HOUSING DEMAND AND RESIDENTIAL CONSTRUCTION IN THAILAND

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I. INTRODUCTION

The amount per-capita and the quality of the services provided by a nation's housing stock are key determinants of national welfare. Whatever the present level of satisfaction derived from the housing stock, as the population grows and changes in composition and as existing units wear out or are destroyed, maintaining existing per-capita standards requires the construction of new dwelling units. And, additional construction may be needed to raise the average quality of the housing stock, either in response to market demand as real incomes rise with development or in response to government programs designed to meet some politically set and presently unmet social standard.

From whatever source, new construction employs land, labor and capital resources that could be used for other purposes. How important this is will depend on the national saving ratio, on the opportunities for external financing, on the expected returns from capital accumulation other than in residential construction and on the political, social, and economic pressures for maintaining or improving housing standards. These circumstances are likely to differ considerably between countries, but in all countries estimates of the additional units needed in the future to maintain existing standards will be helpful to the decision making of either the private sector or the government, both for those directly involved in the construction industry and for purposes of economic analysis and forecasting.

Armed with such forecasts and with estimates of the income elasticity of housing demand and knowledge of supply constraints in the construction industry, various possible scenarios can be worked out, helping to reduce the uncertainties facing the private sector and, where relevant, aiding the sectorial and general economic policy making of the government. Further, given the considerable evidence in many countries of a

construction cycle rooted in underlying demographic changes, demographically based time series forecasts of housing requirements and related residential construction activities will be helpful in understanding the cyclical forces at work nationally.

Understanding of both the potential cyclical impact of demographic changes through residential construction and the national and sectorial allocative implications of such changes is facilitated by the considerable certainty with which the basic demographic profile of the housing population is known up to fifteen years ahead. In fact, because the number of household heads among the population between 15 and 24 years of age is relatively small, this profile is relatively certain up to a quarter of a century ahead. After that, forecasts of birth rates, which are more difficult to make, begin to play an increasingly important role.

This paper presents demographic forecasts (and backcasts) of housing requirements for Thailand based on HOMES estimates of the number of households. These estimates cover quinquennial periods from 1950 to 2015 and show the number of dwelling units that will have to be added to the housing stock in future quinquennia to maintain 1980 household formation relations[1] or that would have had to be added from 1950 to date based on the 1970 demographic determinants of household formations. Assuming that the distribution of housing demand by tenure type (owner-occupancy, renter-occupancy, etc.) by heads in different age classes remains at the 1970 level, base estimates of future (and past) demand by tenure type are also given for the same quinquennia.

Essentially, the base forecasts presented of additional housing units required by on-going demographic changes assume no future changes in the economic circumstances (e.g. per capita incomes, relative prices of housing) and tastes that determined age/sex specific headship rates in 1980 and the backcasts make the same assumption about the 1970 determinants of such headship rates. Thus they provide a benchmark against which the impact of other and less easily predicted variables can be measured.

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[1] The HOMES procedure is briefly described in Chapter 1.

Similarly, the estimates of demand by tenure type hold all determinants of such demand other than demographic changes at the 1970 per-capita level.

The forecasts made on this basis of the additional dwelling units required are adjusted for expected withdrawals from the housing stock and for minimal or "frictional" vacancies to give forecasts of the housing starts required. The forecasts of housing starts are then turned into base estimates of real residential construction by quinquennia by assuming the present average value of a dwelling unit occupied by heads in each age class remains unchanged in the future. Essentially, this amounts to assuming zero income elasticity of housing demand in the future.[2]

Finally, implicit in estimates of residential construction based only on demand considerations is the assumption that the supply of new dwelling units of all qualities is perfectly elastic at the present relative price of housing. There is evidence to support the assumption of a highly elastic supply of new dwelling units in Thailand in the past, but we will have to evaluate future labor requirements relative to labor force growth to determine how reasonable this assumption will be in the future.

Together these assumptions ensure that the estimates presented serve roughly as a lower bound to the likely range of future outcomes. They thus provide a conservative benchmark from which the effect of the variables initially left out can be quantitatively or qualitatively evaluated. Especially important in this context are the the effects of internal migration, clearly expected as industrialization continues, and of feedbacks from growth in per-capita income to household formations and to the quality and type of housing demanded. Also potentially important are the effects of any existing backlogs of demand and the effects of changes in the relative prices of housing that may occur as a result of changing supply conditions in the housing sector and elsewhere or of changes in real exchange rates..

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[2] This is a very conservative procedure not only because of the zero elasticity assumption but also because new units and replacement units can be expected to be priced considerably above the average value for the entire stock.

Briefly summing up some of the key results of the subsequent sections, first, assuming the only determinant of living arrangements that changes is the demographic composition of the housing population the number of Thai households will increase by 2.5% per year from 1985 to 2015, growing from 10.2 to 21.9 million. Over the same period, the Thai population growth rate is expected to be only 1.3% per year, suggesting a significant decline in the average size of households. Along with the accompanying aging of the household population, these demographic developments have significant implications for all sectors of the economy as well as for saving and human resource development.

For housing, they imply that the stock of dwelling units required to maintain housing stock/household standards in Thailand will increase from 9.7 to 20.5 million between 1985 and 2015. By quinquennia the peak in the number of new units required to meet this growth in demand will not come until 1995-2000 and 2000 - 2005. In each of these quinquennia 1.91 million additional units will be required or 33% more than were required in 1980-85. However, by 2010 to 2015 the additional units required will have fallen back to 13% above the 1985-90 level. Taken alone, the demographic determinants of excess demand in Thailand, assuming each quinquennia's excess is filled during that quinquennia, trace out a long cycle over the next thirty-five years. If these were the only factors at work, the Thai house building industry would use about one-third more resources than it presently absorbs annually from 1990 through 2010.

However, in addition to providing housing units for the net growth in households, new dwelling units are required over time to replace the dwellings withdrawn due to aging, natural disasters, city development, etc. If such withdrawals from the housing stock run at the conservative rate of 2% per annum, then required housing starts or the sum of withdrawals plus the above estimates of required additions, will continue to increase, though by smaller and smaller amounts, down to 2010-15, reaching 3.87 million in that quinquennium. This would be a 55% increase in starts compared to the 1980-85

period. Thus, if withdrawals are included, the resources required for residential building in Thailand increase and the direct cyclical effect disappears.

In sum, these outcomes imply that increasing amounts of resources will be absorbed by the Thai residential construction sector through the next two decades before this sector declines early in the 21st century. This is in addition, of course, to the greater land area absorbed (over twice as much as currently) for housing purposes by the larger required inventory[3], the increased infrastructure necessary to service the additional land and new housing required, and the greater on-going expenses to maintain the larger infrastructure and the housing stock. From the perennial issue of the transportation system on down the line, this growth in Thailand's housing requirements raises numerous difficult questions. They become both more pressing and more difficult if the effect of increasing real per-capita incomes on the number, quality and location of dwelling units demanded is considered.

To put these developments in the perspective of the overall economy, estimates of the value of the Thai housing stock and of housing starts (real residential construction) were constructed. Initially these estimates assume the average value of a dwelling unit occupied by each age class constant at the 1970 real level, implicitly assuming zero income elasticity of demand for both the quality and quantity of housing. The result is a set of benchmark estimates of residential construction for Thailand that changes only with the size and the age/sex composition of the housing population.

These benchmark estimates of required residential construction follow the future long-cycle already noted for Thai housing starts. However, because of the changing age composition of housing demand, the amplitude of the swing in required residential construction is greater than in housing starts. Relative to gross domestic product and to gross domestic capital formation, the estimates based on demographic changes only

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[3] It may be that construction of new units goes up rather than out, requiring different but no less expensive capital and current support expenditures.

imply a continually decreasing share of residential construction in both.

However, there is every reason to expect that as has happened everywhere else the average quality and the quantity of housing demanded will increase as per-capita income increases in Thailand. This effect is apart from the positive effects of taste changes associated with urbanization, industrialization, monetization, etc.

Although there is no direct evidence available on the income elasticity of the quantity of housing demanded, the indirect evidence provided by the analysis of consumer expenditures in Chapter 5 of this volume suggests that the quality elasticity is very close to one. Thus in forecasting the impact of income growth on residential construction the income elasticity of the quantity demanded is assumed to be zero (the same as saying the income elasticity of household formations and of undoubling is zero) but the income elasticity of the quality of housing demanded is assumed to be one. In other words, if Thai per-capita income increases 10%, Thais are assumed to buy no more housing units but to upgrade the quality of housing demanded by 10%.

Two approaches to measuring this quality response are taken. The first assumes that if per-capita incomes increase 10% in Thailand then the real value of all newly produced Thai dwelling units will increase by 10% but the value of the existing housing stock will not change at all. In other words, there will be no modernization expenditures, so, if there is no growth in the number of households, the observed income elasticity of housing demand would always be zero. Obviously, this is a special and conservative case. The second approach is at the opposite extreme. In this case, if per-capita incomes increase 10% the value of the entire Thai housing stock is assumed to increase 10%, implying the housing stock is continuously upgraded as real incomes increase.

If adjustment is made for growth in the quality of housing demanded with growth in per-capita income then the future picture in Thailand is much different than that described above. If it is assumed the <u>entire</u> housing stock is continuously upgraded as required by

an income elasticity of one, residential construction will be eleven times the level required by demographic changes only by 2010-15. Even the "conservative" assumption that the income elasticity of one applies only to newly constructed units yields residential construction that will be almost six times the zero elasticity level by 2010-15. For both forecasts the long-cycle exhibited by the benchmark estimates is replaced by continuous expansion though the growth rate of residential construction still follows a cyclical path.

Clearly, introducing an income elasticity of one has a very powerful effect, implying a large and continuing increase in the resources absorbed by the residential construction sector over the next thirty years rather than the increase and then significant decline suggested by the benchmark forecasts. And, since there are so many economic activities complementary to residential construction, including furnishing the new dwelling units and the provision of utilities and transportation links for the units, the forecast increases in real residential construction expenditures would be much amplified in their impact on the Thai economy.

