HOMES

No. 6

Household Projections and Housing Needs in Thailand

Nipon Poapongsakorn

June 1988

EAST-WEST POPULATION INSTITUTE

EAST-WEST CENTER HONOLULU, HAWAII

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Household Projections and Housing Needs in Thailand

I. Introduction

The National Economic and Social Development Board in Thailand has prepared several population projections up to year 2005. However, household projection has never been prepared in Thailand. Household projection is usually done in connection with forecasting demand for housing or housing need in a country because the demographic factors are perhaps ones or the most, if not the most, determinants or residential construction and residential building cycle.[1] Previous research, particularly in the United States, have shown that residential construction has a close inverse relationship with economic growth and fluctuations.

As a result of demographic transition where total fertility rate has rapidly declined from the high level in the 1960's to a low level in the late 1970's, the Thai housing population, composed of persons fifteen years and older has drastically increased and will continue to increase in the rest of the century. This suggests that Thailand will experience an unparalleled increase in housing demand between now and the year 2015 which will put pressure on the construction industry resources. Information about underlying change in housing demand will be necessary for government policies and the private sector to appropriately direct investment and resources in the construction industry.

In the past years, the significance of the construction sector as a whole and the residential construction in particular seems to have been declining. The percentage shares of construction expenditures and residential construction in the gross capital formation as shown in Table 1 were 42.57% and 13.32%, respectively in the 1960-70 period. The corresponding shares declined to 38.92% and 10.03% in the 1970's, but then increased again in the early 1980's. The forecast of housing will enable us to estimate the amount of future resources required to meet housing needs in the next 30 years.

The objectives of this report are as follows.

1. To predict the number of households and housing requirements at 5-year intervals over the 1985-2015 period.

2. To predict housing needs, assuming various income elasticity of demand for housing and economic growth over the same time periods.

3. To forecast the residential construction expenditures required to meet the future housing requirements.

4. To examine the economic impacts of changes in housing expenditures on the economy by employing a social accounting matrix for Thailand in 1981.

This report will be divided into 5 parts. After the introduction, part 2 discusses the methodology and data requirements.

Projections of number of households, housing starts and residential construction expenditures are presented in part 3. Part 4 describes the construction sector in Thailand and the economic impacts of increase in residential construction expenditures in the future. Part 5 is a summary and conclusion.

2. Methodology and Data Requirements

We will first discuss the projection method of the number of households. Then a method to estimate the number of housing starts and residential construction expenditure will be presented. Finally, we will briefly discuss the methods to assess economic impacts of changes in residential construction expenditures.

2.1 Projecting Headship Rates and Number of Households

There were several methods in projecting households, such as simple household-to-population method, life table method, and vital statistics method. (See details in UN manual VII, Methods of Projecting Households and Families 1943). But the most widely used is the headship rate method. This method involves estimating the percentage of population in each age-sex category who are head of a household. Such percentages are called the headship rates. Projected number of households is obtained by multiplying headship rates to the corresponding category of population and sum over all categories.

This method can be further refined by classifying population into smaller categories such as by age-sex-marital status. The technique used in this study based on a new computer package called Homes method (see Mason, 1986). Estimation of the number of households is essentially a refined method of the headship rate which classified household by types: intact households (husband and wife present), female headed households (no husband present), male headed households (no wife present), one person household and primary individual households (several unrelated persons living together). Headship rates for all but intact households are calculated by dividing the number of male and female heads in five years age groups by the corresponding population. Calculation of the headship rates for households with the head and spouse present is complicated by the fact that the proportion of men married and the proportion of women married cannot be held constant in the face of changes in the number of men relative to the number of women. HOMES assumes that the probability that a woman aged y is the spouse of a head aged x does not change. Then the probability that men head intact households is calculated using the joint distribution of the proportion of women at selected ages who are the spouse of a head in selected age groupings and the number of women at each age. (For further details, see Mason, Phananirami 1985). The headship rate is the number of households divided by the number of men aged x and women aged y.

The number of households in each family type can be projected by multiplying type-age-sex specific headship rates in 1980 with the corresponding projected age-sex population. The headship rates used are assumed to be constant over the projection period.

The data used to calculate headship rates is from special tabulations compiled from the one-percent sample for 1980 Population and Housing Census carried out by the National Statistical Office (N.S.O.). The population projections used are under the medium fertility assumption. The projections are prepared by the NESDB. Details about fertility assumption and other input data are given in Appendix 1.

It should be noted that projections by HOMES are consistent with underlying fertility and mortality trends. If, for example, mortality among elderly declines, HOMES accounts for the impact on the number of households headed by elderly.

2.2 Housing Projection

Given the household projections, the next task is to transform the number on households into the units of housing required to meet an increases in the population. However, the number of housing units to be built each year will not simply be equal to the increase in the number of households. Each year a large number of dwelling units may be dilapidated due to obsolescence. Slum clearance,

urban renewal, expansion of business area as well as infrastructure development also lead to a large scale of housing destruction. This implies that a certain number of dwellings withdrawn must be replaced. But at the same time, there may be some vacancies because the housing market cannot always be expected to be cleared and that information costs (of both the buyers, renters, and sellers) are not zero. Taking these factors into consideration, a simple equation forecasting the number of housing starts (or additional units to be built each year) can be constructed as follows:

$$ {}_{i}HS_{i} = HHF_{i} \cdot (A_{f}) \cdot (1 + A_{v}) - V_{i}^{u} + A_{w} HI_{i} \qquad (1) $$

where ${}_{i}HS_{i}$ = housing starts summed over the it h quinquennium

HHF = household formations as forecast for the it h quinquennium (stock concept).

A_{f} = factor adjusting household formations to the number of housing units required per household formation.

A_{v} = vacancy factor relating "frictional" vacancies to the occupied housing stock (OHI_{i})

V_{i}^{u} = unwanted vacancies at the beginning of the it h quinquennium which is assumed to be zero in the case of Thailand.[2]

A_{w} = the withdrawal factor which is defined as the ratio of net withdrawals to the housing inventory

HI_i = the housing stock at the beginning of the it h quinquennium

The information required to forecast the number of housing starts are, according to the above equation, housing stock at the beginning of the period of forecast, the number of withdrawals and vacancies. Unfortunately, in Thailand, these data are not available. Although the Ministry of Interior has been reporting the number of houses, the data is the number of occupied housing units (see Appendix 2). The United Nations also estimated the number of occupied housing units in 1970 from a one-percent tape of the 1970 Population and Housing Census.[3] The estimated figure is 5,923,000 units.

Therefore, we have to use the estimated housing stock for the beginning year in our housing projection. The procedure to calculate the housing stock is to assume that[4]

$$HI_i = HHf_i(A_f)(1 + A_v) - V_i^u$$

where $V^u = 0$

The percentage of number of housing units per household (A_f) is estimated from the distribution of the number of households per housing units in the 1976 Housing Survey. The procedure for calculating A_f is discussed in details in Appendix 3. In 1960, A_f is estimated at 0.984. It is to be decreased from 0.9874 in 1980 to

0.9821 in 2015 because of the higher percentage of urban population which has higher percentage of multiple households in one housing unit than the rural population.

Withdrawal rate (A_w) is assumed to be 0.01 in this study. Although in Appendix 4, A_w is estimated at 0.032 from the information on the type of material used in housing construction in the 1970 Census and the 1976 Housing Census, it is argued there that the rate is too high relative to other countries. This is because as urbanization and development expand, quality of construction materials improves. Moreover, owners also tend to improve or repair their houses from time to time instead of letting them dilapidated. Finally, it is also reported by the Ministry of Interior that in 1984, the ratio of withdrawals to occupied housing is 0.028 percent which is far less than one percent. Since this number did not include houses burnt down by fire, it is not unreasonable to assume that A_w is one percent.

The vacancy ratio is assumed to be 2 and 4 percent. The assumption is based on experience in other ASEAN countries. Appendix 5 discusses its rationale.

After obtaining the number of housing starts by quinquennium from equation (1) above, residential construction expenditures are estimated by applying the price of a housing unit to the number of housing starts. The price of a house is measured at the 1972 price and

estimated at ฿ 19,000 per unit.[5] The figure is obtained by comparing prices of houses from several sources. Appendix 6 presented the detailed information.

After obtaining the residential construction expenditures, they will be related to some key economic indicators such as GDP, GCF and population data such as total population and housing population (defined as population age 15 years and over) in order to draw some implications on the resource requirements of the future housing needs. The data used are obtained from the National Economic and Social Development Board (from hereon, NESDB).

2.3 Evaluation of Economic Impacts

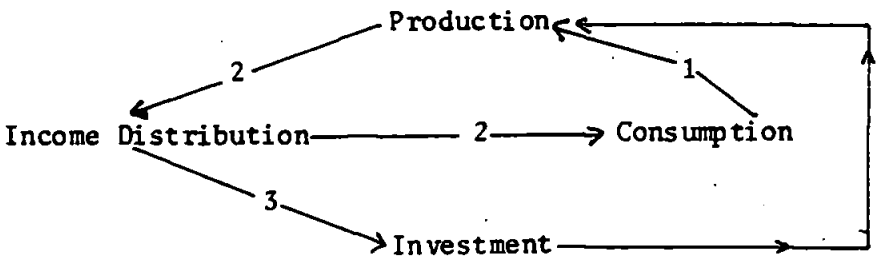
There are several ways to evaluate the impact of changes in the future housing needs on the economy, for instance, econometric model, computable general equilibrium (CGE) and input-output table. To construct an econometric model or a CGE model may not be worthwhile for such simple questions. But to use the input-output table, one would only obtain the impact via the production sector only. The social accounting matrix seems to be the most appropriate choice of technique to evaluate the economic and employment implications of changes in the number of housing starts.

While the input-output table deals with the impact of one unit increase in final demand on the production sector, SAM represents

the relationships between output, factor demands and income and the decomposition of these relationship into separate effects. When there is an increase of one unit in the final demand, production will increase, which in turn, will induce higher level of employment of factors of production. Factor income, hence, will increase. These income will be allocated to various institutions in the economy, i.e. household, private corporation and government. They will increase their consumption (by the product of marginal propensity to consume and the increase in income). This will again stimulate an increase in final demand which will further induce more production in the second round. This effect is called "intergroup effect". Moreover, there will be a third effect called extra-group effect. This is because part of the income saved will be reinvested which constitute another source of final demand stimulation. These three effects are shown in diagram 1 below.

Diagram 1

Impact of a Change in Final Demand



The social accounting matrix used in this study is first constructed to explore the employment implications of government policy. (See Amaranand, et al. 1984) The data base is 1981. It is consisting of 57 accounts. But since it does not have a construction sector in the activity and commodity accounts, we have modified "SAM" to include the construction sector so that the impact of changes in the construction sector can be evaluated.

Detailed description of SAM is provided in Appendix 10. Table A-10 presents the 61 x 61 social accounting matrix in 1981 and Table A-11 gives the aggregated version of SAM 81. This report employs the fixed price multiplier, which is also explained in Appendix 7, to assess the economic impacts of a change in the final demand for residential construction upon output of various sectors, labor income, non-labor income, import multiplier, forward and backward linkages. All formulas are given in Appendix 10.

3. Projection Results

In this section projection of number of households, housing stock or inventory (HI), required housing additions (RA), and housing starts (HS) based on equation 1 in part 2 are presented and discussed. Estimates of real residential construction expenditures relative to GDP and GCF (gross capital formation) will also be given.

3.1 Projection of Number of Households

Table 2 shows that the number of households is projected to increase from 10.2 million in 1985 to 21.9 million in 2015. This amounts to an average annual growth rate over the period of 2.5 percent compared with a population growth rate of 1.3 percent over the same period. The greatest increase will occur between year 2000 and 2005 when the number of households will be increasing by more than 410,000 per year. But the net increase will begin to decline early in the twenty-first century.

Family (or intact) households constitute about 78% and only 4% of all households consist of one-person or primary-individual households in year 2015.

