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THE ISRAEL HOUSING MARKET

BY

STUART GABRIEL

ILAN MAOZ

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CYCLICAL FLUCTUATIONS IN THE ISRAEL
HOUSING MARKET

by

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ABSTRACT

While public construction in Israel is of a magnitude sufficient to exert effective housing market countercyclical influence, it has often had the opposite effect. This phenomenon is viewed with particular concern, given that economy-wide recessions of past decades have been precipitated by significant downturns in the construction industry. This paper describes specification and estimation of a simultaneous-equation structural model of the Israeli housing market. Results of the analysis indicate the importance of disaggregation by public and private sectors as well as the significance of substitution and income effects, disruptions caused by war, speculation, and the like in an explanation of cyclical phenomena.

1. INTRODUCTION

In recent years, considerable academic research and policy debate has focused on the question of cyclical fluctuations in the construction sector. This concern is well-grounded, given the substantial intersectoral linkages and concomitant macroeconomic implications of construction sector cyclical swings. Various remedies have been put forth as a means of diminishing the amplitude of construction fluctuations, and in the U.S. context policy has focused primarily on the workings of capital markets and the supply of mortgage funds.

The Israeli construction sector has similarly been characterized by sizable cyclical fluctuations. This phenomenon is viewed with particular concern, given the leading nature of this sector in the Israeli economy. In terms of product, investment, and employment, the relative weight of this sector is significantly larger than that of other western countries². Further, economy-wide recessions of past decades have been precipitated by significant downturns in the construction industry.

The objective of the current analysis is to evaluate the structure and determinants of cyclical fluctuations in the Israeli housing market. The analysis employs a well-developed set of data for the Israeli economy over the decade of the seventies, which enables specification and evaluation of a variety of mortgage market, budgetary, speculative, and other influences. In particular, the analysis focuses on public policy interventions and the structure of public and private sector interactions in the determination of cyclical swings.

Results of the analysis indicate the importance of disaggregation by public and private sector in an explanation of fluctuations in construction

activity and price. In particular, the significance of substitution and income effects is revealed, as are the impacts of those irregularities of the Israeli context, including disruptions caused by war, concomitant non-military budget constraints, and the erratic nature of immigrant flows. Further, the study suggests the importance of the housing market as an outlet for speculative investment over the period of analysis.

The plan of the paper is as follows. Section 2 documents the nature of cyclical swings in construction and price over the decade of the seventies and reviews previous research on this subject. Sections 3 and 4 describe specification and estimation of a simultaneous-equation structural model of the Israeli housing market. In Section 5, conclusions and policy recommendations are presented.

2. CYCLICAL FLUCTUATIONS IN RESIDENTIAL CONSTRUCTION

Recent housing market analyses have produced widespread agreement regarding the desirability of moderating construction sector cyclical fluctuations. Sharp housing market fluctuations are most likely reflected in increased production costs, and are the cause of uncertainty in price expectations and labor market disruptions. The social costs in the latter case are difficult to estimate, but include the market-wide effects of releasing labor during industry downturns. Moderation of housing market cyclical swings would then involve efficiency gains in input utilization and perhaps encourage further innovation in production.

In the U.S. context, an important approach to the reduction of housing market fluctuations involves an attempt to make the supply of mortgage funding

less sensitive to overall credit conditions. This is implemented by two basic means, including the activities of federally-sponsored housing credit agencies and nondiscretionary tax policies. In the former case, the federal government attempts to direct substantial intermediary support for housing during periods of credit restraints.