Further, if the estimated elasticity is close to correct, then the fact that income adjusted estimates of real residential construction from 1960 to the present exceed actual real residential construction expenditures over the same period suggests that in addition to the continuing requirements of population and income growth there may be a large and growing backlog of demand in Thailand to be worked off.

Whether this backlog reflects supply constraints or implies the income elasticity assumed is too high is moot. Adjusting either the income elasticity or growth rate assumptions downward by half does considerably decrease the forecast levels of residential construction, but it leaves the forecasts far above the zero elasticity level and and the "backcasts" far above actual construction.

If the backlog is ignored and the basic income adjusted estimates are related to GDP

forecasts, the high estimate, based on quality changes in the entire housing stock, shows real residential construction in Thailand accounting for an increasing share of national output quinquennium by quinquennium over the next thirty years. The more conservative forecasts based on quality changes in additions to the housing stock only, shows the share increasing to a peak in 1990-95 and then falling off. However the share of real residential construction in GDP remains above present levels until 2005-10.

Relative to gross domestic capital formation, both forecasts show the share of residential construction in Thailand increasing through the mid-nineties. After that they both fall off but remain above the 1980-85 level until early next century for the estimates based on on quality changes in new units only and until the end of the period covered for those based on upgrading the total housing stock. Given the many other demands of growth on Thailand's savings and foreign resources, the forecast of an increasing share of residential construction in gross capital formation has important implications for economic growth and suggests that some very difficult choices lie ahead - especially when the conservative nature of the forecast is considered.

Looked at in terms of labor requirements, the income adjusted estimates, holding productivity constant at the 1970-75 level in residential construction, show labor requirements growing more rapidly than the labor force in Thailand. For example, for the estimates based on improvement in the quality of new units only, labor requirements in residential construction will increase by nine times over the 1970-75 by 2010-15. Over the same period the labor supply will increase only ..... times. Since it appears likely that, in aggregate, labor demand will grow more rapidly than labor supply (see Chapter 3) to evaluate the impact of the forecast excess demand in the residential construction sector it is necessary to compare the forecast growth in excess demand in residential construction with that in other sectors. Doing so for consumer expenditures (based on the data given in Chapter 2) shows the growth in housing expenditures above the average for all household expenditures.

Thus, unless there are unprecedented increases in the productivity of construction workers, the likelihood is that real wages in residential construction will increase. But, with the probability of a highly real wage elastic supply of construction labor from the agricultural sector, real wages in residential construction are not apt to increase as much as the relative growth in the sector might suggest.

On the brighter side when the economy begins to adjust in the 21st Century to the national excess demand for labor by substituting more capital intensive for more labor intensive production in other sectors, the short-run employment effects of this substitution may be softened by the expected growth in labor intensive residential construction.

One implication of these considerations is that the assumption of perfectly elastic supply on which our housing market forecasts are based is very likely to be breached. So is the implicit assumption that the relative price of housing will not change. Just how the housing market will react to these developments is uncertain, but since the price elasticity of demand for housing units is generally thought to be low, if the relatively elastic supply just discussed materializes, the forecasts of residential construction expenditures and of real resource requirements presented may not be too far off target.

In sum, introducing the effect of income growth on the demand for housing quality in Thailand results in a residential construction boom in absolute terms that, at least for a time, is likely to be reflected in the relative share of the residential building sector in the economy. Since these estimates ignore the impact on construction of the existing quality backlog, of income induced changes in headship rates and of undoubling, of the effect of internal migration and the related changes in tastes with greater urbanization, the likelihood of a major residential building boom seems even greater than suggested by our estimates. In fact, the boom may well already be underway. In any event, beyond the new construction involved, the growth forecast implies either major

complementary expenditures for urban infrastructure or a rapid decline in the average quality of urban services. It also implies some difficult land use and zoning decisions are ahead along with some sharp shifts in land values.

2. HOUSEHOLDS, THE HOUSING STOCK, REQUIRED ADDITIONS AND HOUSING STARTS

Methodology

The basic estimates of the housing stock required by the Thai population are derived from the following symbolic relations:

$$HK^t = HH^t (A_f) (1 + A_{v1} + A_{v2})$$

where: HK^t = the housing stock in year t;

HH^t = households in year t;

A_f = occupied housing stock/ households in base year (1970 or 1980);

A_{v1} = frictional vacancies as a percent of the occupied housing stock in base year;

A_{v2} = cyclical vacancies as a percent of the occupied housing stock in base year (assumed to be zero in making forecasts)

Household forecasts are accomplished by the HOMES methodology described Chapter 1 of this volume. Before 1980, HOMES' household estimates are based on the 1970 Census data for Thailand and from 1980 on they are based on the 1980 Census.

The "doubling rate" or the ratio of occupied housing units to the number of households was derived from Census and other sample surveys covering both the numerator and denominator of the ratio.[4] The considerations used in defining upper and lower

[4]Relatively complete data for the number of households are available in the Censuses of 1970 and 1980. The Ministry of Industry has been reporting the occupied housing stock since the 1960's and the United Nations made a similar estimate for 1970.

bounds on this ratio for purposes of sensitivity analysis and the adjustments made for changes in the urban/rural population split are discussed in Appendix A. The latter adjustment is required because there is considerable world-wide evidence that "doubling" is greater in urban than in rural areas.

The expected level of vacancies is more difficult to derive. Simplifying somewhat, vacancies can be considered to be of two kinds, frictional or normal and cyclical vacancies. Both reflect the fact that, like most non-auction markets, the housing market involves information costs and so does not clear continuously. Housing remains vacant while buyers and sellers of housing services adjust their expectations and discover their transaction prices.

Roughly, the greater the mobility between geographic regions and housing neighborhoods and the more rapid the secular change in the market, the higher the ratio of frictional vacancies to the housing stock. As national or regional economic activity declines or as builders respond to the short-run equilibrium price in typical cob-web fashion, cyclical vacancies arise. Essentially, normal vacancies reflect the irreducible minimum of vacancies at any time and cyclical vacancies involve vacancies above the minimum. In the forecasts and estimates presented, the second or cyclical component of vacancies is ignored, there being no empirical basis for trying to "guess" its variation. However, an adjustment is made for normal vacancies. Based on the considerations noted in Appendix B, these are taken to be 2% of the occupied housing stock for Thailand.

The change in the estimated housing stock between two dates (five year or quinquennial intervals are used) then gives the number of additional units required by changes in demographic factors only or "required additions" (RA^t) during the interval. This number can, of course, be negative as well as positive, and constitutes a base estimate of the change in demand occurring in housing markets from one five year period to the next.

In symbols required additions are defined as follows:

$$RA^t = HK^t - HK^{t-1}$$

Forecasts of required additions will correctly measure the change in housing demand only if population factors are the only determinants of housing demand that change over time and if there are no constraints on the supply side that prevent the stock adjusting to the new required level without any change in relative prices. They would be expected to underestimate the change in the demand for dwelling units when per-capita incomes are growing, especially if the income distribution is shifting in favor of younger workers, when the relative price of housing falls due to exchange rate depreciation, and secularly as industrialization increases the opportunities for non-agricultural employment.

However, the number of new units required is not the same as the change in housing demand. Over time the housing stock declines due to aging, natural disasters or the switching of residential land to other uses, and the units lost must be accounted for in estimating required new units or, as used here after, required housing starts. The procedure for doing so, with a range of possibilities based on experience elsewhere in the region is given in Appendix C. Required housing starts (RHS^t) are then defined as follows:

$$RHS^t = RA^t + A_w (HS^{t-1})$$

where: A_w = the ratio of withdrawals over five years to the beginning housing stock in the base period.

In addition to the reasons already noted for the actual change in the housing stock differing from the estimated change or required additions, actual housing starts may differ from required housing starts if the movement of households between geographic sub-markets of the former can not be matched by the movement of dwelling units in the same direction. Though there are exceptions, this is normally the case and construction

depends on the sum of excess demands in the geographically segregated sub-markets, ignoring excess supply sub-markets, rather than on national totals netting out excess supply against excess demand sub-markets. So internal migration will generally lead to actual housing starts in excess of required housing starts. Accounting for this source of new construction is only possible in qualitative terms and the lack of such accounting in numerical terms underscores the base or minimum nature of the estimates presented.[5]

Actual housing starts may differ from required housing starts as well because of supply side constraints and developments. Among other reasons, when government constraints on residential construction (via resource allocations, price controls, etc.) are added or subtracted, housing starts will not equal required housing starts. And, where, even over five year periods, the supply curve of new housing is considerably less than infinitely elastic, the relative price of housing and so the effective demand for housing will depend on the size of required housing starts. Or, if there is a speculative response to excess demand in the short-run (when relative prices are more likely to change), fed by the usual cob-web adjustment, then actual starts can be expected to differ from required housing starts. All of these factors (and others) can not be adequately incorporated into the base estimates presented, but, like internal migration, must be considered qualitatively in using these estimates.

Required Housing Stock

Estimates of Thailand's households and of the occupied and total housing stock in Thailand from 1950 to 2015 by quinquennia based on the above methodology are given in Table 2.1. In future, Thai households will continue to increase up to 2015. The occupied housing stock, derived by adjusting the number of households for the "doubling up" of

[5] Another source of shifts in demand comes from changes in the real exchange rate. Baht depreciation will generally raise the demand for non-traded goods and services such as housing, while baht appreciation will have the opposite effect.

some households, will also increase up to 2015, but at a slightly slower pace since the doubling rate is assumed to decline marginally over the period. Finally, the required housing stock, the stock of housing required by demographic changes only, derived by adjusting the occupied housing stock by a constant percentage for "normal" vacancies will mirror the increase in the occupied housing stock. The result suggests that 20.54 million dwelling units will be required in 2015 or an increase of 111% over the 1985 level of 9.74 million dwellings.