The rapid increase in the rate of household formation between 1980 and 2005 is the consequences of high population growth in the 1960-75 period, drastic decline in the average household size and change in age distribution of population. Between 1980 and 2005 the average household size will decline by 1.6 members (see Table 2). Moreover, there will be substantial declines in the percentage of households with heads under 35 years of age relative to the percentage of households headed by older persons. The percentage of households headed by persons 35 to 49 years old increases gradually from 36.3% in 1980 to 39.8% in 2005 and declines slightly thereafter.

The percentage of households headed by persons 49 years and over remains relatively stable until the turn of the century and then increases quite markedly (see Table 3).

3.2 Housing Projection

Table 4 gives quinquennial estimates from 1950 to 2015 of the required housing stock, required additions, withdrawals and housing starts based on equation (1). Three sets of predictions are given. The first set is based upon the headship rate from the 1970 Census, and the second one on the headship rate from the 1980 Census. Both sets assume that $A_v = 0.02$ and $A_w = 0.01$. The third set is also based on the 1980 headship rate but with different assumptions of A_v and A_w which are twice as high as the first two sets of predictions. It should be observed that the results from the 1970 and 1980 headship rates are not significantly different, except that the 1970 headship rates predict more number of households and required housing stock until year 2005. From thereon, the 1980 headship rate predict more number of housing stock. The second observation from Table 4 and estimates based on different assumptions about A_v and A_w (which are not shown here) reveal that the required housing inventory (HI) and required additions (RA) are not sensitive to different values of vacancy ratios, while the number of housing starts is quite sensitive to the withdrawal rates. We, therefore, present the estimates of housing inventory and housing starts based upon the assumption that

A_V = 0.02 and A_W = 0.01. This set of estimate should be viewed as the minimum number of housing starts predicted if economic factors are kept constant.

The required housing inventory increases throughout the period covered, growing by 5.1% annually between 1950 and 1980 but forecast to grow by only 4% per year from 1980 to 2015. So by 2015, the required housing inventory will have to be 2.13 times the 1985 level. Absolute increase in HI will peak during 2005-2010 and decline thereafter.

Although the housing inventory keeps increasing throughout, the percent change in HI decreases from 17.4% between 1950-55 to 14.5% in 1965-70 but then picks up again to 18.8 in the 1970's. After that it gradually declines throughout the projection period. This implies that the peak impetus to net investment in housing from population changes has already passed by. But during the 1980's the increase in the demand for housing inventory will still be at a relatively high level comparing to the 1950's decade.

While housing starts and required additions, which is one component of housing starts, steadily increase from 1950 to 2010 and decline thereafter, withdrawals keep on increasing throughout. Even with the assumption of very high withdrawal rate of 2% (projection set C in Table 4), withdrawals are not large enough to reverse the trend

of the housing starts. Table 4 and Figure 1 clearly show that both required additions and housing starts rise steadily and peak in year 2005 and 2010, respectively. But the greatest increase in housing starts in absolute terms - will be between 1985 and 1990.

A better idea of possible cyclical impact of the changes in housing demand forecast is given by the first differences in housing starts (DHS) and changes in required additions (ΔRA) shown in Figure 2. Increasing increments provide a stimuli to expansion while decreasing increments tend to reduce the rate of income growth leading finally to economic downturn. Although more than one sector needs to be involved for this kind of rough "accelerator" effect to occur, the impact of changes in the housing industry can be significant as shown by experience in developed countries. Both ΔHS and ΔRA start from a trough between 1955/59 and 1960/64 and reach the first peak in the 1965/69 - 1970/74 periods. After slowing down until 1975/74 both of them reach the second peak in the 1980/84 - 1985/89 periods. After that they steadily decline and finally the increments become negative in year 2000 which means that economic downturn will be unavoided if other stimuli is not provided. It should also be noted that ΔRA and ΔHS between 1960-1980 correspond very well with the annual growth rate of GDP.

Table 5 compares required additions (RA) and housing starts (HS) to population changes. If age and sex composition remained

unchanged, the ratio of required additions to the growth in the housing population (defined as population aged 15 years and over) would remain unchanged. What is observed from Table 5 is the opposite. After falling in the late 1960's the RA/dHP ratio increases in the early 1970's, then fall again and finally begins to increase in the late 1980's. With population aged less than 15 years continually falling (i.e. increasing dHP/dP), our forecast of required additions (in Table 4) as a constant proportion of the total population change would underestimate the actual required additions. This is confirmed by the same pattern of RA/dP as the RA/dHP ratios.

The housing starts/changes in housing population ratio (HS/dHP) also shows similar pattern as the RA/dHP ratio. The increase in this ratio after the late 1970's at a relatively stable high rate means that more and more housing units will have to be built relative to the growth in the labor force.

Another index of the relative labor resource requirement of the projected housing starts can be obtained by relating housing starts to the beginning housing population in each quinquennia. It is shown from Table 5 and Figure 3 that the labor "burden" increases sharply from the late 1960's to the 1970's and then start to decline, first rapidly in the early 1980's and then gradually after that. Thus for the next 3 decades from 1985, the share of potential labor resources needed to

supply new housing required by population changes and withdrawals at a constant rate will be declining steadily.

All the evidence presented so far show that the rapid decline in population projection from 1980-2015 will have much effects in lessening the demand for housing in the next 3-4 decades.

A broader and perhaps clearer index of the resource costs of the projected new housing construction can be gained by transforming the projection of housing starts into real residential construction expenditures (REX) and relating them to the forecasts of real GDP and real GCF. Here, two assumptions of income elasticity of demand for housing are made : (a) zero, and (b) unitary elasticity.

Table 6 presents the REX/GDP and REX/GCF ratios for the 1970-2015 period. If income elasticity is one, the REX3/GDP ratio will be gradually increasing and start to decline in the early 2000's. Under the assumption that per capita income is growing at 5 percent per annum, REX3/GDP over the 1985-2015 period will exceed the actual REX/GDP between 1980 and 1985. Similarly, the percentage share of REX3 in the gross capital formation also shows the same trend as the REX3/GDP.

On the other hand if the income elasticity is zero, REX1/GDP would have already reached the peak in 1970-74 and decline gradually after that. The same pattern is also observed for the REX1/GCF.

These findings imply that, residential construction can still play a vital role in accelerating the nation's economic growth if income growth at a high enough rate. Had income failed to increase, residential construction will no longer be a key factor in accelerating growth because slower population growth will begin to reduce the demand for housing starts over the projection period.

If the first differences of REC is calculated just like the first differences of housing start (ΔHS), more information about possible cyclical impact of changes in housing expenditure can be obtained. Figure 4 depicts REX under various assumption of E_y and g. If E_y is zero, Δ REX1 shows similar declining pattern as ΔHS in Figure 2 after the 1980-85 to 1985-90 period. But if the assumption of positive E_y is used, then residential construction expenditure will still provide an strong stimuli to expance the economy income. If per capita GDP is 5% per year then we would expect the construction sector to be growing at a steep rate between the period of 1975-80 to 2010-2014. But if g is 4%, then there may be a slowdown of REX in year 2000-04 and 2005-2009.

3.3 Housing Quality, Income Growth and Demographic Factors

We have found that although the number of housing starts and housing inventory will be increasing throughout the projection period, the decreasing increments of housing starts (ΔHS) will lead to

economic downturn. However, income growth and unitary income elasticity of housing demand are two important factors that will offset the declining trend. There are also other demographic factors that may help stimulating the growth of the residential construction sector. This section examines the issue of characteristics of housing starts in relation to income growth, household characteristics and headship rates.

Between 1970-1980, there were substantial increases in the quality of houses as can be seen in Table 7 to Table 9. The number and proportions of detached houses and duplex (or townhouses) increased rapidly over the period. Table 7 shows that the number of households which own detached houses jumped from 1.6 million in 1970 to 7.2 million in 1980. The proportion of households with duplex houses also increased from almost 0 percent in 1970 to 1.6 percent in 1980. Apartment also increased by several times indicating the importance of commuting time, land price in the city and declining household size. With declining fertility and smaller average household size, the types of housing which are not suitable for large families such as duplex, apartment and condominium will play important role in the housing market in the future.

Table 8 also confirmed that there was improvement in the type of construction material. The proportions of houses built by local and reused materials declined from 23.2 percent to 16 percent over the 1970-1980 period. Moreover, larger number of households had

water supply, electric lighting, and better toilet facility as shown in Table 9.

These improvements in the quality of housing coincided with the rapid increase of real GDP during the 1970's. It also implies that the income elasticity of housing demand is high and that our assumption of unitary income elasticity which is based on the estimate by Mason (1987) is realistic. Therefore, our base projection (zero income elasticity) that residential construction will decline may not happen if we allow for income growth in the future. Housing starts in the next few decades will be of better quality which means higher construction expenditure. The second factor that may have positive effect on the residential construction is that household with heads 35 to 49 years of age will grow most rapidly while households with younger heads will grow most slowly (see Table 3). Almost 69 percent of heads will be in the 35-64 age groups in 2015 comparing with 60 percent in 1980. These household heads will certainly have higher average income than both the younger and the older heads. Therefore, quality of housing starts can be expected to be greatly improved in the next 3 decades. Thirdly, although the headship rates in 2015 are projected to be lower than those in 1980 (see Figure A-1 in Appendix 1), the ratio of population aged 15-29 will increase as a result of fertility decline. The declining ratio may have the positive effect on the relative income of the two groups of population (Campbell, 1982). Increasing

relative income of population aged 30-64 will, in turn, increase the headship rates which implies more housing starts.

Another demographic factor that may affect the quality of housing is the average household size and the average age of household members. As can be seen in Figure 5, the average household size will drastically decline in the next three decades. Smaller household size means that fewer bed-rooms and smaller but higher quality houses can be built. Since the average number of members under 15 years of age will decline drastically during the next two decades (see Mason, et.al., 1986, Table 19), family members will become older. The characteristics of housing starts demanded by those older members will, therefore, be affected.

3.4 Modelling Housing Characteristics

The demand for housing characteristics of the utility-maximizing utility can be written as :

$$H = H(P, Y,$$

where H is the demand for housing characteristics

P is the relative price

Y is the household income

is the demand shifters such as demographic variables.

We will use the above model to forecast the future housing characteristics by making use of the projection of demographic variables derived from HOME.

There are a large number of dimensions of housing characteristics. In this study, we classify housing characteristics into 5 categories, i.e. (a) type of living quarters, (b) number of bedrooms, (c) type of construction materials, (d) type of toilet, bathroom, and (e) exclusive use of toilet and kitchen. These characteristics are the dependent variable in our demand model. Table 10 shows that there are a total of 17 demand equations of housing characteristics. The definition of the dependent variables is also given in the some table.

The demand for housing characteristics are postulated to depend upon age of head, sex of head, age composition of household members, type of household, permanent income of the household and price of the characteristics.

Since the data source that we will employ does not contain income and price information, we will use some proxies for household income. Besides education of the head which also represents taste of the head, occupation of the head and availability of certain assets can be good measure of permanent income. We choose to use the availability of television and refrigerator as the proxy for assets.

The variable is a dummy variable with a value of one if the household has a television set or a refrigerator, otherwise it is zero. The list of the independent variables are given in Table 11.

Age of head and its squared are included to represent the life-cycle pattern of demand for housing characteristics of people at different age group. For example, when a head is very young, he may not be able to afford or may not need a large house. As he grows older, the need and ability also increases, but finally decrease at some later age.

Number of household members at each age is positively affecting the demand for bedrooms, and type of living quaters. A family with small children may not need an extra bedroom, but not a family with older children. Moreover, the former can easily live in apartment or row house while the latter may have to find a detached house, other things being equal.

Type of household will also affect the choice of living quarter. For example, a one-person or a single head household will have more tendency to live in a room-house or a row house. But at the same time, they may be able to afford exclusive bathroom and flush toilet.

Sex of the household head is included to control for male-female differences in taste for housing characteristics. The variable is a dummy variable.

Education of head is measured by four dummy variables, i.e., no education, primary, secondary and tertiary education. A head with no education is the reference variable omitted from the equation. We expect the head with tertiary education to demand higher quality of house than those with lower education.

