader may have noted that in Table 1 the centered four

quarter moving average is extended to the second quarter of 1965 rather than terminating in the third quarter of 1964 as in the example in the Appendix.

This additional calculation was used merely to extend the curve to the relevant cutoff quarters for the time period covered by this study. In order to extend the calculations, the first three moving total figures in Column 2 were divided by one, two, and three respectively, moving up from the bottom. The remaining columns were calculated in the outlined manner culminating in the centered moving average figure shown in Column 5.

Appendix B

In statistically adjusting some of the data for independent variables, a simpler method of calculating the moving average was used, because of the absence of any rationale for using the method explained in Appendix A.

The method used is often referred to as the simple method of moving averages. This procedure can best be explained by presenting a simple example. Suppose one wants to find the moving average of the following hypothetical data:

Table 9. Calculation of simple moving average.

Year	Sales in millions	Three year moving total	Three year moving average
1956	3		
1957	4	15	5
1958	8	18	6
1959	6	21	7
1960	7	24	8
1961	11	27	9
1962	9	30	10
1963	10		

Note that the chief difference between this method and the ratio-to-moving average method is that the moving total is centered in the midpoint of the interval and the average is taken by dividing this total by the number of items in the interval. It should be explained that this method is chiefly applicable where the original data exhibits

no ascertainable seasonal variations. This condition was found to exist in most of the data used for independent variables.

Appendix C

Probably the best way to explain the procedure of regression analysis is to present the steps involved in the entire process and then refer only to the essential steps in the body of the text. As an appropriate example, the first regression analysis in the text will be followed through in considerable detail to show the procedures involved.

The first step in the process is to plot the data on graph paper with the dependent variable on the vertical axis. In the study, the data was plotted on semi-logarithmic graph paper with the logarithmic scale on the vertical axis. Semi-log paper was chosen because it consistently presented the data as an approximate linear relationship which simplified the regression analysis. The results of the procedure may be seen in the graph on the following page (Figure 5).

The second step in the analysis is to fit a regression line to the data. The objective in this step is to plot the line so that the deviations of the dots from the line would sum to zero, if opposite values (+ or -) were assigned to the deviations, depending on whether they were above or below the line.

It can be seen from the graph that one line will not appropriately fit all the data; therefore, we must fit two regression lines on the assumption that there is one relationship in the upswing part of the cycle and a different relationship on the downswing. The two lines have already been inserted on the following graph (Figure 5).

The third step in the process is to use the two point formula

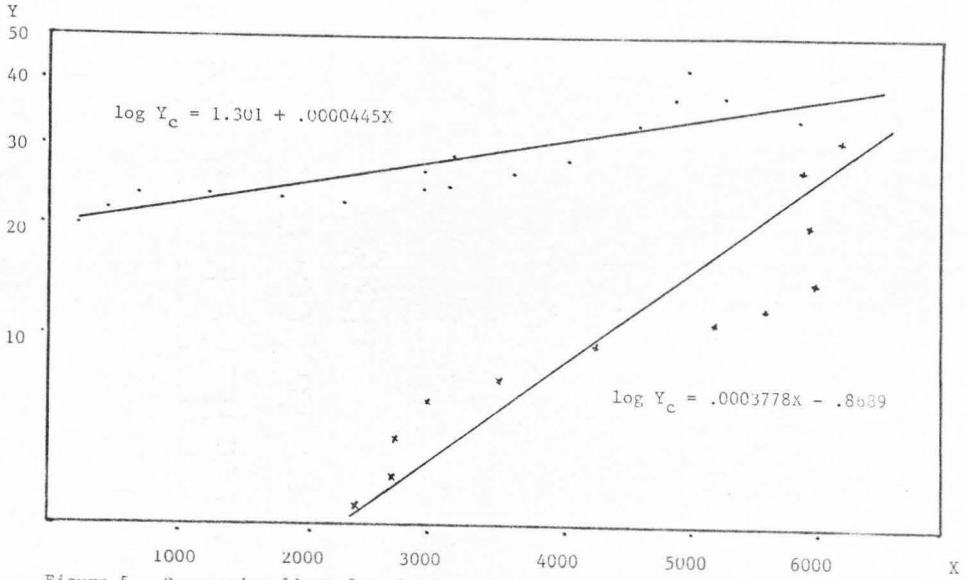

Figure 5. Regression lines for the dependent variable, housing starts, against the cumulative employment levels at Thiokol. Plotted on semi-log paper with X, housing starts, on the vertical log scale and Y, employment levels at Thiokol, on the horizontal scale.