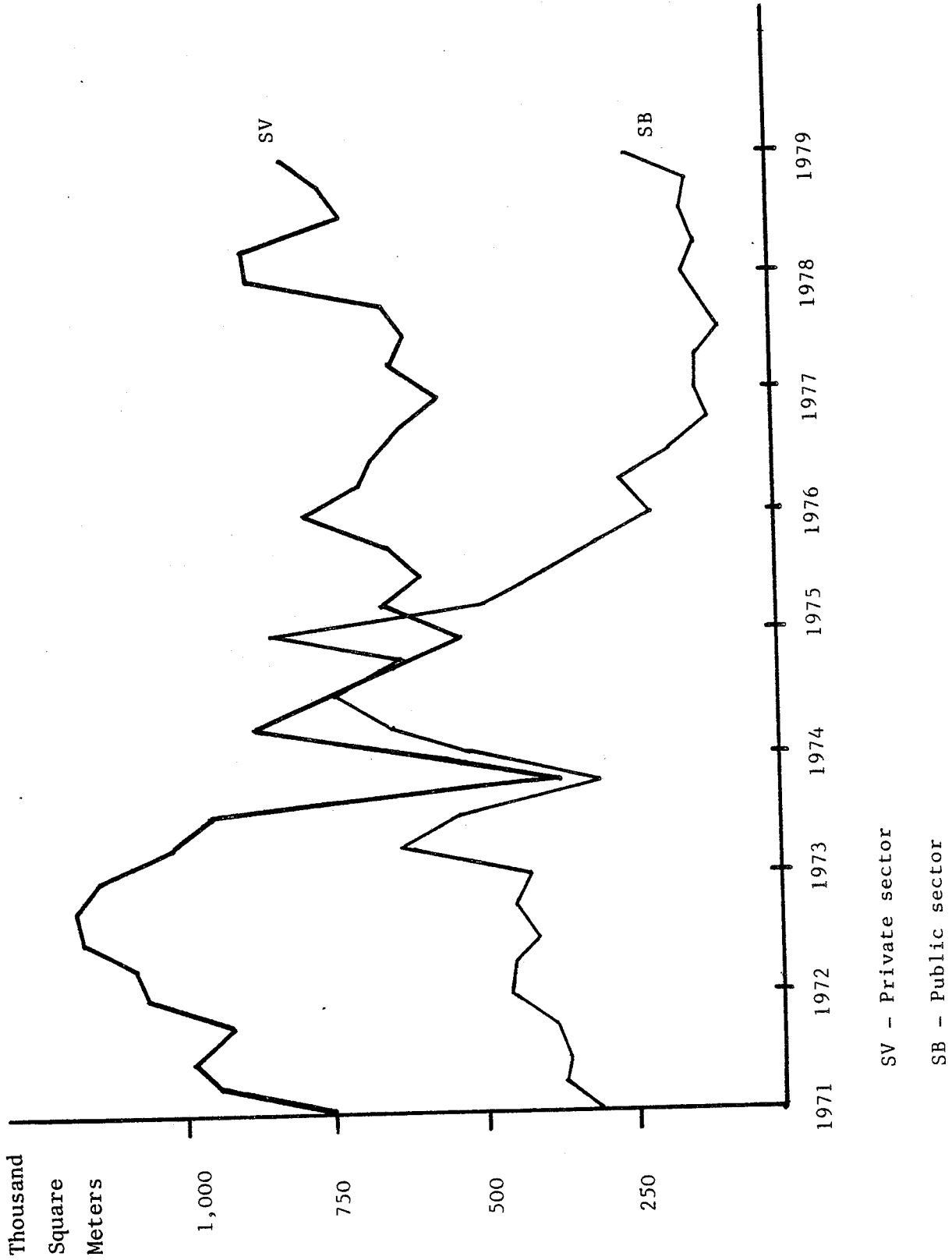
The Israeli government similarly exercises substantial control over housing finance through the regulation of capital flows to mortgage banks. Further, the Israeli context is characterized by sizable public sector construction. In this regard, the government created several large public construction corporations in 1948 to alleviate the housing strain associated with large-scale population in-migration. Given the erratic nature of immigrant flows, however, these public corporations were subsequently charged with the provision of housing for a large segment of the Israeli population.

While public construction is then of an order of magnitude sufficient to provide effective housing market countercyclical leverage, such an avenue of housing market regulation is typically not undertaken. In fact, Israeli government intervention has often had the opposite effect, as public sector construction has served to amplify housing market cyclical fluctuations. This procyclical outcome is indicated below.

2.1 Cyclical Fluctuations in the Israeli Housing Market

Cyclical fluctuations in Israeli public and private sector construction activity are depicted in Figure 1. Public and private sector real housing price variation is illustrated in Figure 2, and together the nature of interaction between construction cycles and price is indicated. As Figure 2 reveals, private sector housing price inflation fluctuated widely during the