Occupation of head is also the proxy for income. There are five groups of occupation : (a) professional workers, (b) managerial workers, (c) other white collar workers, (d) blue collar workers and (e) other workers which are the reference.

Moreover, four employment status variables are also included to be proxy for income. They are employers, government employees, private employees, and the reference group which consists of self-employed persons and unpaid family workers.

Persons who live in the urban area tend to live in a smaller house such as apartment, row house and roomhouse because of high price of land. But the smaller house is usually compensated by high quality type of housing, e.g., exclusive and fluch toilet, cement house, etc.

Since the dependent variables under item number 1, 3 and 4 in Table 10 are dichotomous, the appropriate functional form should be logit or probit function. But there are about 67,392 households in our data set obtained from the Thai census, estimation of logit or probit will be extremely expensive. We, therefore, decide to employ

ordinary least squares technique which will give us biased estimates of coefficients. But it is worth to pay the cost of biasness for two reasons. First, we have very limited computer budget. Secondly, our main objective is only to provide a framework to forecast housing characteristics for the planner.

The demand for number of bedrooms and number of other rooms used for sleeping (item number 2 in Table 10) will be estimated by OLS technique.

A single equation approach will be used to estimate the demand for housing characteristics. It is wellknown that the single equation estimate of demand function will give us biased results due to simultaneity problem. Moreover, there is also limitation arises from the omission of the price variables. However, studies of the simultaneity problem and review of literature found that estimated income elasticities and effects of demographic variables are in line with single equation estimates (S. Malpezzi and S.K. Mayo 1987, p. 703-705).

Our data source is the one-percent sample tape of the 1980 Population and Housing Census of Thailand. The data set consists of 67,392 households after dropping cases with unknown observations.

3.5 Regression Results of Housing Characteristics

Although we have estimated 15 regressions of housing characteristics and the results are provided in Appendix 10, we will only use 11 equations (those with asterisk in Table 10) to forecast the future characteristics of houses. Table 12 presents the means and S.D. of all variables. We will only discuss the interesting results.

Among the regressions of type of living quarters, detached house and row house equations have highest adjusted R-square, i.e., 0.28 and 0.23, respectively. Other equations have very small R-square. So in our projection, we will use only the detached house and the row house equations to do a forecast.

In the detached house regression, only one variable is not significant, i.e. HDEDSEC. Most variables have expected sign. As a family head grows older, the probability of having a detached house is also higher. But after the age of 64 years, the probability declines. Male head has lower probability of having a detached house than female head. Head with all levels of education, except secondary level, have higher tendency to have a detached house than one with no education. However, well-to-do household (TVREF) or household with a head who is employer will have lower probability of having a detached house. Farmers will have higher tendency to have a detached house than people in other occupations. This is also true of a household in the rural area vis-a-vis urban area, female head vis-a-vis male head.

As the family head grows older, he (or she) will have lower probability of having a row house. After the age of 64, the situation is reversed. Households which have higher probability of living in the row house have the following characteristics : (a) head has no education ; (b) head is a self-employed worker or an employer ; (c) head is a farmer ; (d) head is male ; and (e) they live in the urban area.

Among the regressions of type of construction materials, only the cement regression has a good fit with R-square of 0.23. Younger household head has higher probability of having a cement house. The characteristics of the household whose house is made of cement are as follows: (a) head has at least secondary education; (b) he is an employer and his occupation is professional, management or white collar job, (c) the household has television and refrigerator and lives in the urban area; (d) the higher the number of family members aged 15 years and over, the higher the probability of having a concrete house.

In the wood regression, the function has an inverted U-shape with respect to age of head. If a head has college education, an employer, a private employee, a manager or white collar worker, he will have higher tendency to live in a wooden house. Rich household (as measured by TVREF) and household in the urban area have lower probability of having a wooden house.

The bedroom equation has probably the most meaningful result. The coefficient of age is positive and that of age squared is negative as expected. Household head with higher income as measured by education, and occupation tend to have more bedrooms. Government and private employees have smaller number of bedrooms than self-employed heads, but employer has more bedrooms. As the number of family members increases, more bedrooms are required. But the effect is not linear with respect to age of family members. Adult member demand more rooms than younger member. For example, an increase of one member aged 0-5 years will demand 0.24 more rooms, but an equal increase of the member aged 30 years and over will demand about 0.2 more rooms. The difference is five times. Urban and rich household tend to have more bedrooms than rural and poor household.

The households with higher probability of having exclusive bathrooms and kitchen are : (a) urban household, (b) their hea has high education; (c) he is not a famer; (d) the household has TV or refrigerator. Female head also tend to have exclusive bathroom more than male head. Both one-person household and single head household have higher probability of having exclusive bathroom than other family type. But only single head household has more change of having exclusive kitchen than others. Male and female heads are not different with regards to exclusive use of kitchen.

While younger household had have higher probability of having flush toilet, the older head tend to use latrine toilet. This is probably the influence of western culture among younger population. Head with college education has lower probability of using latrine toilet probably because they like to use flush toilet since the coefficient of HDEDCOL in the flush equation is positive and significant. Uneducated head and rural household tend not to use both flush and latrine toilet. While private employee likes to use flush and dislikes latrine toilet, government employee's taste is the other way round.

3.6 Forecast of Housing Characteristics

Table 13 is a summary of the forcast of 5 type of housing characteristics. Detailed forecasts which are also done for various type of households are given in Appendix 11.

To forecast future housing characteristics, we employ 11 regressions (those with asterisk in Table 11) shown in Appendix 10. The projection of the independent variables which are demographic and educational variables are obtained from HOMES. Other independent variables are assumed to be constant at their mean values over the entire projection period. The sum of the product of the regression coefficients and the projected values of independent variables give us the future housing characteristics reported in Table 13.

The percentage of detached house and other type of houses are projected to increase marginally by one percent each over the 1980-2015 period. Percentage share of row houses will decline by 2 percent over the same period. These results imply that changes in demographic variables will have only marginal effect on the housing characteristics. Changes in economic factors such as income (as measured by TVREF) and occupation will be the important determinants of housing characteristics because the magnitude of these coefficients is the largest.

There is also no significant change in the type of construction materials and the number of bedrooms or rooms used for sleeping purpose over the 1980-2015 period if only demographic variables are allowed to change. Again construction materials used will be largely affected by changes in income, occupational structure and employment status because of the relatively large size of their coefficients.

However, the projected results show that there are significant changes in the use of bathroom and type of toilet. Over the projection period, exclusive use of bathroom jumped from 29 percent to 35 percent while shared use of bathroom declined to 65 percent.

Between 1980 to 2015, the percentage share of flush toilet and latrine toilet will increase by 3 percent and 6 percent,

respectively. The other type of bathrooms will decline by 10 percent over the same period.

We can conclude that, first, the demographic variables have significant effects on the exclusive use of bathroom and type of toilet, but not on other type of housing characteristics. Secondly, it seems that changes in economic factors will have more influence upon the demand for housing characteristics. Thirdly, since our projection still ignore price variable, it is possible that changes in prices, such as increase in price of wood will have significant effect on the type of construction materials and type of housing characteristics demanded in the future.

4. The Construction Sector

Before discussing the impacts of construction expenditures on the economy, a brief discussion of the construction sector will be presented.

4.1 Overview of the Construction Sector

The construction sector is the sixth largest economic sector in term of GDP. In 1984, its GDP share was 5.3 percent comparing to 6.1 percent in 1970. According to the Labor Force Survey, this sector exmploys approximately 0.53 million workers or about 2.5 percent of

total employment in 1984. The employment share is surprisingly low comparing to the GDP share of the construction sector. This is partly because a large number of construction workers go back to their farming activity in the wet season. In the dry season (January-March), employment in the construction sector increased by 0.22 million persons, while total employment shrinked by 3.7 million. So employment share of the construction sector is 3.4 percent. Moreover, a large number of farmers are also part time workers in the construction sector. Most of them learn the construction skill from their parents and their own experience.

Investment in the construction sector as measured by gross capital formation (GCF) was 95,800 million baht or 47 percent of GCF in 1984. About 50% of the construction investment is public investment. This is a normal phenomena for a developing country like Thailand where the government assigns high priority to its development projects.

Within the construction sector, residential construction is the largest subsector. In 1984, total residential construction expenditure was 31 million baht or 32 percent of total construction expenditures. The percentage share of residential construction expenditure has been fluctuating from the highest level of 42% in 1961 to the lowest level of 20.5 percent in 1979. Fluctuations in construction expenditure and gross capital formation can be explained by the growth rates of GDP shown in Appendix 8. For example, the decline

in the construction expenditures in 1979 and 1982 coincided with the decreases in the growth rate of GDP from 9% in 1977 to 5.8% in 1979 and from 6.1% in 1981 to 4.1% in 1982.

Residential construction also varies directly with economic growth as can be seen from data in Appendix 8. Moreover, during 1984-1986 when the long-term nominal lending interest rate was at the highest level of 16% - 17%, residential construction particularly investment by the real estate companies was stagnant. Since late 1986, interest rate has come down to the level of 12% to 13%, residential construction has picked up rapidly. As a consequence, prices of construction materials have gone up.

Unlike Indonesia and Korea, Thailand has not experienced severe housing shortages. Although the economy has been growing at the very high rate since 1960, it was not until early 1970's when the private housing market started to expand. This is probably caused by the high value of income elasticity of demand for housing. The growth of the supply of housing was not impeded by any government regulations because the government is always too slow to legislate laws and regulations. The rapid increase in the number of condominium in the early 1980's also caused public concern because they are not subject to special regulations, especially fire control.

Although there are not many large real estate companies, there are a large number of small companies in the housing market.

Prices are very competitive and always reflect the quality of the houses sold. Small company can easily get loan from the commercial bank and develop a small piece of land on which 50-100 town-houses can be built. The prices of one unit of a two-storey townhouse on a 6 x 10 meters plot of land can vary from ฿ 150,000 to ฿ 1,000,000 depending upon the location and quality.

Most of the houses in Bangkok built by the real estaste companies are in the suburb areas especially in the eastern part and along the highway to the North where the government provides relatively better public utilities and social infrastructure.

There are two other factors that make it possible for the rapid growth of the housing market. The first factor is the rapid population growth in the 1960-1975 period. Bangkok has probably experienced the highest rate of growth due to rural-urban migration. The second factor is that Thailand did not have the problems of shortages of construction workers and construction materials, especially wood and cement. Although there were temporary shortage of cement in the late 1970's due to price control, Thailand has now become an exporter of cement after the price control was lifted in 1979. Even though there are a few large suppliers of construction materials, especially the Siam Cement group, competition from small local producers is very strong. Such competition helps keep down the cost and price of houses.

The housing sector has also benefited from the abundant supply of forest. In the recent years, prices of wood products have been increasing rapidly in response to increasing shortages. However, wood products are still major construction materials in Thailand.

The above discussion does not mean that Thailand does not have housing problems. One of the important problems in the housing market is finance. Table 14 shows the distribution of loan made by the commercial banks and the finance companies. Their major business is in the sectors of manufacturing and trade. Housing mortgage loan represents only 3.2% of commercial bank loan and only 2.8% of the finance company loan. Since the interest rates charged to different loan types are slightly different, and returns to loan for manufacturing and trade are relatively higher, commercial banks are not very keen at expanding housing loan. Although more than 50% of housing loan, or ฿ 17 million in 1985 (see Table 14), is provided by the commercial banks, only a few banks are serious in providing housing loan to their customers.

It is also apparent that most finance companies are not interested in providing mortgage loan. Less than 3% of their loan is for mortgage because rate of return to housing loan is lower than other sectors. And yet they provide as high as 11% of loan to the real estate development projects.

According to Table 15, the second largest supplier of housing credit is the Government Housing Bank. However, its credit expansion is severely limited by the regulations of the Finance Ministry and bureacratic procedures.

Credit fonciers and the NHA which should play active role in housing mortgage are not important actors in the housing market. Most of the loan of the credit fonciers is for other activities which are more profitable than housing loan. Due to regulations on promissory notes the credit fonciers' cost of capital is 2% - 3% higher than that of the commercial banks. This forces them to provide loans to the sectors that they can charge higher interest rate (based on a flat rate basis where interest does not decline with the amount of principal owed), e.g. rental purchase. They cannot charge the same high rate of interest for mortgage loan because the interest cost will be too high for the consumers.