method on the above regression lines to find the equation for each. To solve the two point formula, two points are selected at opposite ends of the curve and the X and Y intercepts of each are noted. For example, assume the following co-ordinates from the upper regression line:

$X_1 = 0$
$Y_1 = 20$ $\quad \log Y_1 = 1.301$
$X_2 = 6000$
$Y_2 = 37$ $\quad \log Y_2 = 1.568$

Because the Y axis is in logarithms, the Y values must be converted to logs. These figures are now inserted into the following equation:

$$\log Y_c = \log Y_1 + \frac{\log Y_2 - \log Y_1}{X_2 - X_1} (X - X_1)$$

$$\log Y_c = 1.301 + \frac{1.568 - 1.301}{6000 - 0} (X - 0)$$

$$\log Y_c = 1.301 + .0000445X$$

This last equation would plot all points along the upper (upswing sector of the curve) regression line. The same procedure is followed in calculating the regression equation for the downswing section of the curve; the resulting equation is shown on the graph near the lower line.

The fourth step in the regression process is to calculate the coefficient of determination for each of the regression lines. To facilitate this calculation, the data is divided into the upswing sector of the relationship, which ends in the first quarter of 1962, and the downswing sector, beginning in the second quarter of 1962 and ending in the second quarter of 1965.

In order to expedite the calculation, the completed table of the

upswing section of the curve is presented with explanations of the numbered columns.

Table 10. Procedures for accumulating data to calcualte the coefficient of determination and the standard error of estimate.

(1) Year	Quarter	(2) Y	(3) X	(4) Y_c	(5) d	(6) d^2	(7) Y^2
1958	1	20.50	243	20.50	0.00		420.25
	2	22.00	429	20.90	1.10	1.21	484.00
	3	23.62	813	21.73	1.89	3.57	557.90
	4	23.75	1276	22.79	.96	.92	564.06
1959	1	23.12	1858	24.19	-1.07	1.14	534.53
	2	22.62	2407	25.59	-2.97	7.93	511.66
	3	23.12	2876	25.85	-3.73	13.91	534.53
	4	24.87	3104	27.49	-2.62	6.86	618.52
1960	1	27.87	2923	26.98	.89	.79	776.74
	2	28.50	3279	27.98	.52	.27	812.25
	3	26.25	3667	28.94	-2.69	7.24	689.06
	4	28.25	4079	30.37	-2.12	4.49	798.06
1961	1	33.25	4600	32.04	1.21	1.46	1105.56
	2	39.00	4824	32.78	6.22	38.69	1521.00
	3	43.12	4999	33.37	9.75	95.06	1859.33
	4	38.87	5319	34.48	4.39	19.27	1510.87
1962	1	35.00	5876	36.57	-1.57	2.46	1225.00
Total		483.71				205.07	14,523.32

$(\Sigma Y)^2=(483.71)^2=233,975.36$

Source: X values, employment levels at Thiokol; Y values, taken from dependent variable curve.

Column 1: This section shows the years and quarters applicable to the calculation of the coefficient of determination for the upswing sector of the curve.

Column 2: These are the dependent variable figures showing the moving average of approximate housing starts per quarter. This column is summed and the total is squared to derive a $(\Sigma Y)^2$.

Column 3: This column lists the independent variables that correspond to the quarters in the upswing section of the curve.

Column 4: This column is derived by solving the regression equation calculated for this line using each of the corresponding independent X variables. The Y_c value calculated is placed on the line corresponding to the X value used in the equation.

Column 5: To arrive at the d values in Column 5, the Y_c values in Column 4 are subtracted from the original Y values in Column 2.

Column 6: Column 6 is the individual values in Column 5 squared and summed.

Column 7: These are the individual values in Column 2 squared and summed.

With the data from this chart, the coefficient of determination for the first regression line can be calculated. For this calculation the following formula is used where N equals the number of items in the interval:

$$r^2 = 1 - \frac{\Sigma(d^2)}{\Sigma(Y^2) - \frac{(\Sigma Y)^2}{N}}$$

$$r^2 = 1 - \frac{205.07}{14,523.32 - \frac{233,975.36}{17}}$$

$$r^2 = 73.02\%$$

The coefficient of determination shows the per cent of variations in the dependent variable which can be accounted for by variations in the independent variable, in this case 73.02 per cent.