Since the assumptions made are quite conservative, especially that headship rates will not increase and that undoubling will not pick up as real incomes increase[6], it is almost certain that the market clearing housing stock in 2015 for Thailand will be considerably larger than the required housing stock. If doubling disappears by 2015 for example, that would add 1.33 million units to the required stock. This would about be 7% of the 2015 stock and approximately equal to five times the present annual rate of required additions.

Only government intervention to restrict supply, perhaps to shift resources elsewhere, could prevent this outcome and then only at the expense of rapidly increasing housing prices and speculation or rationing and their attendant misallocations. However, whether or not the government would have an incentive to intervene should depend on the opportunity costs of more than doubling the housing stock over the next thirty years. And, in the addition to the social and political costs of not maintaining (or improving) existing standards, this will in part depend on how rapidly the economy grows and whether the required growth in the housing stock implies a larger or smaller share for residential construction in GDP and gross domestic investment.

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[6] Experience in the U.S. and Europe points to these headship rate and undoubling effects of growth in per-capita income. Japan's experience seems to have differed in that headship rates have fallen off at early life-cycle stages as income has increased. However, this probably reflects the fact that, unlike the U.S. and Europe, in most urban areas housing costs - because of land costs - have increased more rapidly than nominal income in Japan. The relatively abundant supply of land in Thailand suggests the situation there will be more like the U.S. and Europe than Japan.

Required Additions

The quinquennial level of new housing units required by the forecast changes in the required Thai housing stock will increase at a decreasing pace to a peak in 1995-00 and decline thereafter (see Figure 2:1) At the peak, required additions will be 33% above the 1980-85 level but by 2010-15 will have declined to only 13% above that level.

Even more interesting is the age composition of the growth in housing demand in Thailand. With systematic differences in the quality, size, location, and tenure of housing demanded in different age classes, because of the resulting much less than perfect substitutability between the average unit occupied by different age classes, the variation in net demand by age class can be very important. Relative prices can change to offset excess supply or demand in different segments of the housing market but they are sticky (at least downward) and there are likely to be large differences between the short and long-run response. Meanwhile construction will be encouraged in the excess demand segments.

Most impressive in this context is the coming growth in housing demand by the middle-aged (35-59) heads (see Table 2:2) By 2015 the dwellings required for this age group in Thailand will be 253% of the present level. Since, generally, heads in this age class have less postponable housing demand, tend to spend more on furnishings and other housing appurtenances, require better quality or at least larger housing, and are more often home owners than are heads in the other age classes, the significance of this growth is apparent. Enroute to this much increased required housing stock, beginning in the present quninquennia (see Fig. 2:2) required additions for the 35-59 age class will increase continuously to a peak in the first five years of the next century. At that time, the demographic based demand for new units in this age class will be 235% of the present level!

The much slower growth through 2010 and decline there after in the housing units required for the 15-34 age class in Thailand is also interesting. Heads in this age class can postpone demand if necessary and tend to have specialized housing needs, especially in urban areas. In the present increase, then peaking and ultimate decline in housing units required for this age class there is very definitely the possibility of the characteristics of the housing produced getting out-of-line with the characteristics of housing demanded.

In fact, the quinquennial rate of new dwelling units required for this age class has already peaked, though these requirements will remain high through the present, 1985-90 quinquennium. From now on the required number of new units designed for the specialized needs of younger household heads will decline sharply, reaching negative levels in 2010-15. Only a major - but not impossible- upward shift in headship rates could change this conclusion.[7]

Finally, though the total housing required for household heads 60 years of age or older in Thailand will remain considerably smaller than for the other two age groups, the increase, concentrated in the last two quinquennia covered, to 329.8% of the present level will both offer an opportunity in a specialized housing category to the Thai building industry and provide a considerable challenge. Required additions for this age class will move up relatively slowly from the past peak level reached in 1975-80 (1980-85 saw a dip, unlike the other age classes) to 152% of that level in the first quinquennium of the 21st Century. Then they will almost double in the following ten years!!

The story told by required additions by age of head does not take account of withdrawals,

[7]These developments reflect the underlying population changes and will also show up in the age structure of the labor force. The relative shortage of younger workers could easily raise the relative incomes of these workers as economic growth continues. A sharp increase in real incomes for young workers has elsewhere had a significant upward impact on the headship rates of young people.

which could be concentrated in one or the other of the age classes discussed rather than fairly evenly distributed among the age classes. However, if withdrawals even roughly follow the distribution of the housing stock by age class, required construction will have to be tailored to the changing housing characteristics suggested by the variation in required additions by age class.

In sum, if the additional units required by population changes alone in all age classes are considered, after increasing to the end of this century, the resources required by the housing sector will fall off in the early 21st Century. This would be especially true of resources now directed into housing for younger households. However, to adequately analyze the potential importance and economic effect of these demographic based forecasts of additional housing requirements it is first necessary to turn the estimates of required additions into forecasts of housing starts by considering the effect of withdrawals and replacement demand and then to derive forecasts of real residential construction.

Briefly turning to the sensitivity of the results so far presented to the assumptions made, in Fig. 2:3 required additions based on three sets of doubling rates and, for the medium doubling rate, two sets of vacancy rates are shown. The 90% or high doubling rate is close to that found in other more urban areas in developing countries and the 100% rate is similar to the very low levels found in many highly developed countries. Neither this variation nor the variation of "normal" vacancy rates between 2% and 4%, covering the range found in the Asian developing countries for which data were available, changes the general level of or general movement in required additions in a striking manner. However, if doubling hits zero, required additions in Thailand would be increased by 10 to 11% over the medium or basic level forecast in the next six quinquennia.

Required Housing Starts

Required housing starts include the new units required by demographic changes (required additions) and the replacement of units required by withdrawals from the existing stock. There is considerable uncertainty surrounding any forecast of withdrawals since they are influenced by numerous unrelated variables; e.g. natural disasters, the age composition of the housing stock, the rate of economic growth, urbanization. However, as described in Appendix C, there is some evidence available from other countries as well as inferential evidence from past Thai housing inventories that will help set the likely range of outcomes.

After sifting through the various possibilities, a withdrawal rate of 2% of the housing stock per annum is used for the base estimate and rates of 1% and 3% are used to demonstrate the impact of "extreme" values. The 2% rate implies that 92.5% of the Thai housing stock in the year 2015 will be built after 1985, compared to 60.0% if there are no withdrawals at all, but only required additions. The 1% extreme implies that 66.0% of the 2015 stock will be built after 1985 and the 3% rate that 100% will be built after 1985.

On the basic 2% withdrawal rate assumption, Thai housing starts (see Fig 2:4) will exceed required additions by increasing amounts and continue to increase, although slowly, to a 2005-10 peak (where they remain through the final quinquennium.) as required additions fall off from their 2000-05 peak. Thus, in absolute terms, measured by the number of new dwelling units started, the housing sector in Thailand is expected to continue to expand, for a time at least by relatively large amounts, through most of the period covered. Of course, the stock of infrastructure servicing residential dwellings and of capital needed to produce the furniture and household appliances complementary to residential dwellings would then also have to expand just to maintain present service and well-being levels.

The importance of withdrawals in this result is clear. In fact, in the final quinquennium, withdrawals will exceed required additions as a source of housing starts in Thailand. Though in earlier quinquennia they account for fewer housing starts and their relative importance falls off in the 1980's and 90's as demographic pressures have their maximum impact, withdrawals are a very important source of required new construction throughout the period covered. They clearly must be considered in any attempt to evaluate the economic impact of population changes on residential building.

This point is demonstrated still more vividly in Fig. 2:5 where the range of outcomes derived from the different withdrawal rate assumptions is shown. While Thai housing starts based on zero withdrawals(required additions) trace out a cyclical swing, starts based on the 1% assumption simply flatten out at a high level and those based on the basic 2% and on the 3% assumption go on increasing by significant amounts, the latter reaching a level 73% above the 1% withdrawal level in 2010-15. Clearly, varying the withdrawal assumption can have a large and increasing effect on housing start forecasts. This fact suggests that better data on actual withdrawals would be very useful in putting together forward looking business or government policies in the residential construction sector.

Tenure Composition

The distribution of demand between renter and owner-occupied housing is important for several reasons. First is the fact that dwelling units in the rental and the owner-occupied markets are generally far from perfect substitutes. For example, though the differences have been blunted by the development of the condominium form of ownership, the average size of dwelling and so the average price, the amount of land occupied per-unit, infrastructure requirements and the problems associated with population density often differ significantly between renter and owner-occupied units. Also, with rental units most likely to be built in anticipation of demand, the extent of

over-building as housing demand fluctuates depends on the relative share of rental demand.

National estimates of required additions by tenure class were derived by multiplying our basic estimates of households by age of head over time by owner or renter occupancy rates by age of head (from a 1970 survey) Such estimates assume either that the variation between age groups is the same in different housing markets or that the distribution of the population between markets is relatively constant. Neither of these conditions is met in Thailand, with the proportion of renter occupancy being much higher in most age groups in urban areas (see Table 2:3) and with the urban population likely to grow significantly relative to the rural population over the period covered. Thus, national estimates will almost certainly underestimate renter demand in future in Thailand.

Another development pointing toward the same bias is the forecast of declining household size discussed in Chapter Two. Smaller households are more likely to rent (or become condominium owners) and by 2005 households are expected to average 3.7 members compared to the almost six members each in the 1970 base year. Working in the same direction will be the reduced number of children per-family.

With these caveats, Owner-Occupied Required Additions (RAO^t), for example, are forecast using the following relations:

$$RAO^t = \Sigma\{A_{oi}(HH_i^t - HH_i^{t-1})\} = \Sigma\{A_{oi}(HHF_i^t)$$

where A_{oi} = heads in the ith age class in owner-occupied housing/total heads in the ith age class in the base period.