There are two major constraints that limit the role of the financial institutions in housing loan activities (Prasart Tangmatitham 1987). First, while credit fonciers (or building societies or Savings and Loan Association) in developed countries can mobilize short term capital, those in Thailand are required to raise their fund by issuing long-term notes (at least one year maturity). As a result, their capital cost is higher than that of commercial banks because long-term interest rate is higher. But they have to charge the same competitive

loan rate for their mortgage loan. Secondly, the Government Housing Bank's lending rate is 1% - 2% lower than other financial institution. This is in fact a subsidy for its customers. Moreover, depositors at the GHB are exempted from tax on interest income. But those who obtain mortgage loan from other institutions are not subsidized. Since the objective of the GHB is to help the poor to secure mortgage loan, the subsidy should be limited only to poor customers. Elimination of interest subsidy except the low income customers will allow the finance companies and credit fonciers to expand their role in mortgage loan.

In the urban area there are problems of poor and unsanitated housing especially in the slum areas which have been expanding as a result of urbanization and large number of in-migrants. This is probably one of the reason many rural migrants migrate only temporarily to Bangkok. Although the National Housing Authority (NHA) has attempted to solve the problems by building low cost apartment for them, the projects are not very successful. First, many slum dwellers cannot afford the low cost apartment. Secondly, the NHA only build a small number of houses in each year. Finally, many people resell their apartment either because they get good price or because their workplace is too far from their new house. Realizing the last problem, the NHA has now begun to initiate joint projects with the large-scale private companies or public agencies. The projects are to buy the land close

to the companies or government offices and build the low-cost houses and sell them to the employees of those agencies. So far, there have been only a few of this kind of projects.

In the rural area, there seems to be no serious housing problems in term of the place to live. But it is usually observed that most of the rural houses are of low quality. They are made of reused materials, palm leaves and bamboo rods which have short live. Young couples usually build a bamboo hut in their farm and will begin to build a new and stronger house once they have enough saving. In every part of the country, farmers will start building or renovating their houses in the summer when they are free from farm activities. This is why most construction workers in the city come from the rural areas, especially from the Northeast and the North where wood is abundant and they have carpenter skill. However, it should be noted that in the last few years there are a large number of new houses of modern style which are built of high quality material made in the city. In the Northeast, it is the money earned from the Middle East that enables the rural inhabitants to enjoy luxurious houses. In other regions, especially in the Central Plain it may be because of the rising income of farm households due to the facts that Thai farmers have rapidly diversify their produces in such a way as to benefit from the world market.

4.2 Impacts of Construction Expenditures

Appendix 10 presents the fixed price multipliers (Ma) obtained from equation (2). The exogeneous variables in the equation are government, tourist, rest of the world (export) and capital since Thailand is a small open economy.

Since the data do not allow us to obtain a separate account for the residential construction expenditure, the account of construction will be used to estimate the impacts of changes in residential construction expenditures on the economy.

Table 16 presents part of the fixed price multipliers obtained from Appendix 10. The general conclusion drawn from the table is the relative constancy of multipliers along rows of the table. For example, an injection of 100 baht into any activity results in a fixed price multiplier effect on the construction sector. The effect is in a range of 5.96 to 1.02 baht. The implication is that the second- and third-order effects on the economy[6] are largely independent of the structure of demand. The homogeneity of higher-order effects is also important for the structure of employment and income distribution. Table 17 shows that whichever activity, except the government sector, might be expanded, hired labor income multipliers are in the range of 0.26 to 0.40.

An injection into any activity will produce the largest effect on the income of those with primary education. The effects on the income of people with more than primary education are relatively small no matter which activity is expanded. The exception is the government sector which is the largest employers of educated persons.

Comparing with other sectors, an injection into the construction section will produce the second largest size of multiplier (2.69) as shown in Table 16. The multiplier on the industrial sector (1.33) is the largest one. However, the expansion of the construction sector will also lead to a large increase in import with a multiplier of 0.4885 which is only second to the import multiplier of the expansion of the state enterprise (0.6794).

In term of forward linkages, the construction sector has strong forward linkage effect on the industrial (1.367), the agricultural (1.0) and the service (0.965) sectors. If we read along the diagonal of the lower part of Table 10, it can be seen that the construction sector has the second largest forward linkages (9.08) on itself after the government sector (12.68).

However, the results in Table 13 shows that the construction sector has small backward linkages with other sectors. The values of the linkages, except the linkage on itself (6.887), are between 0.47 and 0.61.

Table 17 shows that an injection into the construction sector will produce the fourth largest multiplier on the income of hired labor (0.3609) and own-account workers (0.3087), but will have the second largest multiplier (0.80) on the income of the capital owners. Expansion of the government sector will have largest impact on hired labor income (1.116), while the agricultural expansion will produce highest impact on the income of own-account workers. Income of the capitalists will be increased by the largest size if the service sector is stimulated.

Table 17 also allows us to consider the impact of construction expansion on the income of various groups of persons broken down by educational level and occupation. The table shows that if the construction sector is stimulated, persons who have only primary education or lower will have highest increase in their income regardless of the sources of income, (i.e. wage income, own-account workers' income or capital income). The higher the education level, the lower the multiplier is.

The expansion of the construction sector tends to increase income of the blue collar workers (OC4) who are hired labor more than other occupation groups. But for own-account workers, the income effects on each occupation subgroups depend upon their educational levels. For example, if the persons have primary education, those who are in the service occupation (OC3) will have highest income in

their income. For college graduate, the highest multipliers are in the professional and management (OC1) and clerks (OC2).

The construction expansion has the largest impact on the income of corporations (0.32) and the second largest impact is on the capital income of those in the non-agricultural sector (0.0428). Farmers also share relatively high benefit from the expansion of this sector with the multiplier of 0.0379.

5. Conclusion

This study employed a more refined method of headship rate to forecast the number of households in the year 1985-2015. The method basically classifies families into 4 types : namely the intact households, the households in which the spouse is not present, the primary individual households, and the one-person households.

The results show that although housing inventory and housing starts increase throughout the projection period, the growth rates of housing inventory and housing starts during the projection period will be slower than those in the 1950-1980 period. Though housing starts will peak in 2010, the greatest increases - in absolute terms- will be between 1985 and 1990. These results are not surprising since Thailand has already been experiencing a rapid decline in fertility since the mid 1970's. If the forecast were correct and other things remained the same, the decline in the changes in housing

starts would lead to economic downturn. However, from the optimistic viewpoint, the decreasing increments of housing starts could be interpreted differently, i.e., relatively less resources would be needed in order to provide the same level of existing housing standard to the future population. Hence more resources can be diverted to other uses including better quality housing in the future.

Different assumptions about income elasticity of housing demand and income growth are also employed in the projections. Comparing with the base projection where income elasticity is zero, the results show that income growth and degree of income elasticity will be important factors stimulating the growth of the residential construction sector.

Data on housing quality from two censuses — 1970 and 1980 — reveal that there were substantial improvements in housing quality. Since HOMES also projects smaller household size, higher proportion of households with heads aged 35-49 years, and larger proportion of older family members, these demographic factors will certainly affect the type and quality of housing starts that will be demanded in the next 30 years.

The growth of the residential construction sector is discussed in the report. Factors contributing to and hindering growth are identified. The favorable factors include the well-functioning of the private housing sector with minimal government

regulations and abundance of supply of construction materials as well as skilled construction workers. Government regulations of the finance companies and credit fonciers are perhaps the most important factor constraining the expansion of the mortgage loan. Poverty in the urban slum areas and rural areas is still the major cause of poor housing.

Using the social accounting matrix in 1981, it is found that an injection into the construction sector will produce the second largest size of output multiplier. The expansion of the construction sector will also lead to large increase in import and hence negative balance of trade. The expansion of the construction sector will produce largest benefit for hired labor and own account workers and those with primary education, and those who are blue collar workers. Farmers and corpor te owners will also tend to benefit from the expansion of the construction sector.

It should be noted that the report has some short comings. First, the projections assume constant headship rates. Changes in age composition as a result of fertility decline will affect relative incomes of different age groups which, in turn, will after headship rates and, hence, household formation. But such feedback effects on the headship rates are ignored in this study. Other effects of economic growth on the rate of household formation in different age groups are also not considered in this report. Secondly, the study

does not construc a housing market model where price plays the equilibrating role. Hence, adjustments arising from housing shortages and surplus are ignored.

However, it is our belief that the projections give us the minimum number of housing starts to be built and minimum amount of residential construction expenditures in the future. In the next few decades, moderate economic growth and urbanization are expected. Experience from other countries show that as per capita income increases and mortgage market expands, young people who start their new households can afford to buy their own houses instead of doubling up with their parents. Industrialization and urbanization may also affect the withdrawal rate as there are needs to develop more areas in the city for commercial as well as residential purposes. Shifts in age composition as a result of further decline in fertility will result in the higher growth rate of adult population aged 30-64 relative to that of younger population. This will, in turn, lead to higher headship rate and hence more housing starts.

Footnotes

1. See B.O. Campbell, Population change and Building Cycles, (Urbana, Illinois : University of Illinois, 1966), Bulletin Series Number 91, pp. 1-2.

2. Assuming that the desi ed vacancies equal the actual vacancies results in zero unwanted vacancies.

3. ESCAP, U.N., Statistical Yearbook for Asia and the Pacific 1979, Table 56, p. 502.

4. We did not make use of the occupied housing data because one of the officers at the National Economic and Social Development Board told us that the data is significantly underestimated. For instance, in 1965, 1970 and 1980 the number of occupied housing units reported are 4.93, 5.61 and 7.55 million units, respectively while our corresponding estimates below are 5.43, 6.22 and 8.73 million units.

5. One dollar is approximately 27.5 baht in 1985.

6. The second and third-order effects are the consequences of the circular flow of income within the economy. The second-order effects are the cross effects of the multiplier process whereby an injection into the system has a repercussions on other parts. The third-order effects are the full circular effects of an income injection.

Table 1
Share of Total Construction and Residential Construction in GCF and GDP Growth

Year	C/GCF	RC/GCF	GDP Growth (% p.a.)
1960-1970	42.57	13.32	7.6
1970-1980	38.92	10.03	6.7
1980-1984	45.14	13.03	5.4

Note: C = total construction expenditure
RC = residential constuction expenditure
GCF = gross capital formation

Table 2 : Number of Households

Year	Intact Households	Single Headed Households Male	Single Headed Households Female	Primary Households Male	Primary Households Female
1980	6,778,775	406,500	1,124,423	42,567	26,086
1985	7,985,033	475,158	1,310,767	50,300	30,516
1990	9,394,088	555,652	1,535,092	58,313	35,273
1995	10,938,232	646,303	1,798,575	65,338	39,851
2000	12,508,036	748,325	2,101,307	70,614	43,462
2005	14,027,948	863,248	2,444,292	75,251	47,163
2010	15,421,020	992,857	2,820,844	78,694	50,334
2015	16,584,492	1,133,698	3,224,299	80,638	52,792

Year	One Person Households Male	One Person Households Female	All Households	Households Population (1,000's)	Average Household Size
1980	154,063	156,728	8,689,142	46,016	5.30
1985	180,848	192,077	10,214,699	50,902	4.98
1990	211,479	211,470	12,001,367	55,498	4.62
1995	242,956	245,952	13,977,207	59,638	4.27
2000	274,343	284,208	16,030,295	63,502	3.96
2005	306,180	326,688	18,090,770	67,006	3.70
2010	338,351	372,084	20,074,184	69,960	3.49
2015	370,781	422,979	21,969,679	72,397	3.31

Table 3
Age Distribution of Household Heads

Year	Age of Head 15-34	35-49	50-64	65+
1960	31.0	37.0	23.6	8.5
1980	30.3	36.3	23.6	9.8
2000	26.6	39.3	24.1	10.0
2015	19.8	37.2	30.6	12.4