The final step in the procedure is to calculate the standard error of estimate using the information from Figure 5 and the following formula:

$$S_y = \frac{\Sigma(d^2)}{N}$$

$$S_y = \frac{205.07}{17}$$

$$S_y = 3.47$$

The standard error of estimate indicates that 68.3 per cent of the observations will fall within 3.47 houses above or 3.47 houses below the regression line.

Appendix D

The average rate of change in employment levels at Thiokol Chemical Corporation's Minuteman Plant was figured by application of the following procedures:

1) First, the marginal line of total employment was calculated by using the formula:

$$\text{Marginal} = \frac{Y}{X}$$

In this particular case, the marginal line would equal the change in total employment over the change in the time, and since the change in time is always one quarter, the marginal line would equal the change in the total.

2) Second, by application of the method explained in Appendix B, a moving average of these marginal points was calculated in order to smooth out the fluctuations in the marginal curve. The results of this calculation are shown in the four quarter moving average column of Table 3. This column, then, equals the average rate of change in employment levels at Thiokol.

Appendix E

The accelerator principle explains the relationship between some stimulus, such as investment, income, or employment, and the resulting change in capital formation. For example, it is typical in the American economy for enterprises to hold capital in some multiple of a given period's sales; therefore, an increase in the rate of growth of sales will result in a multiple increase in the formation of capital. In addition, it should be apparent that if the rate of increase in sales leveled off, the rate of capital formation would return to the level of normal replacement.

This same rationale can be applied to increases in population and houses. For example, assume there is a small town, such as Tremonton, Utah, with a population of 4000, five people living in each house, and each home lasting 20 years. With this information the following table can be constructed (Table 11).

This table shows clearly the steps in the accelerator process. They are:

1) A rapidly increasing population level causing a rapid rise in total new houses built.

2) A leveling off in the rate of increase in population, and consequently a rapid decline in the total number of new homes built.

3) Population reaches a plateau and total houses built returns to the level of replacement only.

By applying similar analysis to the situation in Tremonton, Utah, from 1958 to 1965, a very interesting phenomenon appears. If the

Table 11. Population effect of the accelerator.

Year	Population	Change in population	Required houses	Increase in houses built	Replacement demand	Total houses built
0	4000		800		40	40
		400		80		
1	4400		880		40	120
		1600		320		
2	6000		1200		40	360
		2000		500		
3	8000		1600		40	540
		100		20		
4	8100		1620		40	60
		0		0		
5	8100		1620		40	40
		0		0		
6	8100		1620		40	40

curve for the average rate of change in employment levels at Thiokol is divided into two sectors, and trend lines are fitted to each sector; two divergent relationships appear. One relationship, representing the time period prior to the third quarter of 1961, yields a constantly rising line. The other time period, from the third quarter of 1961 to the second quarter of 1965, yields a steeply declining line. The average rate of employment is the dotted line, and the trend line is the broken line (Figure 6).

The interesting facet of this relationship becomes apparent when the dependent variable, or housing started per quarter, is plotted on Figure 6. Note that as long as the average rate of change, represented by the upsloping trend line, was rising, the number of houses started per quarter continued to rise. However, when the trend reversed in the third quarter of 1961, the number of houses started per quarter immediately started a steep decline.

Empirically, then, it appears as if the accelerator was the cause of the unusual situation in Tremonton, and, with further research, it may be found that the accelerator had a similar effect in Brigham City as well.

For calculation of the average rate of change in employment, see Appendix D.