HHF_i^t = net households formed in the ith age classes in year t[8]

So, to place a "boundary" on the likely underestimate of rental demand introduced by the biases discussed, two categories of forecasts are given for the number of required additions by the two broad tenure classes for which data are available, owner-occupants and non-owner occupants (renter occupants, rent-free occupants, and unknown tenure type). The first gives future rental and owner-occupied required additions based on the tenure rates that applied nationally in 1970 in Thailand and the second gives the same distribution over time on the assumption that the urban tenure rates in 1970 become the national rates. Since a continued trend toward urbanization of the population is likely, especially if the present successful growth story continues, the actual outcome will be somewhere between the two extremes shown.

In the absence of further movement into urban areas, the growth in Thai housing demand will be concentrated on owner-occupancy and located largely in rural areas (see Fig.2:6). Rental required additions, as suggested by the variation in the age composition of demand discussed above will decline after 1990-95. This decline holds for both the total and the urban forecasts. However, if urban growth does in fact adjust national tenure rates to something near the present urban ratios by 2015, there would be a very large boom in rental (or condominium) type housing rather than a decline. Since the necessary urban growth is a possibility with unknown probability, in the absence of HOMES based forecasts of the rural and urban population distribution, these results primarily demonstrate how the methodology described could be used to forecast the tenure composition of tenure demand if the requisite data were available.

To the extent condominium growth has occurred the key differences between rental and owner-occupied units noted will be blurred and it is more directly relevant to use HOMES to forecast the distribution of households between dwelling units by size and by

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[8] Because there is no basis for dividing normal vacancy rates or doubling rates between tenure categories there is little reason to present estimates of required additions by tenure type adjusted for these factors. The same conclusion holds for the allocation of withdrawal rates and estimates of housing starts by tenure type.

type (stand alone, row, high rise) rather than by tenure class. There are sample data that make such forecasts possible, but the differences between rural and urban areas are even more striking and so the relative growth in the urban and rural population in future even more important for housing characteristics than for tenure. Thus, only the tenure type forecasts are presented. However, the methodology for estimating future demand by the characteristics of housing, if the needed population estimates by location become available, involves a straight forward adjustment of the relations shown above for owner-occupied housing, with rates of occupancy by age of head by housing characteristic substituted for owner-occupancy rates. Again the theoretical basis for using such estimates is that dwelling units with different characteristics are not perfect substitutes and that as relative demands change the adjustment in their relative prices will leave new construction profitable in the sub-market for one or more of the characteristics.

3. RESIDENTIAL CONSTRUCTION EXPENDITURES

Introduction: Benchmark Estimates

To turn our fore- and backcasts of required housing starts into required residential construction expenditures, estimates of the average value of housing occupied by heads in different age classes in Thailand were made, using data on the distribution of rents paid by age of head (see Appendix D) for 1970, the only year for which the requisite data are available. Then, assuming that average value of the units occupied by heads in different age classes remains at the 1970 level over time, the value of the required housing stock was computed by multiplying this average value by the number of heads in each age class at different points in time. Net real residential construction is then equal to the change in the value of the required housing stock. Assuming the withdrawal rate is the same in each age class, this procedure gives the following definition of required gross residential construction (RRC^t):

$$RRC^t = [\Sigma\{A_{pi}{}^t (HS_i{}^t)] - \Sigma[A_{pi}{}^{t-1}(HS_i{}^{t-1})\} (1 - A_w)]$$

where $A_{pi}{}^t$ = the average value of housing occupied by heads in the ith class in time t

$HS_i{}^t$ = housing stock required by the ith age class at time t.

All the sources of difference between required and actual housing starts apply to required and actual residential construction. The necessity of assuming either no change in the income distribution between age classes or that the income elasticity of demand is the same in all age classes, that the withdrawal, "doubling", and frictional vacancy rates are the same for the housing occupied by all age classes, and possibly most important, that the the average value of houses withdrawn from each age class is the

same as the average value of houses remaining further biases the results in unknown ways.

It is also important to recall that underlying all the residential construction estimates presented, is the assumption that both the supply of dwelling units and, where relevant, the supply of repair and modernization, are perfectly elastic at present prices. This is, of course, an oversimplification in any circumstances, but perhaps less so in Thailand where the supply of labor to residential construction from the agricultural sector (especially in the monsoon off-season) may be very wage elastic.

Finally, whether the pattern of rents paid over the life-cycle in 1970 provides a reasonable basis for investigating the rents paid by age of head in future decades is subject to question. The 1970 data (see Appendix D) show the peak rent paid in the 20-24 age class. They also show an equally unexpected major downward shift in rent paid in the later life-cycle stages (from 55-59 on). It seems quite possible that this pattern reflects the movement of younger household heads into the modern sector and the impact of this movement on their incomes, tastes, and housing expenditures. If so, rents paid over the life-cycle can be expected to show significant changes as economic development continues and as the effects of development become more fully reflected throughout the housing life-cycle.

Based on the above assumptions and caveats, benchmark estimates of value of required additions in Thailand trace out a long cycle similar to the one already seen in required additions. (Table 3:1) Changes in the age composition of demand accentuate this cyclical movement since the the average value of housing unit occupied is lower in the older age classes and the heads in these age classes first fall and then increase in relative importance (see Fig. 3:1) But, the economic effect of residential construction can not be fully evaluated without considering withdrawals and so gross investment in dwelling units. With replacement demand added the estimates of residential construction are greatly increased but the cyclical pattern still exists, with the peak shifted forward in

time (to 2000-05).

Income Adjusted Estimates of Residential Construction

Although providing a bottom line measure of the effects of demographic changes only, it must immediately be added that the basic assumption of the benchmark estimates, that the demand for housing quality has zero income elasticity, is not reasonable. In fact, evidence on consumer expenditures presented in Chapter 2 suggests that the income elasticity of expenditures on housing in Thailand is slightly over one. Therefore, to adjust the quality of housing demanded for the expected growth in per-capita income it is assumed that the demand for housing quality has an income elasticity of one in all age classes (and that real income increases by the forecast national growth rate in all age classes, i.e. that the income distribution by age class remains unchanged).

Two estimates of the effect on the quality of housing demanded of increasing per-capita income will be given. The first assumes that the total housing stock is upgraded in quality as real per-capita incomes increase. Estimates of residential construction based on this assumption will serve as the upper bound on the forecasts since they upgrade the constant baht unit value of the existing stock as well as of newly constructed dwelling units. The second assumes that per-capita income growth raises the quality of newly constructed units (both required additions and withdrawals) only and so ignores the modernization of existing units. This provides a relatively conservative forecast though one that with any reasonable per-capita income growth rate and income elasticity is far above the level based on demographic changes only.

Another set of factors likely to affect the characteristics and so average price (quality here) of housing demanded are the changes forecast in the nature of Thai households, especially the decline in average size and the decrease in the number of children per household. Both changes might be expected to raise the relative demand for rental or condominium style housing and so to reduce, relatively, the average construction cost of

new dwellings. However, some of the saving on land and dwelling unit size may be put back into higher quality of housing per square meter. And, in fact, consumer expenditure data suggest that at the same income smaller households spend a larger share of their income on housing. They also imply that older households, which will increase relatively in future, do the same. Thus, the net effect on measured income elasticity of demand of these demographic developments should be small.

In symbols, the income adjusted estimates of real residential construction are then defined as follows:

1. $RCU = [(HH_i * AV_{70}) * Ya_i] - [(HH_{i-1} * AV_{70}) * Ya_{i-1}] + WD * (AV_i + AV_{i-1})/2$ or

$[(dHH_{di} * AV_{70}) * Ya_{i-1}] + [(dHH_{di} * AV_{70}) * (Ya_{i-1} * Yg_{di})] + [(HH_{i-1} * AV_{70}) * (Ya_{i-1} * Yg_{di})]$

"population only" "joint variation" "income only"

$+ [WD_{di} * (AV_i + AV_{i-1})/2]$

"withdrawals"

2. $RCL: = [dHH_{di} * (AV_i + AV_{i-1})/2] + [WD_{di} * (AV_i + AV_{i-1})/2]$

Where: RCU = The upper bound estimate based on the upgrading of the entire stock with income increases

RCL = The lower bound residential construction estimate based on upgrading newly constructed units with income increases.

HH_i = Households in year i

dHH_{di} = Change in Households between years i and i-1.

AV_{70} = Average value of the occupied dwelling units in 1970

AV_i = Average value of the occupied dwelling units in year i

or $[(HH_i * AV_{70} * Ya_i)/HH_i]$

Ya_i = Adjustment of housing value to account for income elasticity and per-

capita income growth between 1970 and year i (based on the assumed income elasticity and growth rate in each instance)

Y_{gdi} = Growth rate in per-capita income for the period between year i and year i-1

WD = Withdrawals (estimated as described).

Using this methodology, the estimated quality income elasticity of one and the actual and forecast variation in real income per-capita over the period covered yields the results given in Table 3:1 and shown in Fig 3:2 There are very large differences in the estimates shown, especially in the future. If the entire housing stock is continuously adjusted to meet the increased quality demanded as per-capita income increases over time residential construction expenditures in Thailand will literally explode! How important this is depends on the implications of these developments for residential construction's share in GDP and GDI and in the forecast growth in the labor supply discussed below. But that growth of the sort indicated would be highly competitive with resource demands elsewhere is fairly obvious.

While they are less than half the above estimate by 2010-15, the growth in residential construction expenditures based on an income induced quality response that is limited to newly constructed units is also impressive. Compared to the forecasts based on demographic changes only, these estimates yield expenditures and resource requirements almost six times higher in 2010-15! If the required expenditures on infrastructure, furnishings, etc. for the forecast increase in the quality (and number) of dwelling units are considered, the impact of a boom of the sort indicated on Thai economic activity could be great.