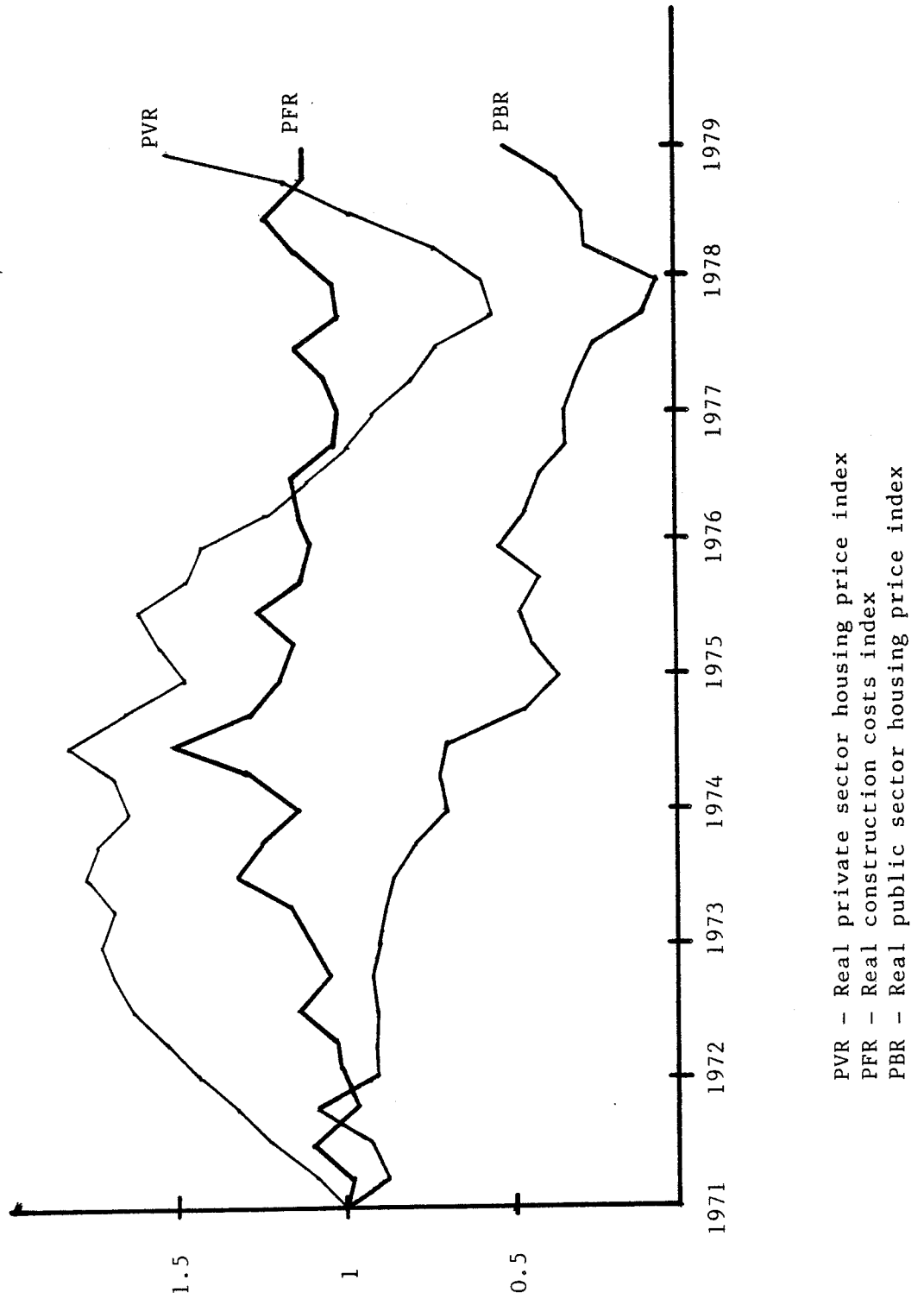
FIGURE 1
HOUSING STARTS



SV - Private sector

SB - Public sector

FIGURE 2
RELATIVE HOUSING PRICES



seventies, with prices outstripping the CPI in all but seven quarters of the decade. The opposite is true of the public sector, where real prices exhibited a downward trend throughout the decade, outpacing the CPI only during a particular six-month period.

The early years of the decade are characterized by sharply rising real private sector housing values and similar trends in both public and private sector housing starts. Some decline in real private and public sector housing prices occurred during mid-1973, which was accompanied by a sharp decrease in overall construction activity. In that regard, the fall in private sector construction during the second and third quarters of 1973 was approximately 68 percent from a high of 1100. The public sector decline was by about 58 percent from the 650 thousand square meter level reached during the first quarter of 1973.

In the aftermath of the 1973 war, both public and private sectors registered initial sharp increases in construction rates, responding to high and increasing real private sector prices. By the second quarter of 1974 private sector construction rates were again on the decline, however, and continued to fall until 1975. Interestingly enough, public sector construction moved in precisely the opposite direction during late 1974 and early 1975, such that aggregate supply further outstripped demand. In this regard, 218,000 new dwellings were completed between 1970 and 1974, approximately 88,000 in excess of the number of new households³. Contrary to public policy goals, public sector construction policy served to exacerbate cyclical fluctuations in housing price.

Public and private sector construction activity continued to be at odds during most of 1975, the former being characterized by a significant downturn. During this period of rising real housing prices, the private sector responded

with sizable increases in activity. Finally, public sector construction reached new lows during the latter years of the decade, falling to a rate of approximately 100 thousand square meters per quarter. In contrast, private sector activity was at high and increasing levels throughout this period.