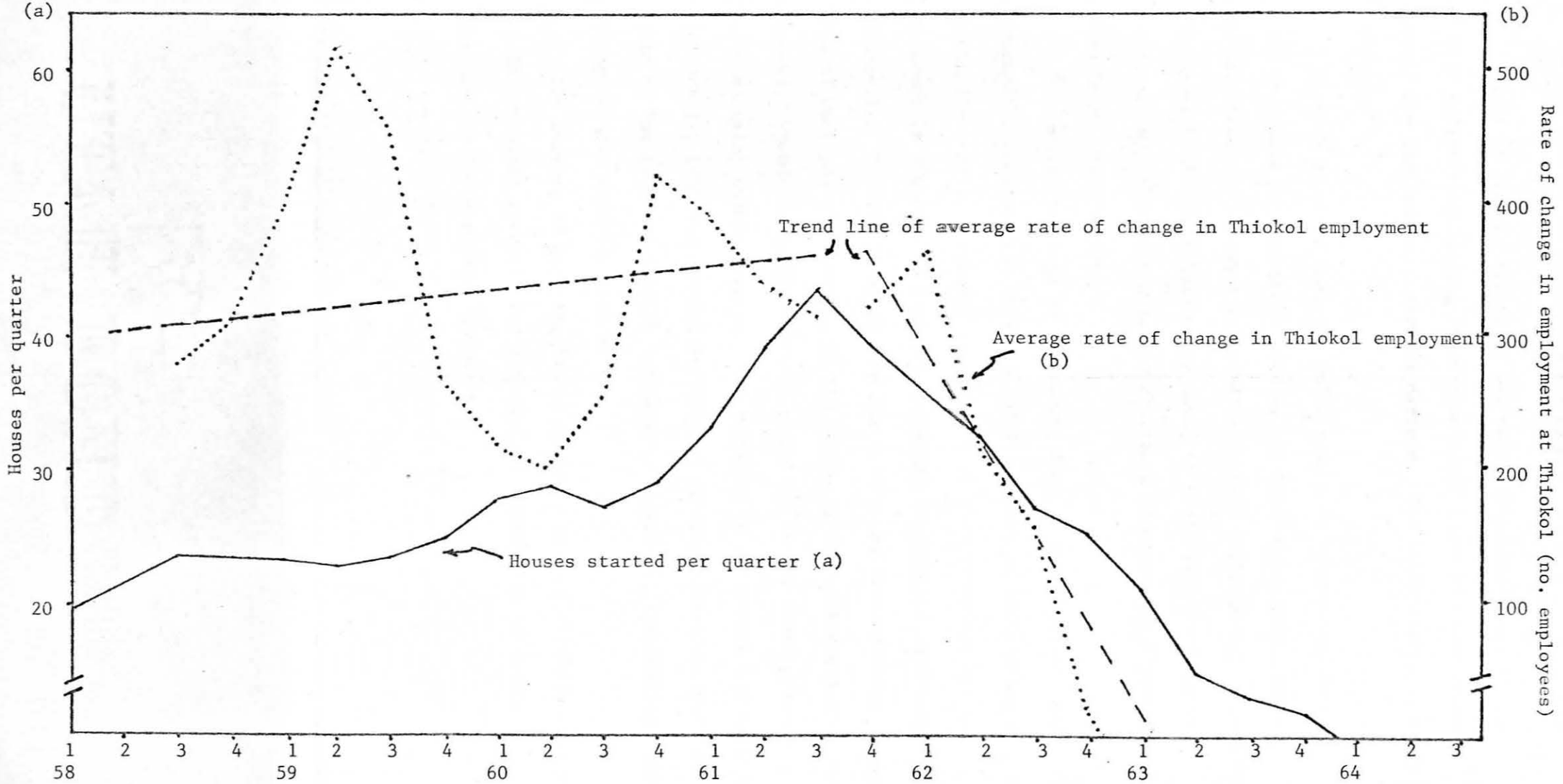

Figure 6. The accelerator effect of population on housing starts.

Appendix F

While no leading indicator was found to predict housing starts, a very interesting leading relationship was found to exist between two of the independent variables derived. The relationship is graphed in Figure 7.

It will be noted that the relationship is between the average rate of change in employment levels, the leading variable, and the actual value of contracts received at Thiokol. (Table 3.) A probable explanation of this relationship could be that Thiokol employment personnel anticipated changes in contracts received and adjusted employment rates accordingly.

Following this type of reasoning, then, a model builder may proceed with regression analysis and from there to postulating a predictive model. However, the fallacy of this procedure becomes apparent if the data on contracts received is examined carefully. (Table 3.) It will be noted that the data given is cumulative to the end of each year; therefore, if the timing of the contract awards was actually known, it could very well yield the two or three quarter leading relationship invalid. For example, if the entire 110 million dollars for 1959 was awarded in January, it would actually lead the peak in the proposed leading indicator. Therefore, the leading indicator may not actually lead at all.

The purpose of this section is to point out the pitfalls possible in any economic analysis and indicate the importance of carefully researching and analyzing the data.