And, these estimates ignore the apparent backlog from the last two decades. This is illustrated in Fig 3:3. The estimates based on upgrading the entire housing stock everywhere exceed the actual level of Thai residential construction. If the assumptions underlying these estimates are correct, then a considerable quality backlog has built up

over the last two decades, with supply side constraints, including financial constraints, limiting the adjustment (through direct interventions or price rationing). Second, the estimates that upgrade only new units are about the same as actual construction in 1960-65 and then pull away from the actual rate, again suggesting a growing quality backlog. Since the assumptions underlying these estimates are conservative and since the income elasticity assumed is not out of line, it seems likely that there is a growing residential construction backlog in Thailand, probably at a level somewhere between the backlog based on the upper and lower bound estimates. If so, the key questions to answer are, what has kept supply from meeting the implied demand and when, if ever, will the market begin to remove the backlog. And, if this happens will speculation take over the resulting residential construction boom? There are certainly policy issues here of concern to the Thai government.

Turning briefly to the sources of growth in demand for housing in Thailand as measured by the estimates include existing as well as new units, withdrawals provide a fairly constant but rapidly increasing source of total residential construction (Fig. 3:4), finally overtaking "population growth only" in the last quinquennium. Up until the present "population only" and "income only" sources move together fairly closely, though "income only" is a slightly more important source. But from here on, based on our assumptions, the major source of growth in the value of the housing stock from one quinquennia to the next will be income growth, by 2010-15 accounting for over half the total. Of course the effect of "income only" is based on the assumption that the entire stock is upgraded, [9] but the significance of income elasticity in future Thai housing markets is clear. Conversely, the residential construction expenditures caused by "population changes only" will increase by decreasing amounts and finally fall in the last quinquennium (to 17% of the total; from 46% in 1950-55).

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[9] "Population only" is weighted by the result of the net upgrade due to income growth up to the beginning of each quinquennium .Essentially, each quinquennium starts with the average value of the housing occupied by each age class adjusted for the differences in per-capita income and so quality of housing demanded from the 1970 level.

Net residential construction expenditures (on new units only; there is insufficient information on the distribution by age of expenditures on existing units) by broad age classes assuming withdrawals are roughly distributed in proportion to the share of the housing stock occupied by heads of different ages are shown in Fig. 3:5 A major and continuing boom in residential construction in Thailand of dwellings designed for household heads in their middle ages (35-60) seems likely even given the many uncertainties surrounding our estimates. Since expenditures by this age group are less postponable, the result is even more significant. On the other hand, while expenditures by younger heads (15-34) will remain relatively high in the present quinquennium after peaking in 1980-85, they will drop below present levels quickly there after and finally, in the last quinquennium, become "negative". To the extent that housing is specialized to the needs of different age classes, this suggests some difficult times ahead for the builders and owners of properties designed for younger households in Thailand. Finally, the market for older households will increase consistently but relatively slowly until the final quinquennium when it will take off.

Given the importance of the income growth and elasticity assumptions, it is relevant to test the sensitivity of the results presented to variations in the assumed income elasticity and to the forecast growth rates. Lower bound estimates based on an assumed income elasticity of 0.5 and the actual and forecast growth rate, on an assumed income elasticity of 1.0 and a growth rate of 2% per-annum in per-capita income, and on the combination of the 0.5 and 2% per-annum growth assumptions are compared in Graph 3:6 with the lower bound estimates already presented [10]

Clearly, shifting the income elasticity and growth rate assumptions as indicated does markedly change the Thai results. All the changes made in the underlying assumptions restore the long-cycle in residential construction observed on the basis of zero elasticity of demand and greatly reduce the forecast future levels of construction. But,

[10]Only RCL estimates are presented since the relative variation in the RCU estimates is similar though wider in amplitude.

all, when compared with the actual level of residential construction, suggest a large and growing quality backlog in Thailand.

Relation to Gross Domestic Product, Gross Domestic Investment and the Labor Force

As mentioned, to fully evaluate the impact on the Thai economy of the growth in residential construction forecast it is necessary to relate these various residential construction forecasts to forecasts of the growth in gross domestic product (GDP) in gross domestic capital formation (GDI) and in the labor supply in Thailand. Estimates involving the continual upgrading of the quality of the entire housing stock show the share of residential construction in GDP increasing throughout the period covered, though the increase between the last two quinquennia will be small (see Fig3:7). However, if the income induced adjustment in quality is restricted to newly built units, then the share of residential construction will slowly rise to a peak in 1995-00 and fall off thereafter. Still, the share will remain above the 1980-85 level until the final quinquennium.

Thus, both of the basic income adjustment forecasts suggest a substantial increase in the share of residential construction in national output in Thailand for some time to come. In other words, real resources will be attracted to the residential building sector from others (agriculture?) if the scenario suggested by our investigation comes through. A coming residential building boom in Thailand is implied, if one is not already here.

The forecast share of residential construction in GDI tells a similar story, with an important exception. Even upgrading the entire housing stock will not keep Thai residential construction growing as a share of GDI throughout the period covered. If income adjusted residential construction follows the assumptions underlying either of estimates presented, the share of residential construction in GDI in Thailand will grow most rapidly in the present quinquennium with the peak share coming in the next, the

1990-95, quinquennium. However, while falling, residential construction's slice of GDI will remain above the 1980-85 level to the end of the period for the upper bound estimates and through the first quinquennium of the next century for the estimates based on upgrading new units only. For most of the next three decades then, residential construction will use up a larger share of Thailand's domestic saving and foreign borrowing then it has in the recent past, with obvious growth implications.

Another way of looking at the relative impact of the different forecasts made is to relate them to the labor force. Table 3:2 gives indices of labor requirements for all the residential construction estimates discussed using a 1970-75 base and of the labor supply (based on a constant participation rate) and labor demand (from Chapter 3) The growth in requirements shows that 12.6 times as much labor will be required in 2010-15 as was required in 1970-75 to build the units and make the improvements needed to meet the demand arising if the entire housing stock is upgraded. This growth is much larger than the growth in the labor supply, as shown in Table 3:3, and larger than the growth in labor demand.

Only if future residential construction is limited to the level based on demographic factors alone would it appear that there would be no upward pressure on real wage rates in this sector. However, with the skills required for the construction trade relatively easy to acquire and with "surplus" labor in the agricultural sector now and the prospect of development and excess demand for labor in the 21st Century leading to more capital intensive production and so greater labor productivity in industry at that time, the supply of labor to residential construction is likely to be relatively wage elastic both in the short and long-run. This may not be sufficient to prevent the relative prices of new dwelling units from increasing. if requirements do in fact increase by a factor of twelve and there are no unprecedented increases in productivity in the construction sector, This would not necessarily reduce the baht amount of residential construction expenditures below the levels forecast but it could reduce the real resources required.