Table 4 : Projected Housing Inventory, Withdrawals and Starts
(a) Using the 1970 Census Headship Rates (Av=0.02, Aw=0.01)

Year	Household Number (HHF) (1)	Af (2)	Housing Inventories (HI) (3)	Required Additions (RA) (4)	Withdrawals (W) (5)	Housing Starts (HS) (6)
1950	3,449,000	0.9894	3,480,689			
1955	4,046,000	0.9894	4,083,175	602,485	348,069	950,554
1960	4,734,000	0.9894	4,777,496	694,321	408,317	1,102,639
1965	5,423,000	0.9889	5,470,061	692,565	477,750	1,170,314
1970	6,211,000	0.9885	6,262,365	792,304	547,006	1,339,310
1975	7,354,000	0.9880	7,411,067	1,148,702	626,236	1,774,939
1980	8,718,000	0.9874	8,780,316	1,369,249	741,107	2,110,356
1985	10,250,000	0.9868	10,316,994	1,536,678	878,032	2,414,709
1990	12,011,000	0.9862	12,082,153	1,765,159	1,031,699	2,796,859
1995	13,903,000	0.9855	13,975,435	1,893,281	1,208,215	3,101,497
2000	15,801,000	0.9847	15,870,430	1,894,995	1,397,543	3,292,538
2005	17,681,000	0.9839	17,744,263	1,873,833	1,587,043	3,460,876
2010	19,412,000	0.9831	19,465,616	1,721,353	1,774,426	3,495,780
2015	20,941,000	0.9821	20,977,479	1,511,863	1,946,562	3,458,425

Note : (1) Following assumptions are used : (a) vacancy ratio =0.04; (b) Factor adjusting household formations to the number of housing units required per household formation = 0.9894 in 1950-60, 0.9885 in 1970, 0.9874 in 1980 , 0.9862 in 1990 and 0.9847 in 2000 and 0.9821 in 2015 (see appendix 3) ; and(c) withdrawal rate is 0.02

(2) Col 3 = HHF*Af*(1+av)

(3) Col 4 = first difference of col 3 = change RHS

(4) Col 5 = col 3*aw*5years

(5) Col 6 = col 4 + col 5

Table 4 : Projected Housing Inventory, Withdrawals and Starts

(b) Using the 1980 Census Headship Rates (Av=0.02, Aw=0.01)

Year	Household Number (HHF) (1)	Af (2)	Housing Inventories (HI) (3)	Required Additions (RA) (4)	Withdrawals (W) (5)	Housing Starts (HS) (6)
1950	3,419,000	0.9894	3,450,414			
1955	4,015,000	0.9894	4,051,890	601,476	172,521	773,997
1960	4,701,000	0.9894	4,744,193	692,303	202,594	894,897
1965	5,387,000	0.9889	5,433,748	689,556	237,210	926,765
1970	6,172,000	0.9885	6,223,042	789,294	271,687	1,060,981
1975	7,310,000	0.9880	7,366,726	1,143,683	311,152	1,454,835
1980	8,689,142	0.9874	8,751,252	1,384,526	368,336	1,752,863
1985	10,214,699	0.9868	10,281,462	1,530,210	437,563	1,967,773
1990	12,001,367	0.9862	12,072,463	1,791,001	514,073	2,305,074
1995	13,977,207	0.9855	14,050,028	1,977,565	603,623	2,581,188
2000	16,030,295	0.9847	16,100,732	2,050,704	702,501	2,753,205
2005	18,090,770	0.9839	18,155,499	2,054,767	805,037	2,859,803
2010	20,074,184	0.9831	20,129,629	1,974,130	907,775	2,881,905
2015	21,869,679	0.9821	21,907,776	1,778,147	1,006,481	2,784,629

Note : (1) Following assumptions are used : (a) vacancy ratio =0.02; (b) Factor adjusting household formations to the number of housing units required per household formation = 0.9894 in 1950-60, 0.9885 in 1970, 0.9874 in 1980 , 0.9862 in 1990 and 0.9847 in 2000 and 0.9821 in 2015 (see appendix 3) ; and(c) withdrawal rate is 0.01

(2) Col 3 = HHF*Af*(1+av)

(3) Col 4 = first difference of col 3 = change RHS

(4) Col 5 = col 3*aw*5years

(5) Col 6 = col 4 + col 5

Table 4 : Projected Housing Inventory, Withdrawals and Starts
(c) Using the 1980 Census Headship Rates (Av=0.04, Aw=0.02)

Year	Household Number (HHF) (1)	Af (2)	Housing Inventories (HI) (3)	Required Additions (RA) (4)	Withdrawals (W) (5)	Housing Starts (HS) (6)
1950	3,419,000	0.9894	3,518,069			
1955	4,015,000	0.9894	4,131,339	613,270	351,807	965,077
1960	4,701,000	0.9894	4,837,216	705,878	413,134	1,119,011
1965	5,387,000	0.9889	5,540,292	703,076	483,722	1,186,798
1970	6,172,000	0.9885	6,345,063	804,770	554,029	1,358,800
1975	7,310,000	0.9880	7,511,171	1,166,108	634,506	1,800,615
1980	8,689,142	0.9874	8,922,845	1,411,674	751,117	2,162,791
1985	10,214,699	0.9868	10,483,060	1,560,214	892,285	2,452,499
1990	12,001,367	0.9862	12,309,178	1,826,118	1,048,306	2,874,424
1995	13,977,207	0.9855	14,325,519	2,016,341	1,230,918	3,247,259
2000	16,030,295	0.9847	16,416,433	2,090,914	1,432,552	3,523,466
2005	18,090,770	0.9839	18,511,489	2,095,056	1,641,643	3,736,699
2010	20,074,184	0.9831	20,524,328	2,012,839	1,851,149	3,863,987
2015	21,869,679	0.9821	22,337,340	1,813,013	2,052,433	3,865,445

Note : (1) Following assumptions are used : (a) vacancy ratio =0.02; (b) Factor adjusting household formations to the number of housing units required per household formation = 0.9894 in 1950-60, 0.9885 in 1970, 0.9874 in 1980 , 0.9862 in 1990 and 0.9847 in 2000 and 0.9821 in 2015 (see appendix 3) ; and(c) withdrawal rate is 0.01

(2) Col 3 = HHF*Af*(1+av)

(3) Col 4 = first difference of col 3 = change RHS

(4) Col 5 = col 3*aw*5years

(5) Col 6 = col 4 + col 5

Table 5 Selected Key Housing/Demographic Ratios 1960-2015

Year	RA/dHP %	dHP/dP %	RA/dP %	RA/HS %	HS/dHP %	HS/beginning HP %
1960-65	29.1%	51.1%	14.9%	74.4%	39.1%	6.2%
1965-70	28.5%	50.5%	14.4%	74.4%	38.4%	6.1%
1970-75	33.1%	75.6%	25.0%	78.6%	42.1%	7.3%
1975-80	30.7%	78.2%	24.0%	79.0%	38.8%	7.5%
1980-85	32.0%	100.0%	32.0%	77.8%	41.2%	7.0%
1985-90	37.8%	104.1%	39.4%	77.7%	48.7%	7.0%
1990-95	42.8%	110.8%	47.5%	76.6%	55.9%	6.9%
1995-00	47.3%	111.8%	53.0%	74.5%	63.6%	6.5%
2000-05	49.2%	120.3%	59.1%	71.8%	68.4%	6.2%
2005-10	54.4%	125.7%	68.3%	68.5%	79.4%	5.7%
2010-15	55.1%	141.0%	77.6%	63.9%	86.2%	5.1%

Source: Calculate from table in Appendix 7

Table 6
Residential Construction Expenditures in Relation to
Forecasted GDP and GCF, 1970-2015

Quinquennium	REX/GDP (actual) (1)	REX1/GDP (Ey=0) (2)	REX2/GDP (Ey=1,g=4) (3)	REX3/GDP (Ey=1,g=5) (4)	REX/GCF (actual) (5)	REX1/GCF (Ey=0) (6)	REX2/GCF (Ey=1,g=4) (7)	REX3/GCF (Ey=1,g=5) (8)
1970-74	0.028	0.033	0.033	0.033	0.113	0.132	0.132	0.132
1975-79	0.025	0.028	0.034	0.035	0.095	0.108	0.131	0.137
1980-84	0.029	0.023	0.034	0.037	0.130	0.103	0.153	0.168
1985-89		0.020	0.037	0.042		0.100	0.180	0.207
1990-94		0.017	0.038	0.046		0.083	0.182	0.220
1995-99		0.014	0.037	0.047		0.065	0.172	0.219
2000-04		0.011	0.035	0.046		0.049	0.159	0.212
2005-09		0.008	0.032	0.044		0.036	0.142	0.199
2010-14		0.006	0.028	0.041		0.025	0.122	0.179

Source: Calculated from (1) GDP and GCF data in appendix 8 and (2) Rex in appendix 9

Note: (1) REX = actual real residential construction expenditure
(2) Ey = income elasticity of demand for housing
(3) g = growth rate of per capita GDP
(4) REX1-REX3 = predicted real residential construction expenditure under various assumptions about Ey and g
(5) GCF = real gross capital formation

Table 7 Private Households by Type of Living Quarters

Type of Quarter	1970 (Number)	1970 (Percent)	1980 (Number)	1980 (Percent)
Detached House	1,632,172	79.26	7,172,247	85.24
Duplex	0	0.00	137,453	1.63
Row House	369,214	17.93	890,762	10.59
Apartment	12,389	0.60	65,850	0.78
Room	32,785	1.59	51,322	0.61
Mobile	3,428	0.17	4,469	0.05
Other & Unknown	9,387	0.46	92,545	1.10
Total	2,059,375	100.00	8,414,648	100.00

Source : NSO. Population & Housing Census 1970, 1980

Table 8 Private Households by Type of Construction Materials

Construction Materials	1970 (Number)	1970 (Percent)	1980 (Number)	1980 (Percent)
Cement of Brick	124,102	6.06	534,039	6.35
Wood and Cement	78,780	3.85	509,973	6.06
Wood	1,349,617	65.95	5,888,114	69.97
Local Materials	413,865	20.22	1,273,284	15.13
Reused Materials	62,282	3.04	74,332	0.88
Unknown	17,914	0.88	134,967	1.60
Total	2,046,560	100.00	8,414,709	100.00

Source : NSO. Population & Housing Census 1970, 1980

Table 9 Private Households by Sources of Water Supply, Lighting, Type of Bathroom and Kitchen

Type	1970 (Number)	1970 (Percent	1980 (Number)	1980 (Percent
Source of Water Supply	2,046,560	100.00	8,410,989	100.00
Piped inside	436,677	21.34	1,305,437	15.52
Piped outside	166,185	8.12	286,180	3.40
Others & Unknown	1,443,698	70.54	6,819,372	81.08
Lighting	2,046,560	100.00	8,411,119	100.00
Electric Lighting	766,633	37.46	3,615,019	42.98
Pressure Lamp	0	0.00	57,327	0.68
Oil Lamp	0	0.00	4,608,031	54.78
Other & Unknown	1,279,927	62.54	130,742	1.55
Bathrooms	0	0.00	8,411,050	100.00
Exclusive	0	0.00	3,213,187	38.20
Shared	0	0.00	224,406	2.67
Terrace/Verandah	0	0.00	2,233,781	26.56
Others & Unknown	0	0.00	2,739,676	32.57
Toilet Facility	2,046,560	100.00	8,410,940	100.00
Flush, Exclusive	41,470	2.03	318,627	3.79
Flush, Shared	6,735	0.33	37,810	0.45
Moulded Bucket Latrine, Exclusive	777,288	37.98	3,838,810	45.64
Moulded Bucket Latrine, Shared	143,420	7.01	394,648	4.69
Pit	0	0.00	790,264	9.40
Others & Unknown	1,077,647	52.66	3,030,781	36.03

Source : NSO. Population & Housing Census 1970, 1980

Table 10

Housing Characteristics

Characteristics	Definition of Dependent Variable
1. Type of living quarters	
*1.1 Detached house (DETACHED)	1 if detached house
	0 otherwise
1.2 Duplex house (DUPLEX)	1 - 0
1.3 Apartment (APT)	1 - 0
*1.4 Row house (ROW)	1 - 0
1.5 Room house (ROOM)	1 - 0
2. Number of bed-rooms	
*2.1 Bed-rooms (BEDROOMS)	No. of bedrooms in the house
*2 2 Other-rooms (OTHERRMS)	No. of other rooms used for sleeping
3. Construction materials	
*3.1 Cement (CEMENT)	1 if a house is made of cement
	0 otherwise
*3.2 Wood and cement (WOODCEM)	1 - 0
*3.3 Wood (WOOD)	1 - 0
*3.4 Local materials (LOCALMAT)	1 - 0

Table 10 (Cont.)