An initial review of the Israeli experience over the decade of the seventies thus suggests the perverse effects of public construction policy on housing price fluctuations. Undesirable sectoral and macroeconomic effects are unaccounted for in the determination of public housing policy, which instead responds to the housing needs of low-income and new immigrant groups. In Section 3, those determinants of public and private sector swings in construction activity and price are formalized in a structural model of the Israeli housing market. Prior to a description of the model, however, it is useful to review various recent attempts to evaluate housing market cyclical phenomenon.

2.2 Previous Research on Cyclical Fluctuations in Residential Construction

This section reports on previous research concerned with cyclical fluctuations in housing markets. While housing sector fluctuations often have pervasive impacts on general economy-wide movements, analyses of these trends and appropriate policy interventions are constrained by the lack of well-articulated structural models. Of those multi-equation models which address this question, many suffer from simultaneous-equations bias and none focus specifically on the structure of public and private sector interactions.

Interestingly enough, a number of multi-equation models of the Israeli construction sector have been specified and tested. These include the quarterly econometric models of Meridor [7] and the Israeli Housing Ministry [2]. In the former case, the model was developed for the purposes of prediction, and on the basis of an analysis of the 1958-67 period, forecasts of the years

1977-80 are provided. This model estimates five equations, including public and private sector housing starts, housing completions, investment in residential construction, and housing price. Yet these equations are estimated separately, and no attempt is made to account for simultaneous-equation bias.

Of the equations pertinent to this study, private sector starts diverges from that characterized herein in that it accounts primarily for demographic variables and excludes analysis of construction costs or the relationship between output and price. The public sector housing starts equation is further limited in purview, reflecting government budgetary allocation, number of new immigrants, and a term indicating whether or not the market is depressed. The author explains the low explanatory power of this equation on the basis of various political and bureaucratic factors which could not be taken into account. In our specification, however, proxies for public-private sector interactions, targeted population groups, and the like are supplied. Finally, Meridor provides a similarly limited specification of housing prices as a function of rate of change in the CPI and a variable proxying speculative demand. As such, she makes no attempt to evaluate differential rates of price fluctuation by public and private sectors as relate to various mortgage market, permanent income, and substitution effects.

Unlike the above model, the Israel Housing Ministry model was calibrated for the purpose of evaluating short-run impacts of government policies on the construction sector, particularly as relates to employment. The model is then expansive, including ten equations for the private sector which seek to explain housing starts and completions by residential and non-residential sectors, area of dwellings under construction, vacancies, prices, and the like. Yet here again

only limited information estimation techniques are utilized and there is no accounting for the simultaneous structure of these relations. The model is characterized by the assumption that public and private sector construction activities are exogenous to one another. Further, no attempt is made to evaluate public sector behavior. Yet public sector regulation of housing outcomes significantly alters resource allocation and demand for residential construction. An evaluation of those linkages is then fundamental to an analysis of intertemporal housing fluctuations in Israel.

In a recent paper, Conway and Howard [1] report on the estimation of a regional housing investment model for Washington State. Yet, as is similar to many analyses of housing market phenomenon, their's is a single-equation, reduced-form specification in which per capita housing stock investment is represented as a function of per capita income, a measure of credit availability, and a lagged form of the dependent variable. The model performs well over the 1958-74 observation period, however applications in other regions met with less satisfactory results. While the model is of limited relevance as regards the set of interactions to be evaluated herein, the authors do suggest the requirement of improved speculative demand and permanent income proxies. Those effects were then subsequently accounted for in the analysis presented below.

A thorough investigation of cyclical fluctuations in the U.S. housing sector was conducted by Rosen [8]. While the primary purpose of this study was an analysis of seasonality in residential construction, the author estimates a structural model that accounts specifically for the nature of housing and mortgage market linkages. Public and private construction interactions are not primary to this model, but housing policy effects are proxied among explanatory variables.

Further, the model offers improvements in accounting of residential construction costs, simultaneous equations bias and the definition of permanent income. Causal elements in an explanation of construction seasonability are indicated, as are the policy means of ameliorating their undesired effects.

It should be noted that models of cyclical fluctuations in housing emanate from the early work of Maisels [5,6]. In this model, demand varies primarily as a function of demographic factors, as represented by household formation. Supply-side variation is viewed as an inventory response by builders. The empirical specification here consists of a single, reduced-form equation of housing starts which does not explicitly account for mortgage or financial market considerations. While results of the model were taken to indicate the predominance of supply variations in cyclical behavior, such a view is questionable on the basis of the empirical specification. In the later version of this model, greater attention was paid to federal housing market financial intermediaries and conventional mortgage rates -- factors which are subsequently viewed as important determinants of construction in the short run.