Figure 3.6

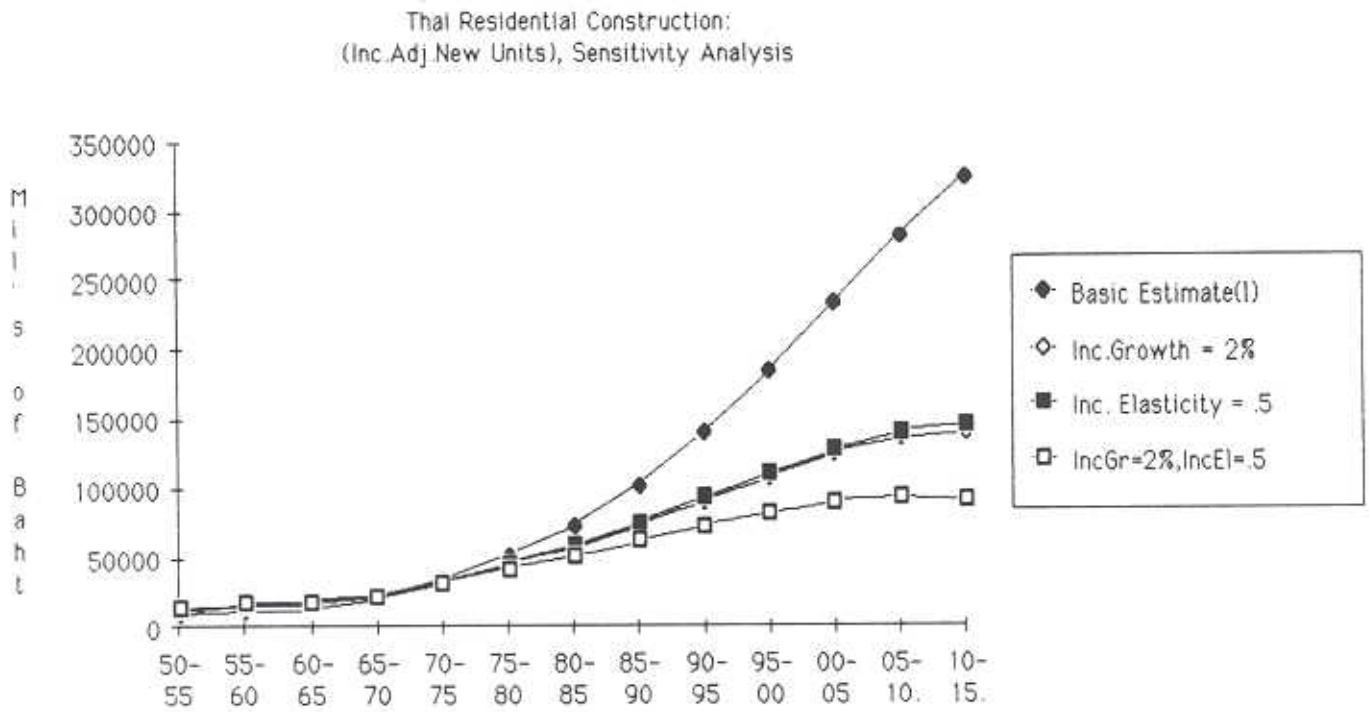
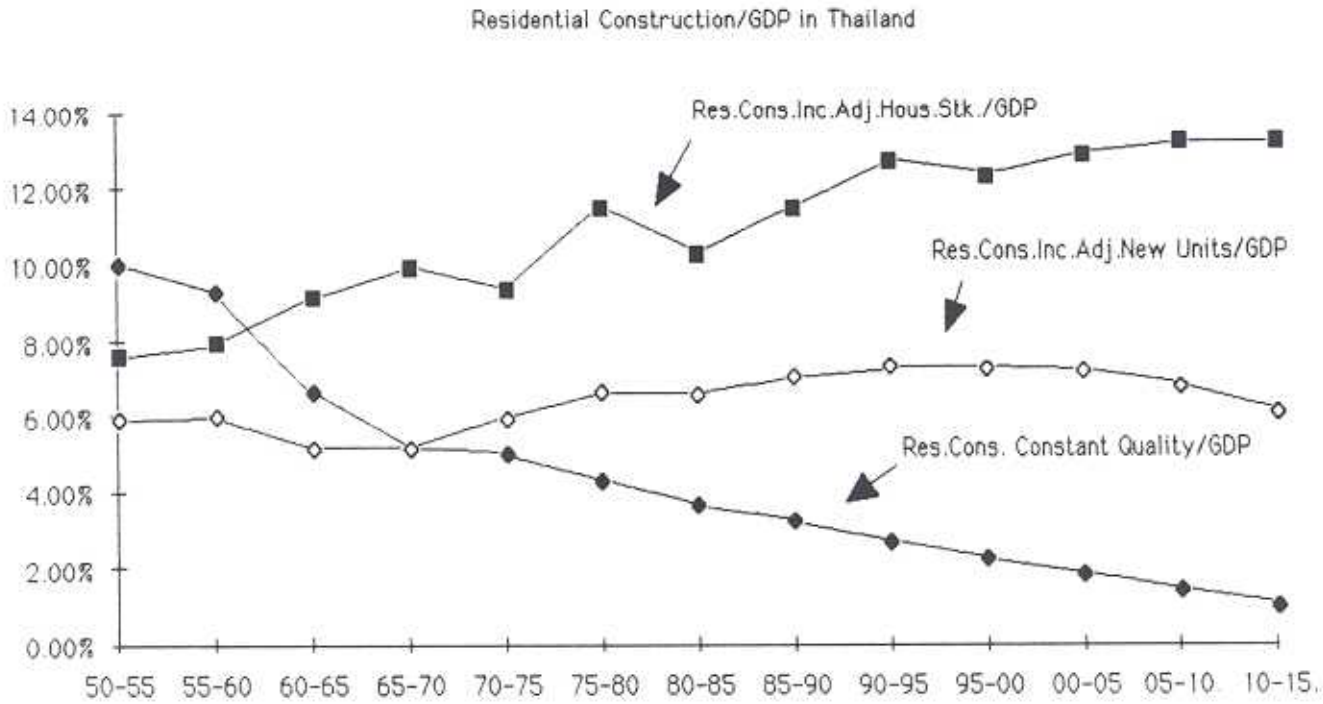

Thai Residential Construction:
(Inc.Adj.New Units), Sensitivity Analysis
Mil. of Baht
350000
300000
250000
200000
150000
100000
50000
0
50-55
55-60
60-65
65-70
70-75
75-80
80-85
85-90
90-95
95-00
00-05
05-10.
10-15.
Basic Estimate(1)
Inc.Growth = 2%
Inc. Elasticity = .5
IncGr=2%,IncEl=.5

Figure 3.7


Residential Construction/GDP in Thailand
Res.Cons.Inc.Adj.Hous.Stk./GDP
Res.Cons.Inc.Adj.New Units/GDP
Res.Cons. Constant Quality/GDP
14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
50-55
55-60
60-65
65-70
70-75
75-80
80-85
85-90
90-95
95-00
00-05
05-10
10-15.

International Effects

The final effects of a residential building boom involve the exchange rate and the balance of payments. Increased residential construction will increase demand for imports directly as some inputs are import competing in both the construction industry and the industries complementary to residential building. Increased residential construction will also have an indirect effect through its impact on GDP and so on imports. Except for the minor possibility of better housing increasing productivity nationally, increased residential construction is not likely to increase exports and so the net effect of a residential building boom in Thailand should to be worsen the current account and depreciate the baht, other things equal.

4. CONCLUDING COMMENTS

On balance, if the effects of income growth on the quality of housing are correctly included, the forecasts presented point to a residential construction boom in Thailand, at least into the first decade of the 21st century. Further support for this conclusion derives from the fact the estimates presented most likely err on the conservative side since, for example (1) no makeup of any actual quality backlog is accounted for, (2) a zero income elasticity of "undoubling" and of household formation is assumed, (3) internal migration does not leave any regional markets with an excess of housing while creating an excess demand for housing elsewhere and shifts in demand between types of housing (e.g. as the age composition changes) are not considered as a source of net excess demand (both circumstances in which new units are required even if there is no population change).

However, it is necessary to investigate further the premises on which the forecasts are based to narrow analytically the range of possible outcomes. The point is, the present analysis is able to set out the possibilities and the assumptions upon which they are

based and so aids the advance planning that is so important for rational decision making in both the private and public sectors.

Appendix A

Estimation of the Occupied Housing/Households Ratio (Af) in Thailand

Estimates of the number of occupied housing units are available for 1970 (two estimates), 1975, and 1980 from the Ministry of Interior, Registration Record (unpublished). Estimates of the number of occupied units are also available for 1970 based on samples of heads by tenure type and heads by character of living quarters conducted for the 1970 Population and Housing Census. These various estimates are not the same, ranging from 5.608 to 5.923 million.. Both these extreme values come from the Ministry of Interior records. The Census estimates fall in between at 5.857 and 5.856 million.

The total number of households reported by the Census was 6.211 million. Combined with the foregoing estimates of occupied housing, this number of households yields the following range of A_f ratios, .903, .943, .945, .954[1] Since there is little basis for choosing between the four available estimates of the occupied housing stock, the decision was to take the average of the four estimates just presented as the 1970 value of A_f. This is .936.

As shown in Table A:1, this puts the A_f for Thailand just slightly above the level for Malaysia, where there is a similarly large proportion of the population in rural areas, and considerably above the A_f found in the almost entirely urban countries of Singapore and Hong Kong. Thus the estimate used seems quite reasonable.

However, since the evidence elsewhere as well as one Thai estimate [2] clearly shows that "doubling" rates differ between urban and rural areas, some adjustment for the growth in the relative size of the urban population over time was necessary. This was accomplished by assuming that the 1970 estimate of A_f given is correct for the country as a whole and that Thailand's urban "doubling" ratio is the same as in urban Malaysia (.8333). The implicit rural ratio (A_{fr}) for Thailand was then found by solving the following equation using the 1970 shares of

[1] Calculated in the same way using the single Ministry of Finance estimates available the A_f ratios for 1975 and 1980 were .900 and .866 respectively.

[2] see Table A, p.26, Housing Survey 1976, National Statistical Office, 1977

the urban (.1418) and rural (.8582) populations:.

$$A_{fr} = [.936 - .8333(.1418)]/(.8582) = .953$$

The urban and rural "doubling" ratios are assumed to remain unchanged over time and so the national A_f changes with the percent of the urban and rural populations in the total population. The latter was estimated by one of the authors from a trend equation using the percent share of the urban population reported in the 1960, 1970, and1980 Censuses as the base points. Finally, a zero level of "doubling" or an A_f of 1.00 was used as an upper limit and one of .90 was used as a lower limit for purposes of sensitivity analysis.

Table A:1

A_f's In Selected Countries

Country	A_f
Hong Kong	0.7692
Malaysia	0.9259
Peninsula Malaysia (Urban Area)	0.8333
Singapore	0.8333

Sources: Hong Kong, Peninsula Malaysia (Urban Areas), Singapore from Yeh, S.H.K. (ed.), Public Housing in Singapore: A Multi-Disciplinary Study, (Singapore: Singapore University Press, 1975); Malaysia from Yeh, S.H.K. and Laquian, A.A., (eds.), Housing Asia's Millions (Ottawa: IDRC, 1979)

Appendix B

Estimated "Normal" Vacancy Ratios (A_{V1}) for Thailand

Since there are no data on vacancies available for Thailand,[1] a range of ratios from other, possibly similar, ASEAN countries is used instead. Data on the vacancy ratio are available for Singapore and the Philippines and are given in Table B:1.[2]

Considering that Singapore is an urban area and that vacancy ratios in urban area's generally are higher than in rural areas, the Singapore A_V's can be assumed to be higher than those normally found in Thailand. The structure of the economy of Thailand is similar to that of the Philippines in many respects, and the reported A_V's for that country, ranging from 1.5% to 3.1%., seem more likely benchmarks for the Thai estimates. Consequently, the standard, non-cyclical vacancy rate used in the estimates presented is 2% and the maximum value used, for comparative purposes, is 4%.

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[1] In the 1980 Population and Housing Census data were collected on vacancies, but the National Statisitical Office has not released these data.

[2] Data are also available for Malaysia but they are so far out of line with experience elsewhere that they must be seriously questioned. They suggest a vacancy ratio of 15% in 1947 and of 11% in 1970 in a predominantly rural country with a growing rural and urban population!

Table B:1

Vacancy Ratios: Singapore, Philippines

Singapore	1970	5.92%
	1980	9.86%
Philippines	1970	3.07%
	1970	1.48%
	1980	3.05%

Sources: Singapore: 1970: P.Arumainathan, Report on the Census of Population 1970, Singapore, Vol.I, p.211; 1980 ,Khoo Chian Kim, Census of Population 1980, Singapore, Release No. 6, Households and Houses, p.9; Philippines: 1960 from Bureau of Census and jStatistics, Census of the Philippines: Population and Housing, 1960, Summary Report, Vol. II, p. 23; 1970- from National Census and Statisitics Office, 1970 Census of Population and Housing, National Summary, Vol II, p.635; 1980 from private communication.