Characteristics	Definition of Dependent Variable
4. Type of toilet & bathroom	
*4.1 Flush toilet (FLUSH)	1 - 0
*4.2 Latrine toilet (LATRINE)	1 - 0
*4.3 Exclusive use of bathroom (BATHROOM)	1 - 0
4.4 Exclusive use of kitchen (KITCHEN)	1 - 0

* Indicate equations used for projection

Table 11

Definition of Independent Variables

Name	Definition	Unit
Demographic factor		
HDAGE	age of head	years
HDAGE	age of head squared	years
HDSEX	sex of head	1 if male ; 0 if female
Household type		
ONEHH	one-person household	1 - 0
SHEAD	single head household	1 - 0
Education		
HDEDPRIM	head has primary education	1 - 0
HDEDSEC	head has secondary education	1 - 0
HDEDCOL	head has college education (reference group is no education)	1 - 0
Head's status		
BOSS	head is an employer	1 - 0
GOVT	head is a government employee	1 - 0
PRIV	head is a private employee (reference group is self-employed persons and unpaid family workers)	1 - 0

Table 11 (Cont.)

Name	Definition	Unit
Head's occupation		
PROF	head is a professional worker	1 - 0
MANAG	head is a blue collar worker	1 - 0
WHITE	head is a white collar worker	1 - 0
	(reference group is farmer)	
Family size		
M 0 T 5	Number of family members aged 0 - 5 years	No. of persons
M 6 T 14	Number of family members aged 6 - 14 years	No. of persons
M 15T 29	Number of family members aged 15 - 29 years	No. of persons
M 30T 59	Number of family members aged 30 - 59 years	No. of persons
M 60 UP	Number of family members aged 60 and over	No. of persons
Proxy for asset		
TVREF	a household has a set of TV or refrigerator	1 - 0
Other variables		
URBAN	a household lives in the urban area	1 - 0

Table 12

Means and SD in the Regressions of Housing Characteristics

Name	Means	SD	Minimum	Maximum
DETACHED	0.881	0.324	0	1
DUPLEX	0.017	0.130	0	1
ROW	0.090	0.286	0	1
APT	0.006	0.076	0	1
ROOM	0.006	0.075	0	1
CEMENT	0.054	0.226	0	1
WOODCEM	0.061	0.239	0	1
WOOD	0.720	0.449	0	1
LOCALMAT	0.157	0.364	0	1
BEDROOMS	1.682	0.896	0	7
OTHERRMS	0.543	0.717	0	7
BATHROOM	0.403	0.491	0	1
KITCHEN	0.780	0.414	0	1
FLUSH	0.037	0.188	0	1
LATRINE	0.510	0.500	0	1
HDAGE	44.726	14.547	0	99
HDSEX	0.838	0.369	0	1
HDEDPRIM	0.708	0.455	0	1
HDEDSEC	0.076	0.265	0	1
HDEDCOL	0.029	0.169	0	1

Table 12 (Cont.)

Name	Means	SD	Minimum	Maximum
URBAN	0.155	0.362	0	1
M 0 T 5	0.710	0.864	0	7
M 6 T 14	1.228	1.294	0	8
M 15T 29	1.522	1.346	0	11
M 30T 59	1.396	0.892	0	12
M 60 UP	0.311	0.611	0	10
ONLHH	0.032	0.176	0	1
SHEAD	0.037	0.189	0	1
TVREF	0.219	0.414	0	1
BOSS	0.004	0.060	0	1
GOVT	0.084	0.278	0	1
PRIV	0.112	0.316	0	1
PROF	0.030	0.170	0	1
MANAG	0.019	0.138	0	1
BLUE	0.119	0.324	0	1
WHITE	0.106	0.308	0	1
HDAGE 2	2,211.991	1,446.559	0	9,801

Table 13

Projections of Housing Characteristics

(Percent)

Characteristics	1980	1985	2005	2015
1. Living quarters (%)				
- Detached house	88	88	88	89
- Row house	9	9	8	7
- Other house	3	3	4	4
2. Construction material (%)				
- Cement	5	6	7	8
- Wood & Cement	6	6	8	8
- Wood	71	71	70	70
- Local materials	16	16	14	13
- Others	1	1	1	1
3. Bathroom use (%)				
- Exclusive use	29	31	35	35
- Shared use	71	69	65	65
4. Type of Toilet (%)				
- Flush	4	4	6	7
- Latrine	50	51	55	56
- Others	47	45	39	37
5. No. of Bedrooms (No.)				
- Bedrooms	1.68	1.68	1.64	1.64
- Other rooms for sleeping	0.55	0.53	0.48	0.47

Note: Figures do not add up to 100 percent due to rounding error.

Table **14**
Distribution of Loan by Economic Sectors
(31 December 1985)

(Percent)

Sector	Commercial Bank	Finance Companies
Agriculture and Mining	8.0	1.7
Industry	23.1	23.9
Construction	5.5	5.3
Real Estate Development	3.6	11.1
Foreign Trade	14.9	6.0
Domestic Trade	23.0	15.2
Financial Institutions	6.2	10.6
Service	5.1	9.0
Mortgage Loan	3.2	2.8
Rental Purchase	5.4	13.4
Others	2.0	1.0
Total	100.0	100.0

Source : Finance Unit , Bank of Thailand

Table 15
Source of Housing Mortgage Loan

Institutions	1981	1983	1984
Commercial Bank	7,063	12,733	16,998
Bank of Housing	6,497	6,337	7,846
Credit Companie	1,481	1,867	2,763
National Housin	1,402	1,675	1,474
Insurance Compa	565	875	1,390
Credit Fonciers	482	516	388
Others	646	647	784

Source : (1) Finance Unit , Bank of Thailand
(2) Prasart Tangnatitham , Financial Institutions in some countries and Implications on the Housing Credit Policy in Thailand, research report, Faculty of Economics, Thammasat University ,1987.

Note : e = estimated by Prasart Tangmatitham.

Table 16 Output Multiplier

	Agriculture	Industry	Construction	Service	Government	State Enterprise
Import	0.4401	0.4857	0.4885	0.3882	0.4190	0.6794
Agriculture	0.4963	0.5207	0.3709	0.3275	0.3555	0.1978
Industry	1.1622	0.8615	1.3316	0.9645	1.0334	0.7230
Construction	0.0996	0.0638	0.0688	0.0897	0.1019	0.0596
Service	0.5244	0.3231	0.3930	0.0459	0.5254	0.2113
Government	0.0599	0.0347	0.0393	0.0475	0.0565	0.0205
State Enterprise	0.3005	0.3074	0.2646	0.2766	0.3478	0.3793
Total (17 Sectors)	2.7824	2.2994	2.6922	2.2832	2.4917	1.8916

Table 17 Impacts of One Unit Increase in Final Demand of Various Sectors

Factors	Agriculture	Industry	Construction	Service	Government	State Enterprise
Hired Labor	0.2977	0.3002	0.3609	0.4089	1.1164	0.2578
1. Primary Education	0.1333	0.2129	0.2576	0.2477	0.4431	0.1862
OC1	0.0089	0.0063	0.0090	0.0135	0.0591	0.0046
OC2	0.0197	0.0156	0.0207	0.0351	0.0317	0.0126
OC3	0.1137	0.0366	0.0264	0.0236	0.0346	0.0140
OC4	0.1439	0.1544	0.2015	0.1755	0.3177	0.1550
2. Secondary Education	0.0453	0.0367	0.0455	0.0649	0.2032	0.0323
OC1	0.0105	0.0076	0.0095	0.0160	0.0618	0.0074
OC2	0.0171	0.0138	0.0153	0.0289	0.0531	0.0108
OC3	0.0022	0.0008	0.0006	0.0006	0.0019	0.0006
OC4	0.0155	0.0145	0.0201	0.0194	0.0864	0.0135
3. Vocational Education	0.0397	0.0292	0.0334	0.0535	0.3403	0.0203
OC1	0.0213	0.0133	0.0156	0.0237	0.2774	0.0088
OC2	0.0145	0.0115	0.0129	0.0253	0.0419	0.0080
OC3	0.00015	0.00005	0.00004	0.00003	0.00003	0.00002
OC4	0.0037	0.0033	0.0049	0.0045	0.0210	0.0035
4. College Education	0.0276	0.0224	0.0243	0.0427	0.1297	0.0190
OC1	0.0240	0.0191	0.0208	0.0371	0.1178	0.0167
OC2	0.0029	0.0023	0.0026	0.0049	0.0042	0.0020
OC3	0.0002	0.00060	0.00004	0.00004	0.00004	0.00002
OC4	0.0006	0.0004	0.0009	0.0007	0.0077	0.0003
Own Account Workers	0.8761	0.3449	0.3044	0.3642	0.2753	0.1505
1. Primary Education	0.1707	0.3242	0.2796	0.3211	0.2528	0.1386
OC1	0.0047	0.0045	0.0064	0.0065	0.0039	0.0022
OC2	0.0623	0.0427	0.0554	0.1260	0.0589	0.0294
OC3	0.7531	0.2406	0.1714	0.1513	0.1642	0.0814
OC4	0.0284	0.0364	0.0464	0.0373	0.0258	0.0156
2. Secondary Education	0.0348	0.0190	0.0203	0.0321	0.0186	0.0098
OC1	0.0019	0.0019	0.0020	0.0032	0.0018	0.0010
OC2	0.0100	0.0070	0.0089	0.0202	0.0095	0.0047
OC3	0.0197	0.0063	0.0045	0.0040	0.0043	0.0024
OC4	0.0032	0.0038	0.0049	0.0047	0.0030	0.0017
3. Vocational Education	0.0099	0.0061	0.0064	0.0103	0.0117	0.0032
OC1	0.0007	0.0007	0.0007	0.0011	0.0064	0.0004
OC2	0.0032	0.0023	0.0029	0.0065	0.0031	0.0015
OC3	0.0047	0.0015	0.0011	0.0009	0.0010	0.0006
OC4	0.0013	0.0016	0.0017	0.0018	0.0012	0.0007
4. College Education	0.0026	0.0027	0.0024	0.0047	0.0024	0.0012
OC1	0.0012	0.0011	0.0012	0.0023	0.0012	0.0006
OC2	0.0011	0.0008	0.0010	0.0023	0.0011	0.0005
OC3	0.0002	0.00067	0.00004	0.00004	0.00004	0.00002
OC4	0.00008	0.00009	0.00029	0.00010	0.00007	0.00004

Factors	Agriculture	Industry	Construction	Service	Government	State Enterprise
Capital Income	0.7539	0.6308	0.8002	1.0077	0.6271	0.3793
Corporations	0.2744	0.3122	0.3201	0.4250	0.2542	0.1459
Government	0.0023	0.0013	0.0015	0.0018	0.0109	0.0003
State Enterprise	0.0145	0.0148	0.0129	0.0133	0.0167	0.0647
Agriculture	0.1669	0.0532	0.0379	0.0335	0.0363	0.0202
Others	0.2958	0.0249	0.0428	0.5340	0.2790	0.1477

Note : OC1 = Professional and Management
OC2 = Clerks
OC3 = Service Workers
OC4 = Blue-Collar Workers