Finally, Maisel's behavioral assumptions underlie the housing sector specifications of many large-scale econometric models. These models typically estimate a large number of housing structural equations, including intersectoral linkages, and diverge from the interests of the current research. It is interesting to note, however, that in past versions of the Brookings model [3], for instance, demand for housing is linked to demographic changes and further varies as a function of income, relative price, and credit term variables. This specification, in general, is reflected in Rosen's work as well as our own. In the following section, those structural relationships relevant to the Israeli context are made explicit.

3. A SIMULTANEOUS EQUATION MODEL OF THE ISRAELI HOUSING MARKET

This section specifies those cyclical structural relationships fundamental to the Israeli housing market. Interactions between private and public sector housing form the core of this model, particularly as involves the effects of various policy variables on construction and price fluctuations. Further, this context provides specification and test of the determinants of private inventory creation.

These relationships are specified in a five-equation econometric model. The five endogenous variables include housing starts in both private and public sectors, the ratio of housing price to construction cost indices in both sectors, and stock of unsold private sector housing units. Explanatory variables include both private sector housing price level and lagged change in rate of price increase, lagged private sector vacancy rate, number of new immigrant families, government non-military expenditures, income level of underprivileged households, construction costs, dummy variables accounting for the 1973 War and the 1977 currency devaluation, mortgage and debenture interest rates, and proxies for land prices.

The structural equations of the model are as follows:

- (1) Private sector housing supply: $SV = H_p^s(PVF, VV1, D3, D4)$
- (2) Private sector housing demand: $PVF = H_p^d(SV, PBF, GV1, RVR, YR)$
- (3) Public sector housing supply: $SB = H_b^s(PVR, BR, YLR, PFR, IMLL, D3)$
- (4) Public sector housing demand: $PBF = H_b^d(SB, PVF, YLF, D1)$
- (5) Private sector housing vacancy: $VV = V_p(GV1, PVR, RFR, PVL R, GL1, VV1, D4)$

Demand for housing is traditional in its composition and varies as a function of permanent income, relative price of the public sector housing substitute,

conditions in the mortgage market, and return on housing as an investment. Furthermore, as is typical of demand formulations, the price of housing relative to construction costs should be inversely related to housing starts.

A significant subset of the population, including various underprivileged groups, new immigrants, and young married couples are eligible for both public housing and low-interest, government-subsidized mortgages which may be applied in either sector. The price of the public sector substitute is then relevant to this significant portion of the market. The important linkages between housing and mortgage markets on the demand side are well-known and suggest that higher mortgage interest rates function to constrain housing demand. Finally, private sector housing has further been the focus of much speculative activity, particularly over that period evaluated herein. As such, change in rate of housing price increase over past periods is taken to indicate the return on investment in this sector, and is expected to vary positively with relative price.

Demand for public housing similarly varies as a positive function of the relative price of the substitute private sector commodity. It is also assumed that the traditional inverse relationship between relative housing price and housing starts exists in the public sector. The income variable here represents that of those targeted underprivileged and low-income groups. As in the private sector case, we expect a direct relationship between income level and relative housing prices. Demand for public housing may be aptly characterized as demand for shelter rather than speculative in character, suggesting the limited relevance of this factor. Finally, public pricing policy promoted a decrease in relative public sector housing prices in the wake of the major disruption associated with the 1973 War and its aftermath.

Supply of housing in the public sector is hypothesized to vary as a function of the cost of production, indicators of need for public housing provision, as represented by the magnitude of low-income and new immigrant populations, availability of government funding for non-military public programs and price of the private sector housing alternative. Furthermore, increases in public housing supply are indicated in the aftermath of the 1973 War and 1977 currency devaluations.

Cost of production, as represented by the construction costs index, serves to inform the public sector contractor as to the profitability of the project and should then influence the supply of starts. As described above, low-income and new immigrant groups are the focus of government housing policy, and a determination of their housing requirements is hypothesized to be directly reflected in public construction. As is well-known, defense spending is accorded a high priority in Israel's budget allocation, and as such fulfillment of entitled population housing needs is constrained by the availability of funds to the non-defense sector. Determination of public housing needs is further influenced by the degree to which the private sector commodity is within reach to those entitled groups. As such, we expect a direct relationship between private sector housing prices and provision in the public sector.