Appendix C

Estimated Withdrawal Rates (A_w) in Thailand

Since there is no direct information on total withdrawals from the housing stock in Thailand, it is not possible to calculate the withdrawal rate directly. Instead, the rate must be inferred from the implications of different rates or based on the more complete data collected elsewhere or on the partial estimates available for Thailand. These approaches were all considered, with the first given precedence and the others used as a check on the relations assumed.

Using the forecasts of the housing stock presented (Table 2:1) as a starting point the implications of a 3%, a 2%, and a 1% per annum withdrawal rate were analyzed.

If future withdrawals occur at a 3% per annum or 15% per quinquennium rate (ignoring as is done throughout, intra-quinquennium compounding) then the cumulated withdrawals from the housing stock, beginning in 2015 and summing backward, will exceed the 2015 housing stock some time late in the 1985-90 quinquennium. The implication of this assumption is that all of the housing stock in 2015 will be 25 years of age or less.[1] Since it seems unlikely that actual withdrawals will ever reach and certainly are not likely to exceed 3% per annum, this rate is taken as an upper bound.

Making the same calculation for a 2% rate, we find that the 2015 stock will be 35 years old or less and that 93% will have been built after 1985. Finally, a 1% withdrawal rate implies that the 2015 housing stock includes only houses 50 years old or less and that 81% of the housing stock in 2015 will have been built after 1985.

These results can be given perspective by contrasting them with what would happen if the required withdrawal rate is zero. In this case 60% of the 2015 housing stock would have been built after 1985 (or, alternatively, 40% of the 2015 stock would be over 30 years of age). From this starting point, it seems reasonable to take 1% per annum withdrawals as a lower bound and 2% per annum (10% per quinquennium) as the standard case.

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[1] It would be more correct to say "almost all" of the housing stock. Some of the withdrawals will be the result of random disasters (or economic events) effecting new as well as old units so the numbers given do not rule out the possibility that some older units will remain.

All of these assumed withdrawal rates make no adjustment for the effects of industrializtion and rising incomes. The same rate is assumed to apply throughout the period covered. Although a case could be made for moving the rate from the lower to the upper bound through time, this seemed simply to compound the guess work already involved. For similar reasons, the more complicated approaches to inferring withdrawal rates originally worked through (e.g. estimating the age composition of the stock from experienced and forecast housing stock data; using data on the materials composition of the stock to forecast dwelling unit aging) were discarded.

Looking at experience elsewhere, the only regional data available are for Singapore. These would, of course, be greatly influenced by Singapore's pervasive public housing program. In any event, the Singapore rate was 2.8% per annum in the 1970's (1976 Housing Survey, National Statistical Office, 1977). The United Nations estimates the standard or "typical" withdrawal rate to be 2% (World Housing Survey, report of the Secretary General, United Nations, 1973). All in all these additional guesstimates give no reason to change the withdrawal rate range assumed for this study.

Appendix D

Estimates of the Price of Housing

The distribution of rents by age of head in 1970 was used to compute the average value of units occupied by heads in each age class. To do this the average monthly rent for each age class was computed and multiplied by twelve to find the average annual rent paid by heads in each age class. These rents are shown in Table D:1. To adjust for the inclusion of land costs in the rents paid, the average annual rent paid was then divided by .15 to estimate the price of a dwelling unit that would generate the estimated average annual rent paid by each age class. This devisor derives from the assumptions that rents paid average 10% of the value of the property rented, a common rule of thumb, and that on average land accounts for one-third of the value of the property rented, yielding a ratio of rents paid to dwelling unit values of 15%. The resulting estimates of the average value of dwelling unit occupied in each age class are also given in Table D:1

The estimates shown implicitly assume that the average value of the rental units occupied by each age class of household heads is the same as the average value of the owner occupied units in each age class. With rental units accounting for such a small portion of the total housing stock and with renters as a group being considerably different in location (more in urban areas) and age (younger) than the general population, this assumption can obviously be questioned. This procedure most likely underestimates the average value of housing occupied by older heads, which will lead to underestimating residential construction as the share of older heads in the housing population increases.

On the other hand, the procedure used very likely tends to overestimate the average value of housing in all age classes since it is more heavily weighted by urban dwellings than is the actual housing stock and urban housing, based on very partial data, appears to be more costly on average than rural.

Because of the uncertainty surrounding the procedure used to estimate house prices other approaches, different but equally uncertain, were used to cross check our estimates. These included using (a) aggregative data on residential construction and the number of additional households (there are no data on housing starts) and (b) information on the rural and urban prices of dwellings classified by different building materials along with different data on the number of households in housing classified by building materials in a slightly different manner.

The range of resulting estimates of the average value of a dwelling unit in 1970 was from 17,100

baht to 21,200 baht with the average value based on the procedure used in the text in the middle at 19, 230.

Thus, the approach is probably reasonable in terms of the average value implied and has the distinct advantage over any of the other possible approaches of giving a breakdown of the average value by age of head. This, of course, makes possible tracing the impact of the significant coming shifts in the age composition of households on residential construction.

Looking at the variation between age classes in the average rent paid shown in Table D:1, the fact that the younger age classes tend to spend more on average on housing than do older age classes stands out. This could reflect the variation in rental occupancy over the life cycle, with mostly households at the bottom end of the income ladder continuing to rent as they grow older, or it could reflect the concentration of the impact of industrialization and economic growth at the earlier life cycle stages. If the latter is the main reason, then the estimates shown will clearly underestimate the average expenditures on housing of people now at the early life cycle stages as they age.

For the forgoing reason and others noted above and because it is almost certain that the average value of additions to the housing stock will be greater than the average value of the entire housing stock, the forecasts of residential construction presented in the text are clearly likely to err on the low side.

Table D: 1

Average Rents and Housing Prices by Age of Head

Age Class	Avg. Annual Rent	Avg. Price Housing
15-19	237	18986
20-24	276	22119
25-29	278	22208
30-34	262	20990
35-39	276	22071
40-44	261	20871
45-49	251	20077
50-54	258	20674
55-59	200	15994
60-64	174	13895
65-69	185	14795
70-74	159	12714
75-79	156	12443
80-84	131	10465
85+	149	11918
Wt. Average: A	252	20150
Wt. Average: B		19230

A = the weighted average of the rent paid household sample
B = the estimated average value based on total households by age of head

Appendix E

Table E:1 Change in Households by Age of Head in Thailand 1950-55 to 2010-2015

Age:Head	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-00	00-05	05-.10	10-.15
15-19	9853	11015	21189	25834	23418	27952	30213	13746	6918	5507	-3126	-9866	-6802
20-24	62729	72807	71202	81395	122040	128173	137890	154760	66042	28740	27176	-16529	-53605
25-29	95539	112260	65422	70566	222013	166675	253673	230599	258457	103686	46517	47354	-29246
30-34	82872	94648	59758	64198	157003	169054	288627	297402	270500	300076	118353	145500	-33373
35-39	61932	68665	92901	106534	68227	175372	184547	318786	326978	295495	329476	126811	60569
40-44	56986	63696	91305	106484	103993	184080	80200	201921	345896	353397	318580	355903	134941
45-49	54538	62751	75901	89161	97953	155618	141340	82434	209077	358985	363470	327915	367539
50-54	55109	68069	45719	54829	116143	119002	131463	139953	80255	210602	360442	362751	325506
55-59	45500	62326	34712	48523	59568	89368	130728	123373	133212	74170	199887	344361	345116
60-64	32406	53739	19065	39012	54788	63508	67062	116200	108397	118127	65862	181431	309663
65-69	17849	21834	26428	32984	35052	59288	36769	55799	96741	89360	98372	54505	152905
70-74	11347	13785	19335	24601	16119	52832	17921	27349	43604	73284	68590	76700	44228
75-79	6527	7885	7378	8628	12474	22291	14799	14560	17442	24688	39494	45228	52025
80-84	3453	4390	2230	2458	5176	12651	6842	6634	7928	11206	18177	20788	23998
85+	1846	2299	1564	1580	3363	3360	3496	3439	4116	5772	9211	10565	12024

Table E:2 Value of Required Additions by Age of Head in Thailand 1950-55 to 2010-15

15-19	180	201	384	467	421	502	541	240	115	89	-68	-189	-134
20-24	1334	1548	1498	1710	2563	2680	2876	3215	1333	541	500	-423	-1194
25-29	2040	2397	1375	1481	4692	3497	5327	4811		2085	865	863	-746
30-34	1672	1910	1186	1272	3129	3356	5738	5884	5316	5875	2231	2739	-810
35-39	1314	1457	1951	2234	1415	3666	3845	6644	6782	6087	6755	2486	1091
40-44	1143	1278	1815	2113	2054	3641	1559	3966	6798	6911	6181	6866	2486
45-49	1053	1211	1450	1702	1863	2960	2675	1535	3939	6769	6813	6090	6796
50-54	1095	1353	896	1074	2283	2329	2566	2719	1531	4075	6976	6972	6202
55-59	700	958	526	737	902	1353	1979	1857	1996	1090	2982	5136	5114
60-64	433	718	250	515	723	835	879	1524	1413	1533	837	2342	4000
65-69	254	311	373	465	492	832	511	776	1347	1237	1355	733	2095
70-74	139	169	235	298	194	639	213	326	520	875	813	904	510
75-79	78	94	87	102	147	264	174	170	203	287	459	523	599
80-84	35	44	22	24	51	126	68	65	78	110	178	202	233
85+	21	26	18	18	38	38	39	38	46	64	103	117	133

Table 2:1

Thai Housing Markets: 1950 to 2015
(000's of units)