Table 18 Backward and Forward Linkages

Sector	Agriculture	Industry	Construction	Service	Government	State Enterprise
Backward Linkages						
Agriculture	7.930	3.368	2.105	1.840	1.829	1.774
Industry	4.875	12.159	6.523	4.680	4.591	5.597
Construction	0.550	0.469	6.887	0.572	0.596	0.608
Service	4.702	4.288	4.804	11.031	4.715	4.097
Government	0.330	0.255	0.253	0.303	6.174	0.209
State Enterprise	1.717	2.321	1.777	1.819	2.085	14.111
Forward Linkages						
Agriculture	4.401	1.193	0.846	1.103	0.719	0.984
Industry	1.404	2.235	0.542	0.755	0.417	0.999
Construction	1.000	1.367	9.080	0.965	0.472	0.873
Service	0.883	0.990	0.762	2.237	0.570	0.902
Government	0.958	1.061	0.366	1.044	12.686	1.129
State Enterprise	0.533	0.742	0.507	0.521	0.246	4.383

Figure 1–A

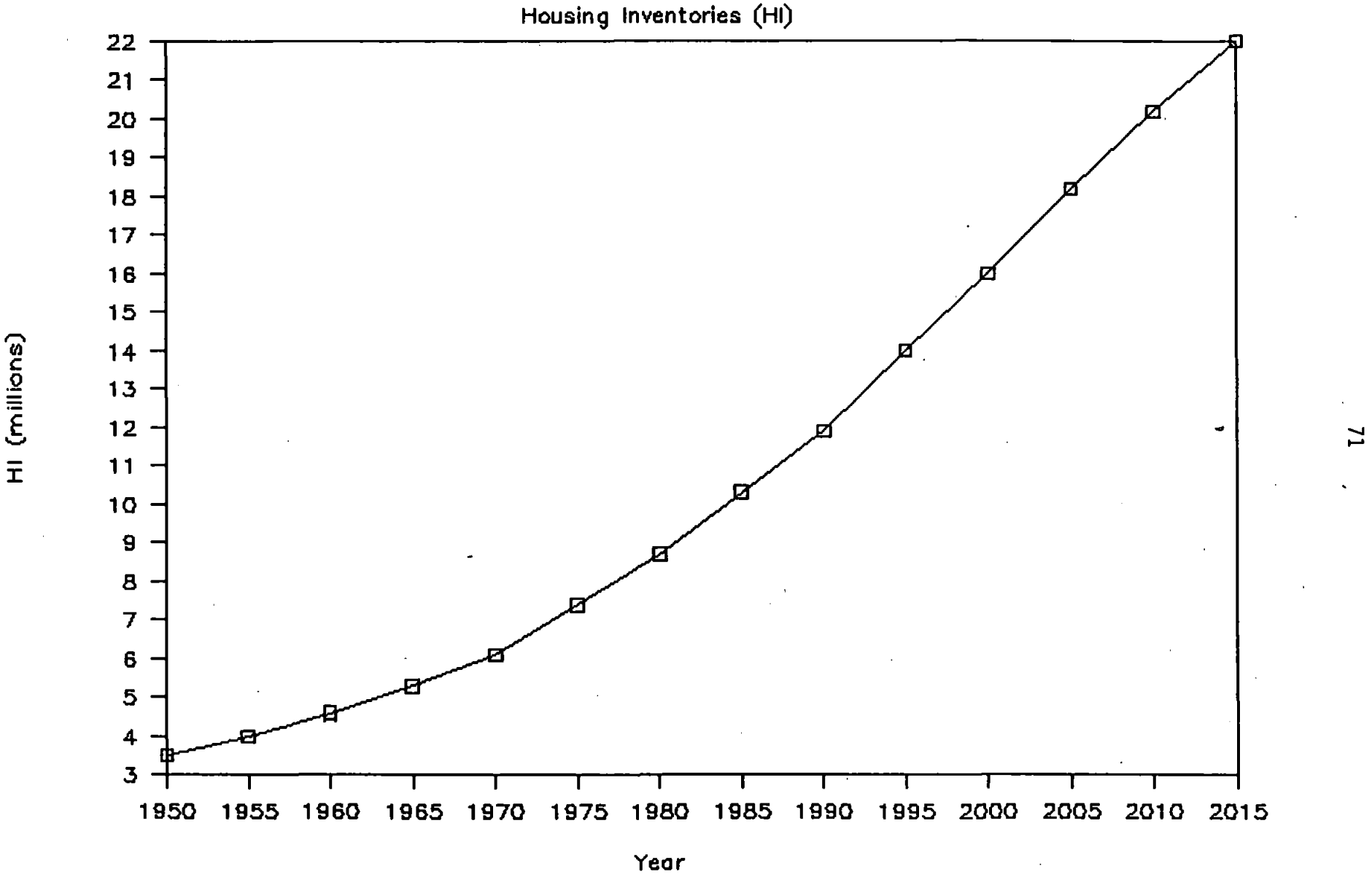

Housing Inventories (HI)
HI (millions)
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year

Figure 1–B Housing Starts (HS)

and Required Additions (RA)

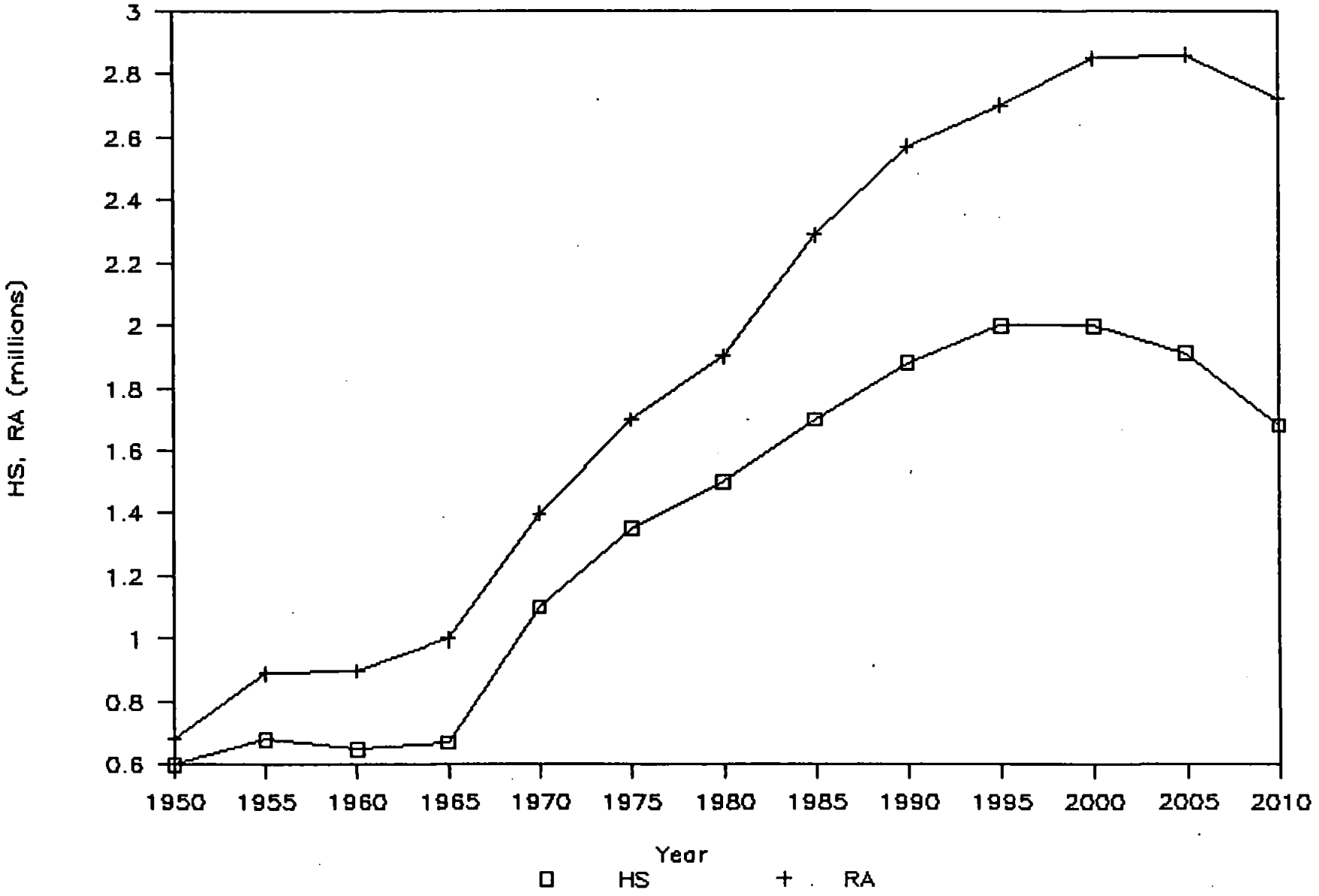


Figure 1—C Growth of GDP

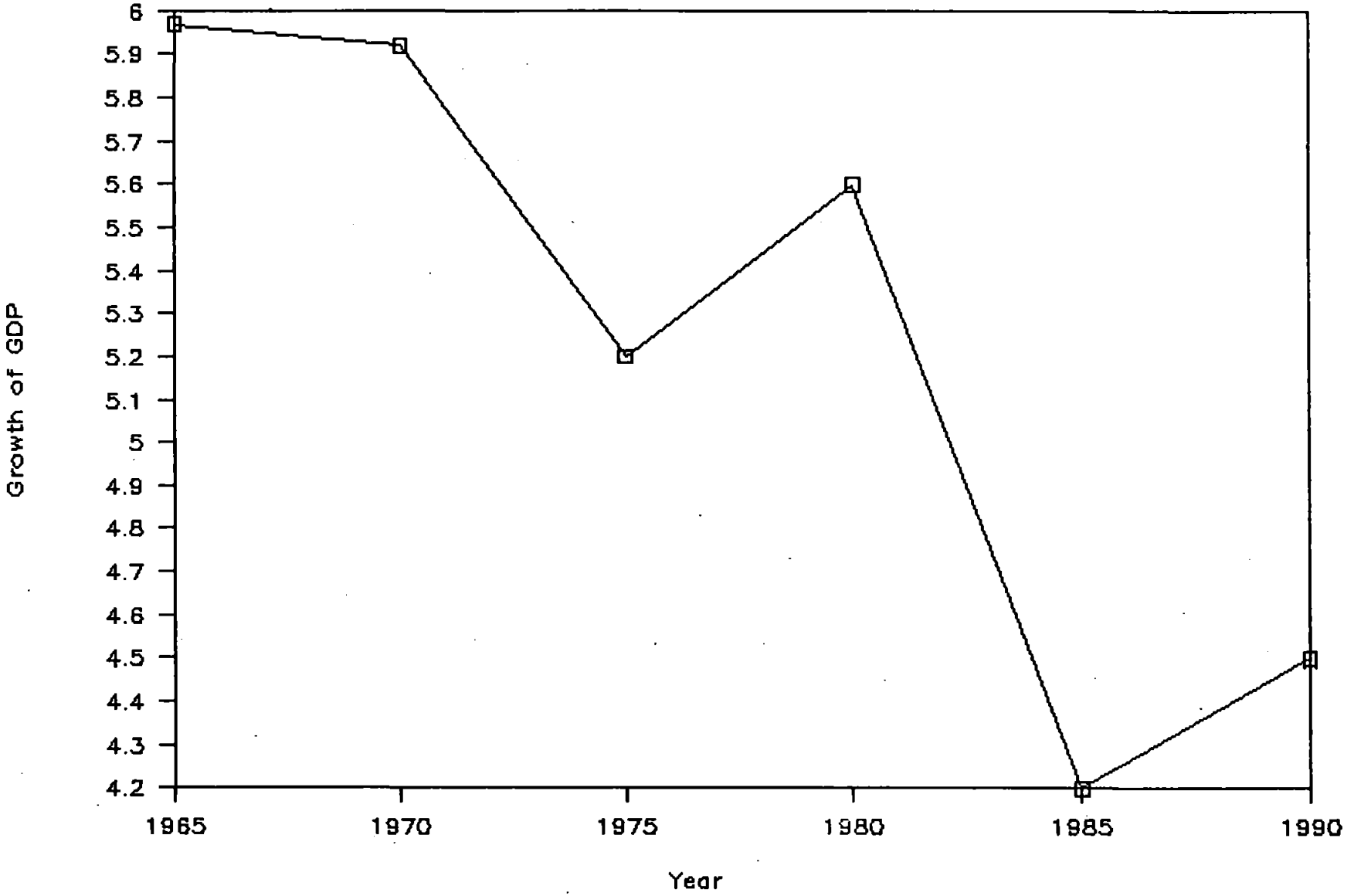


Figure 2 Changes in

Req'd Addition (RA) & Hsg. Starts (HS)