Private sector supply of housing varies as a function of those traditional market and production cost determinants. The level of private housing prices relative to input costs determines the return on the builder's investment and hence indicates the degree to which construction is worthwhile. A further determinant of private housing starts is that sector's vacancy rate, indicating the extent to which excess supply acts as a damper on new construction. The 1973 War and the 1977 currency devaluation are also expected to impact on private

housing supply. In this case, the relationship between private starts and the war is assumed to be indirect, given the substantial uncertainty which characterize such a context. Alternatively, the 1977 devaluation should serve to redirect investment into the housing sector.

The final equation describes the determinants of private sector inventory creation. Vacancy rates are evaluated as a function of the level and past rate of change in both private housing and land input prices, interest rates, and the residual stock from previous periods. The current and lagged rate of change in private sector prices indicate builder expected return on speculative inventory creation. Here positive relations are hypothesized. Alternatively, higher price level suggests increased current sales. A priori, the relative strength of these factors as regards the former variable is unclear. Financing costs should constrain builder creation of speculative inventories, hence the expected inverse relation in the case of market interest rates. Furthermore, builder turnover and reinvestment is accelerated in the context of high and increasing residential land prices, implying an inverse relationship between these variables and creation of inventories. Finally, current vacancy level is expected to vary as a positive function of that residual stock from previous periods.

4. ESTIMATION OF THE MODEL

The housing market model is estimated using quarterly data for years 1979-79. Since the model is simultaneous, instrumental variables methods are required. In that regard, the results of both full-and limited-information estimation techniques are presented⁴. Housing information, including price indices, construction rates, mortgage financing and the like was compiled from various statistical abstracts of the Israel Central Bureau of Statistics. Appendix A contains variable definitions and sources⁵.

Referring to Table 1, results of the estimation procedure indicate our specification captures a large portion of the fluctuations in the housing market and in general confirm a priori expectations. Lagged rate of housing price increase, relative price of public sector housing, and household permanent income appear important causal elements in an explanation of private sector housing demand⁶. These variables are all of appropriate sign and statistically significant. These findings underscore the importance of speculative return on the housing purchase, as proxied by the former variable, as well as the relevance of the permanent income constraint. As is further indicated, government public sector pricing policy serves to allocate entitled groups between housing sectors. Higher mortgage interest rates constrain housing demand, suggesting some efficacy of government capital market regulation as a means of housing policy intervention. Finally, housing starts, while similarly of appropriate inverse sign, is small in magnitude and insignificant, indicating an insensitivity of relative prices to current construction activity.

Results of the estimation procedure with respect to public sector demand conform to model hypotheses. Here all variables are significant at the 99 percent level. Government public sector pricing policy varies as a function of housing affordability among targeted low-income groups, such that relative improvements in the economic position of the underprivileged are reflected in diminished public housing price subsidies. Further, results of this equation indicate a strong, direct response in public pricing policy to those relative price fluctuations in private sector housing. While the traditional demand relation between price and quantity appears important in the public sector, the magnitude of this effect is small. Finally, the Yom Kippur War and its aftermath result in a substantial decrease in public sector housing demand.

TABLE 1
CYCLICAL MODEL OF THE ISRAELI HOUSING MARKET

ESTIMATION TECHNIQUE: TWO-STAGE LEAST SQUARES*
EQUATIONS (1) THROUGH (5)

	(1) HOUSING SUPPLY PRIVATE	(2) HOUSING DEMAND PRIVATE	(3) HOUSING SUPPLY PUBLIC	(4) HOUSING DEMAND PUBLIC	(5) HOUSING VACANCY PRIVATE
	SV	PVF	SB	PBF	VV
PVR			5.00 (2.56)		6.60 (8.50)
BR			9.63 (1.64)		
YLR			-.23 (3.04)	.007 (3.44)	
PFR			2.64 (.66)		
D3	-.02 (1.54)		.01 (2.33)		
D4	.002 (.93)		.02 (1.66)		
IMLL			.02 (.99)		
PVF	.01 (6.78)			.56 (6.19)	
VV1	-.20 (1.17)				.27 (3.10)
SV		-.0001 (0.49)			

TABLE I
(continued)

	(1) HOUSING SUPPLY PRIVATE	(2) HOUSING DEMAND PRIVATE	(3) HOUSING SUPPLY PUBLIC	(4) HOUSING DEMAND PUBLIC	(5) HOUSING VACANCY PRIVATE
	SV	PVF	SB	PBF	VV
PBF		.63 (2.83)			
GV1		.01 (1.46)			.12 (1.95)
RVR		-.01 (0.98)			
YR		5.35 (5.20)			
SB				-.0002 (1.96)	
D1				-.18 (5.86)	
RFR					-4.95 (1.19)
PVLR					-8.34 (2.73)
GL1					-1.33 (1.46)
C	.006 (0.95)	-.0001 (2.49)	-.13 (1.88)	-.00004 (2.36)	.02 (.60)
NUMBER OF OBSERVATIONS	31	31	31	31	31
DW	1.40	1.30	1.62	1.81	1.49
ρ	-	.85	-	.85	-
SSR	622751.	.055	311837.	.047	119985.
SER	155.	.048	116.	.044	72.