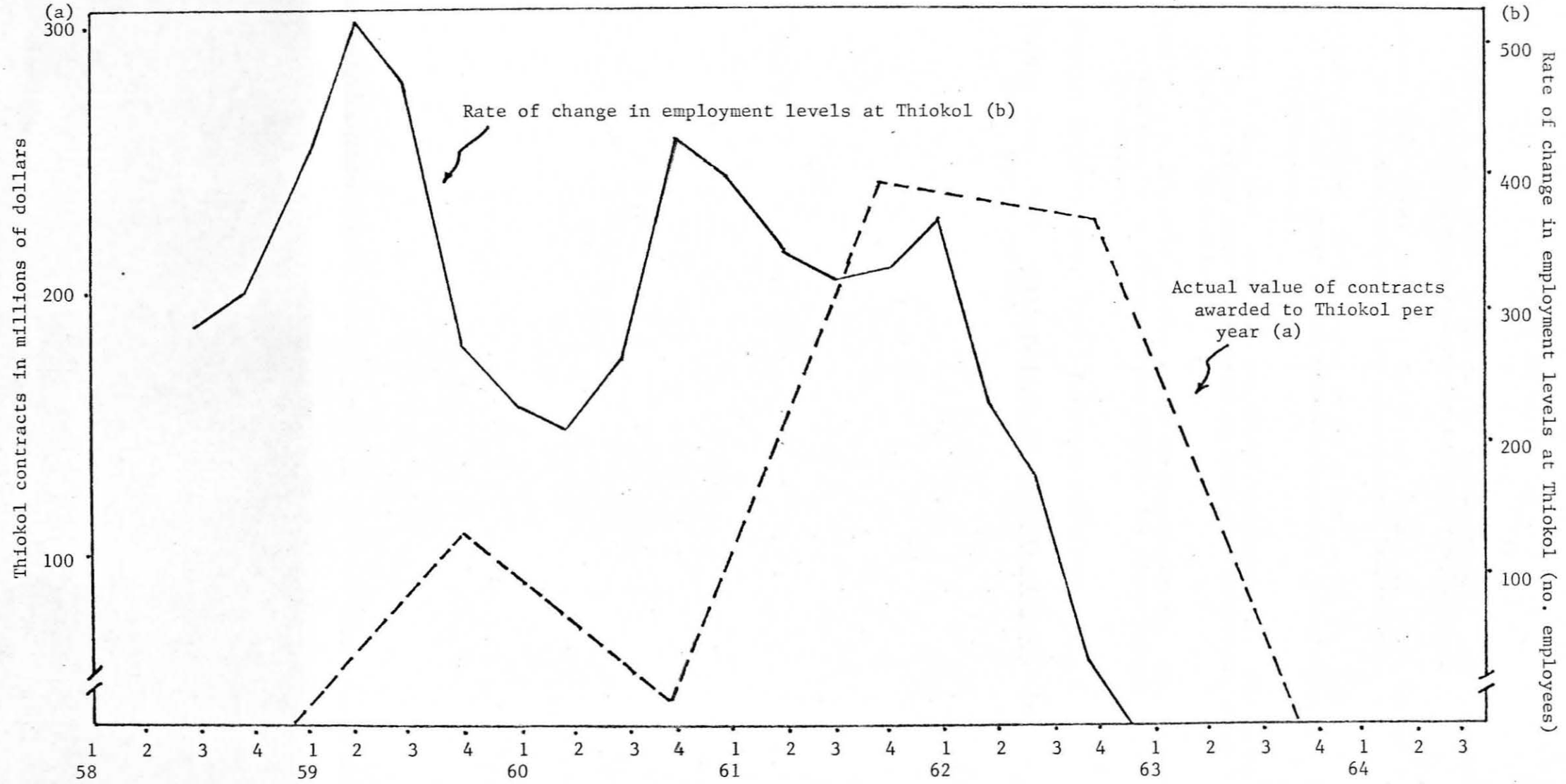

Figure 7. Rate of change in employment levels at Thiokol plotted against the actual value of contracts received at Thiokol.

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VITA

Douglas I. Ward

Candidate for the Degree of

Master of Business Administration

Thesis: Development of Leading Indicators for Housing Starts in Tremonton, Utah

Major Field: Business Administration

Biographical Information:

Personal Data:
Date of Birth: April 19, 1944
Place of Birth: Tremonton, Utah
Parents: Ira Z. and Gwen Smith Ward
Date Married: September 4, 1964
Wife: Karen Christensen Ward

Education:
High School: Bear River, Class of 1962
College: Utah State University, Bachelor of Science in Accounting, 1966, Master of Business Administration, 1967