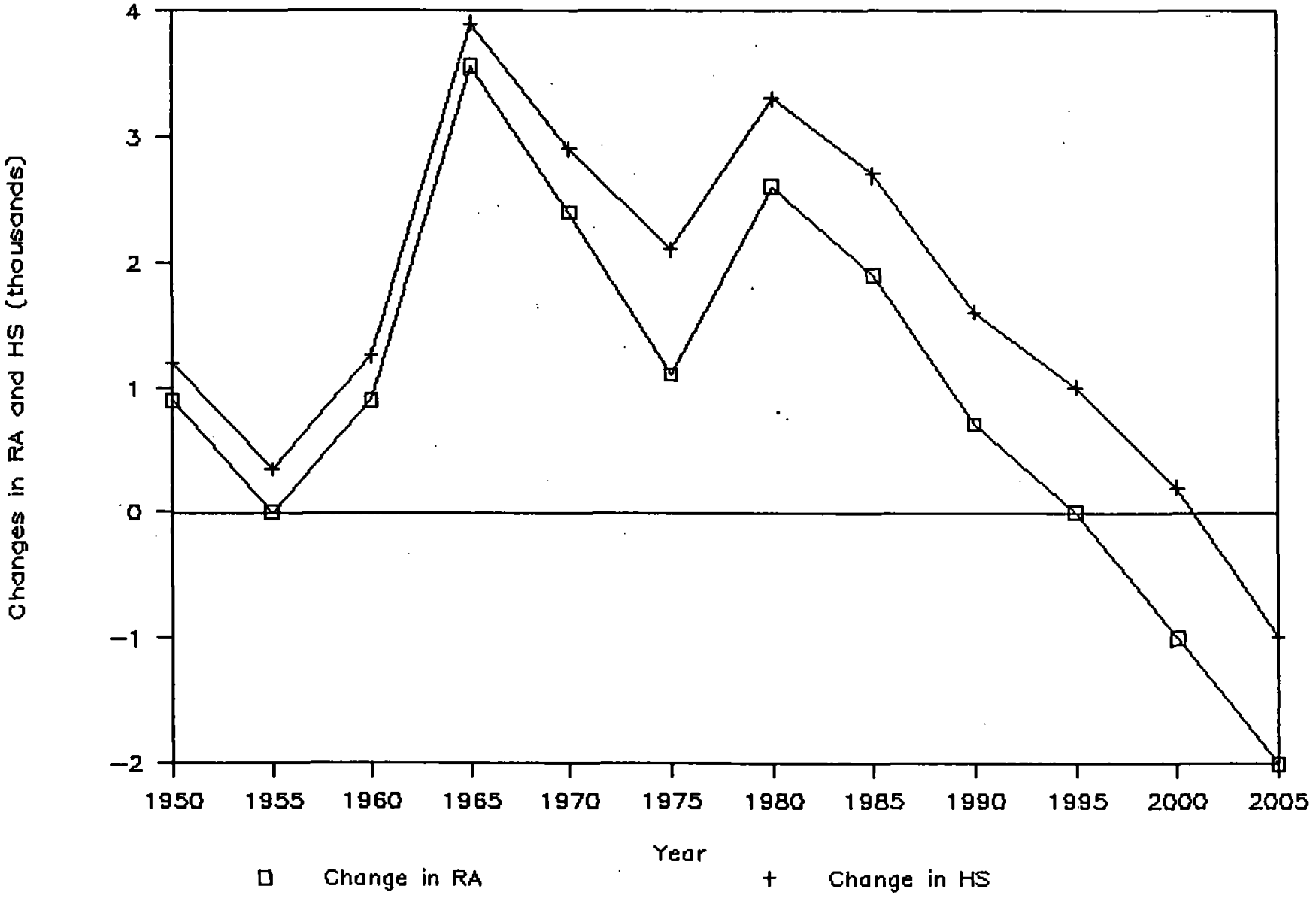


Figure 3 Housing Starts/Housing Pop

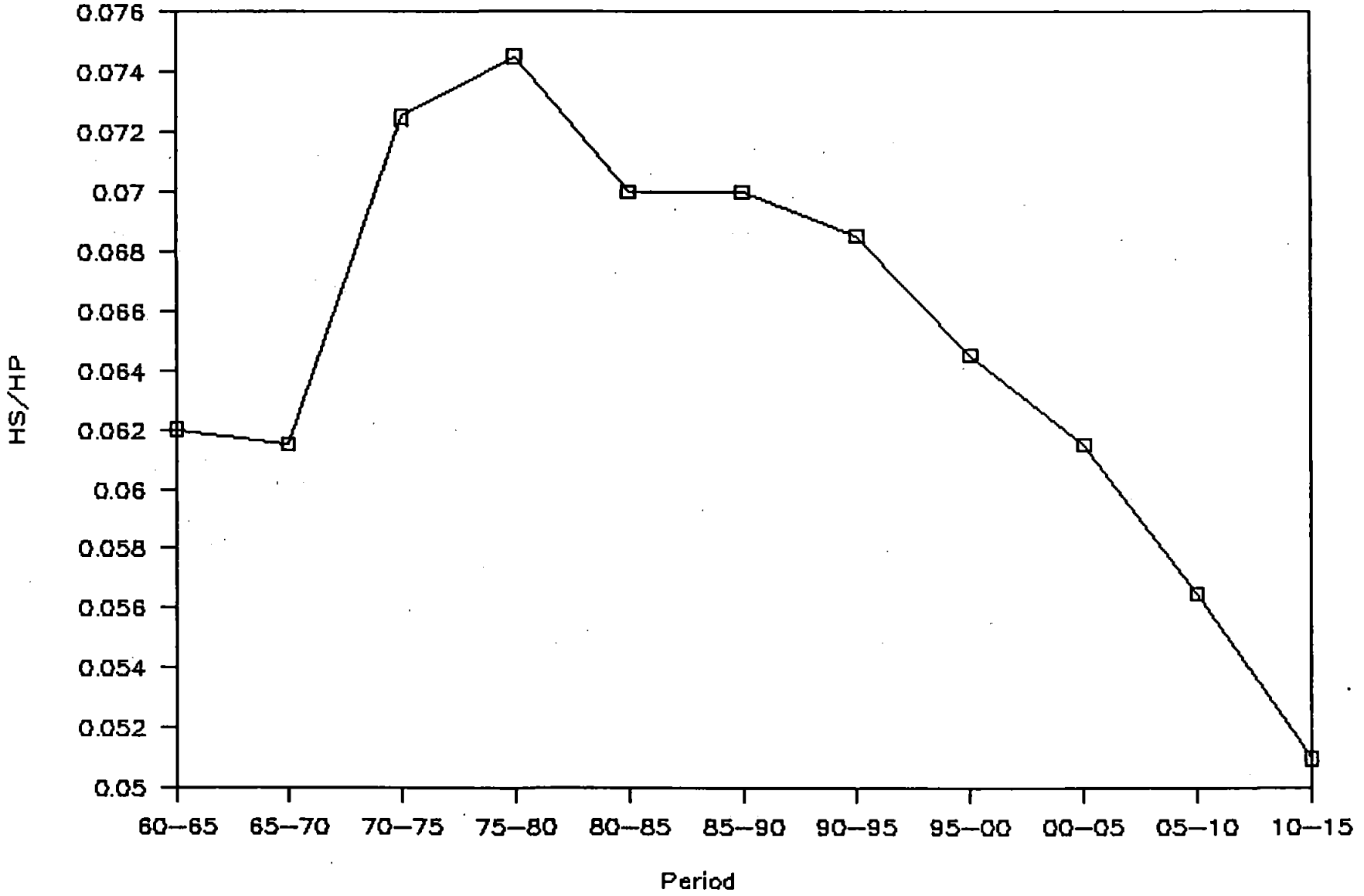
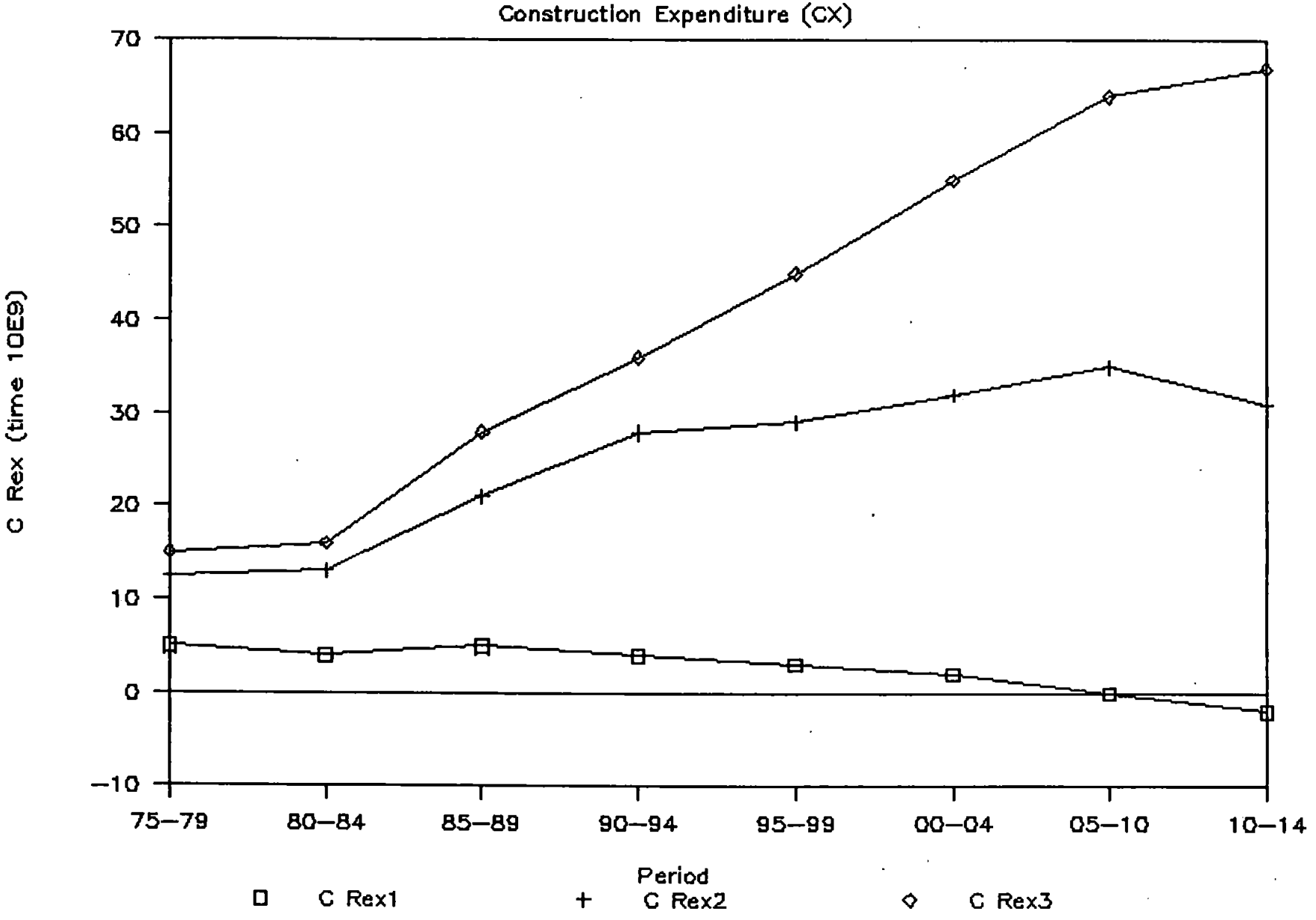


Figure 4 Changes in Residential—



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