*Absolute t-ratios in parentheses

Among those determinants of private sector supply, builder return on investment, as proxied by the ratio of private sector price to construction costs, is highly significant. As expected, remaining vacant stock from the previous period exerts a substantial, negative effect on private housing starts. The estimated coefficient proxying the 1977 currency devaluation, while not large in magnitude, indicates increased private sector starts in this context. Finally, the Yom Kippur War coefficient suggests a significant decrease in private sector construction activity in subsequent years.

Intertemporal fluctuations in public housing supply reflect various policy and budgetary in addition to economic effects. The estimated coefficient of the government non-military expenditures variable is positive and large in size, indicating the extent to which variations in public housing provision reflect overall budgetary constraints. Similarly, fluctuation in public housing starts reflect changes in the composition and magnitude of the targeted population. In this regard, increases in underprivileged group income level results in significant decreases in public housing provision. Further, the highly erratic increases in immigrant population result in associated subsequent increases in public housing construction. Public sector supply varies positively with the real price of private sector housing, suggesting adherence to the national policy goal of affordable, decent housing. In this case, the variable is both of substantial magnitude and highly significant. While public supply also fluctuates directly with real housing input costs, the estimated coefficient in this case lacks a reasonable degree of statistical significance. Finally the dummy variables proxying the 1973 War and 1977 devaluation contexts are of similar magnitude and significant, indicating increased public starts in the wake of those effects.

Results of the final equation, modeling private sector inventory creation,

in general conform to a priori expectations. In this case, all variables are significant at the 90 percent level or above. Here higher real housing prices or rates of price increase result in increased inventory creation. Alternatively, higher loan rates, reflecting increased inventory carrying costs, discourage speculative holdings. Increased reinvestment costs, as reflected in land values as well as rate of increase in land values, similarly result in diminished holding of inventory. As expected, housing vacancy rate also varies as a positive function of the previous level of unsold stock.

5. CONCLUSION

Results of the analysis indicate the importance of disaggregation by public and private sector in an analysis of Israeli housing market cyclical phenomenon. In that regard, model specification accounts for important interdependencies in public and private sector housing activities, yet illuminates as well divergence in the determinants of those flows. Private housing supply responds to traditional price and existing inventory effects and further reflects war-related and other peculiarities of the Israeli context. Private sector inventory creation similarly reflects various builder profit-maximizing indices, including those indicating expected appreciation in stock, carrying and reinvestment costs. In contrast, public sector construction, while also varying as a function of war-related and other irregularities, further reflects non-military spending and targeted population affordability constraints. Here such indices as underprivileged population real income level and relative private housing prices are important determinants of public sector supply. The analysis indicates new immigrant flows are no longer primary to public construction activities, which instead reflects recent emphasis on the improved housing position of indigenous underprivileged groups.

In the case of housing demand, the traditional inverse relation between price and quantity is estimated for both public and private sectors. Demand specifications for both sectors further reveal the relevant real income constraints and substitution effects. The private sector demand function diverges, however, in its representation of important household speculative and mortgage market effects. Finally, private sector demand is shown to be depressed in those years subsequent to the 1973 War.

The study has implications for housing policy, particularly as regards conflict among goals. Public housing supply appropriately responds to indicators of targeted population affordability. Yet overall this policy has served to amplify private sector price fluctuations, in turn reducing associated homeownership opportunities for low-income groups and others. Self-defeating elements of public construction policy are thus illuminated, indicating further tuning of this instrument is required to effectively moderate housing sector cyclical tendencies. One alternative is simply diminished reliance on public sector construction as a means of accomplishing the redistributive goal. In that regard, the recent trend toward subsidization of eligible populations through mortgage instruments rather than price eliminates much of the justification for public construction activities.

APPENDIX A

Variable List

SV	Number of private sector housing starts, in thousands (Israel Statistical Abstract)
PVF	Ratio of private sector housing price index to construction Cost Index (Israel Statistical Abstract)
SB	Number of public sector housing starts, in thousands (Israel Statistical Abstract)
PBF	Ratio of public sector housing price index to construction Cost index (Israel Statistical Abstract)
VV	Stock of unsold private sector housing units in the twenty-one largest cities, in thousand square meters (Israel Statistical Abstract)
VV1	VV lagged one quarter
GV1	Rate of increase in private sector housing prices over previous quarter (Statistical Abstract of Prices, Central Bureau of Statistics)
PVR	Private sector housing price index (Statistical Abstract of Prices, Central Bureau of Statistics), in real terms
IMLL	Number of new immigrant families, lagged two quarters (Israel Statistical Abstract)

APPENDIX A
(continued)

- BR Real non-military government expenditures, in million
Israeli shekels (Israel Statistical Abstract)
- YLR Average monthly real income of low-income households
in thousand Israeli shekels (Israel Statistical Abstract)
- PFR Construction Cost Index, in real terms (Statistical Abstract
of Prices, Central Bureau of Statistics)
- D3 Supply-side dummy variable taking on value of one in
aftermath of October, 1973 War
- D4 Supply-side dummy variable taking on value of one in
aftermath of 1977 Israeli currency devaluation
- RVR Real average interest rate on private-sector (non-directed) mortgages
(Statistical Abstract of Prices, Central Bureau of Statistics)
- YR Real Gross National Product, in million Israeli Shekels
(Israel Statistical Abstract)
- D1 Demand-side dummy variable taking on value of one in the
aftermath of the October, 1973 War
- RFR Real interest rate on debentures (Research Division, Bank of Israel)

APPENDIX A
(continued)

- PVLR Real average price of 3-bedroom single-family homes in
 large, metropolitan areas, in thousands of Israeli shekels
 (Statistical Abstract of Prices, Central Bureau of Statistics)
- GL1 Rate of increase in lagged real price of single-family
 housing over previous quarter (Statistical Abstract of Prices,
 Central Bureau of Statistics)

APPENDIX B

CYCLICAL MODEL OF THE ISRAELI HOUSING MARKET

ESTIMATION TECHNIQUE: THREE-STAGE LEAST SQUARES*
EQUATIONS (1) THROUGH (5)

	(1) HOUSING SUPPLY PRIVATE SV	(2) HOUSING DEMAND PRIVATE PVF	(3) HOUSING SUPPLY PUBLIC SB	(4) HOUSING DEMAND PUBLIC PBF	(5) HOUSING VACANCY PRIVATE VV
PVR			5.39 (2.82)		6.42 (8.61)
BR			9.97 (1.75)		
YLR			-.23 (3.10)	.004 (1.99)	
PFR			1.84 (0.47)		
D3	-.92 (.99)		.02 (2.43)		
D4	.002 (1.49)		.02 (1.65)		
IMLL			.02 (1.06)		
PVF	.01 (7.42)			.69 (8.39)	
VV1	-.25 (1.56)				.28 (3.34)
SV		.0001 (.65)			
PBF		.70 (3.68)			
GV1		.002 (.29)			.12 (2.22)
RVR		-.01 (1.30)			

APPENDIX B
(continued)

	(1) HOUSING SUPPLY PRIVATE	(2) HOUSING DEMAND PRIVATE	(3) HOUSING SUPPLY PUBLIC	(4) HOUSING DEMAND PUBLIC	(5) HOUSING VACANCY PRIVATE
	SV	PVF	SB	PBF	VV
YR		4.2 (4.55)			
SB				-.0002 (2.58)	
D1				-.14 (5.04)	
RFR					-7.06 (1.84)
PVLR					-6.84 (2.42)
GL1					-1.76 (2.11)
C	-.003 (0.59)	-.00004 (2.06)	-.13 (1.93)	-.00002 (1.59)	.007 (0.27)
NUMBER OF OBSERVATIONS	31	31	31	31	31

* absolute t-ratios in parentheses

Footnotes

(1) The research assistance of Daniel Levy is gratefully acknowledged. Financial support for this study was provided by grants from the University Research Fund and Faculty of Humanities and Social Sciences, Ben-Gurion University of the Negev.

(2) See Israel Housing Ministry (1976), pg. 2 for detailed information on this subject.

(3) Lithwick (1980) pg. 8

(4) Two-stage least squares results are presented in Table 1, whereas three-stage least squares findings are contained in Appendix B. The estimation method does not significantly alter the nature of research findings.

(5) Note that land price information is unavailable. Single-family housing prices in the major urban areas are used to proxy variation in land values.

(6) We estimate a consumption function of the form $C_t = 0.30 Y_t + 0.52 C_{t-1}$.
(3.41) (3.62)

$R^2 = 0.997$, $DW = 1.89$, $SSR = 12691$, $SER = 20.23$. These variables are represented in real, per-capita terms. The permanent income proxy utilized in the housing market model is then \hat{C}_t .

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