	House-holds	Occupied Stock	Housing Stock	dHouse-holds	Required Additions	With-drawals	Housing Starts
1950	3449	3251	3316				
1955	4046	3814	3890	597	574	332	906
1960	4734	4462	4552	688	661	389	1050
1965	5423	5105	5207	689	655	455	1110
1970	6211	5838	5955	788	748	521	1269
1975	7354	6902	7040	1143	1085	596	1680
1980	8689	8140	8303	1335	1305	700	2005
1985	10215	9552	9743	1526	1440	830	2270
1990	12001	11200	11424	1787	1681	974	2655
1995	13977	13014	13274	1976	1851	1142	2993
2000	16030	14891	15188	2053	1914	1327	3241
2005	18091	16761	17096	2060	1908	1519	3427
2010	20074	18545	18915	1983	1819	1710	3529
2015	21870	20142	20545	1796	1629	1892	3521

Table 2:2

Required Housing Stock by Age Class in Thailand, 1950-2015

Age Class	1950	1955	1960	1965	1970	1975	1980
Age15-34	1374401	1625394	1916124	2133695	2375688	2900162	3392016
Age35-59	1738915	2012980	2338487	2679025	3084556	3530440	4253880
Age60+	339732	413160	517092	593092	702355	829327	1043257
Total	3453048	4051534	4771703	5405812	6162599	7259929	8689153
Age Class	1985	1990	1995	2000	2005	2010	2015
Age15-34	4102419	4798926	5400843	5838852	6027772	6194231	6071205
Age35-59	4922158	5788625	6884043	8176692	9748547	11266288	12499959
Age60+	1190146	1414127	1692355	2014792	2314498	2703715	3298558
Total	10214723	12001678	13977241	16030336	18090817	20164234	21869722

Source: based on Appendix E:1

Table 2:3

1970 Tenure Rates by Age of Head: Total and Urban
(percent)

Age Group	Total OwnOcc Rate	Urban OwnOcc Rate	Total Non OO Rate	Urban Non OO Rate
15-19	68.04	19.55	31.96	80.45
20-24	78.10	21.51	21.90	78.49
25-29	81.65	29.23	18.35	70.77
30-34	84.62	38.23	15.38	61.77
35-39	87.50	43.52	12.50	56.48
40-44	88.40	47.46	11.60	52.54
45-49	89.78	52.16	10.22	47.84
50-54	91.31	53.29	8.69	46.71
55-59	91.34	55.53	8.66	44.47
60-64	92.07	58.92	7.93	41.08
65-69	92.64	63.77	7.36	36.23
70-74	93.06	68.29	6.94	31.71
75-79	94.33	72.43	5.67	27.57
80-84	95.49	73.88	4.51	26.12
85+	94.55	76.10	5.45	23.90

Table 3:I

Real Residential Construction: Adjusted for Income Elasticity of Housing demand
And Growth in Per-Capita Income (Mil's of Baht; at 1970 prices)

	[1] Value Req Add's (1970 Prices)	[2] Value Req. Add's (Adj Prices) (A)	[3] ΔValue Housing Stock (Adj Prices) (A)	[4] Value With-drawals (1970 Prices)	[5] Value With-drawals (Adj Prices) (A)	[6] Res.Cons. Constant Quality [1]+[4]	[7] Res.Cons. Inc.Adj. New Units [2]+[5]	[8] Res.Cons. Inc.Adj. Hous. Stk. [3]+[5]	[9] Actual Res. Cons.
50-55	11491	6747	9823	6622	3888	18114	10635	13712	
55-60	13676	8816	13331	7683	4953	21360	13769	18284	
60-65	12067	9427	22028	9116	7122	21183	16549	29150	15224
65-70	14213	14213	37028	10302	10302	24515	24515	47330	20965
70-75	20968	24966	47566	11994	14281	32962	39248	61848	23854
75-80	26715	40593	86449	13902	21123	40617	61716	107572	31332
80-85	28990	52203	98951	16714	30097	45703	82300	129048	52082
85-90	33774	73598	147450	19573	42651	53347	116250	190101	
90-95	36784	99258	218152	22710	61281	59494	160539	279433	
95-00	37627	121699	264127	26105	84433	63731	206131	348560	
00-05	36980	144669	350270	29456	115234	66435	259903	465504	
05-10.	33580	160586	456696	31810	152122	65391	312708	608818	
10-15.	28153	166250	586194	32481	191806	60634	358056	778000	

(A) based on an income elasticity of demand of one

Sources: based on Appendices D and E and Table 2:1

Table 3.2

Percent Change in the Share of the Residential Construction Sector in the Total Labor Force by Quinquennia (1)
(Various Estimates)

	Est. I. Based on Constant Quality of New Units	Est. II. Based on Upgraded Quality of New Units Only	Est. III Based on Upgraded Quality of Entire Housing Stock
55-60/50-55	1.44%	11.37%	14.71%
60-65/55-60	-14.92%	3.12%	36.78%
65-70/60-65	0.62%	28.80%	41.17%
70-75/65-70	16.25%	38.41%	12.98%
75-80/70-75	4.74%	33.66%	47.84%
80-85/75-80	-4.75%	12.89%	1.55%
85-90/80-85	-0.54%	20.36%	25.52%
90-95/85-90	0.31%	24.21%	32.21%
95-00/90-95	-7.07%	11.39%	8.21%
00-05/95-00	-7.30%	12.12%	18.76%
05-10/00-05	-7.43%	13.15%	23.00%
10-15/05-10	-13.01%	7.42%	19.89%

(1) The quinquennial changes presented assume a fixed average product of labor in Residential Construction and a fixed national labor force participation rate.

Table 3:3

Indicies of Labor Force Requirements In
the Residential Construction Sector: Various Estimates (1)

	Est. I. Based on Constant Quality of New Units	Est. II. Based on Upgraded Quality of New Units Only	Est. III Based on Upgraded Quality of Entire Housing Stock
1950-55	54.95	27.10	22.17
1955-60	64.80	35.08	29.56
1960-65	64.26	42.17	47.13
1965-70	74.37	62.46	76.53
1970-75	100.00	100.00	100.00
1975-80	123.23	157.25	173.93
1980-85	138.66	209.69	208.66
1985-90	161.85	296.19	307.37
1990-95	180.49	409.04	451.81
1995-00	193.35	525.21	563.58
2000-05	201.55	662.21	752.66
2005-10	198.38	796.75	984.38
2010-15	183.95	912.30	1257.93

(1) The base quinquennia is 1970-75; all estimates assume the average pr oduct fixed at the 1970-75 level.

Figure 2:1

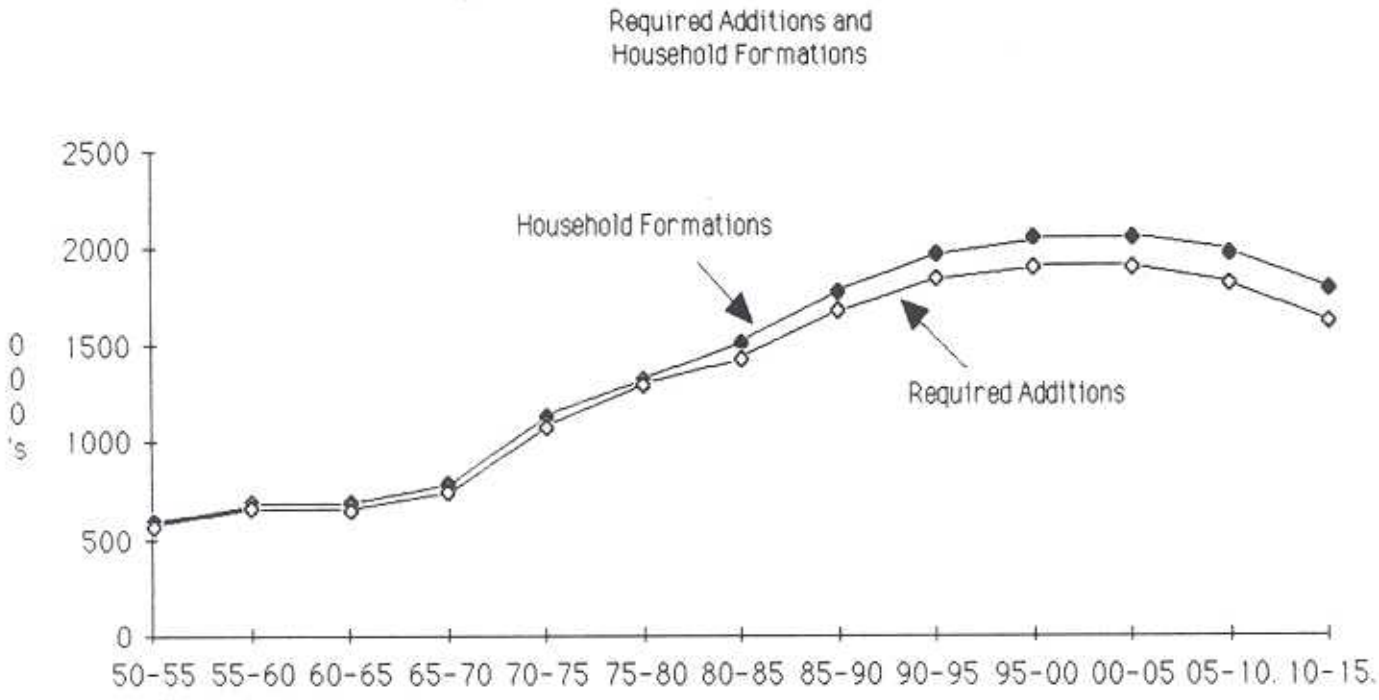

Required Additions and
Household Formations
2500
2000
1500
1000
500
0
0
0
's
Household Formations
Required Additions
50-55 55-60 60-65 65-70 70-75 75-80 80-85 85-90 90-95 95-00 00-05 05-10. 10-15.

Figure 2:2

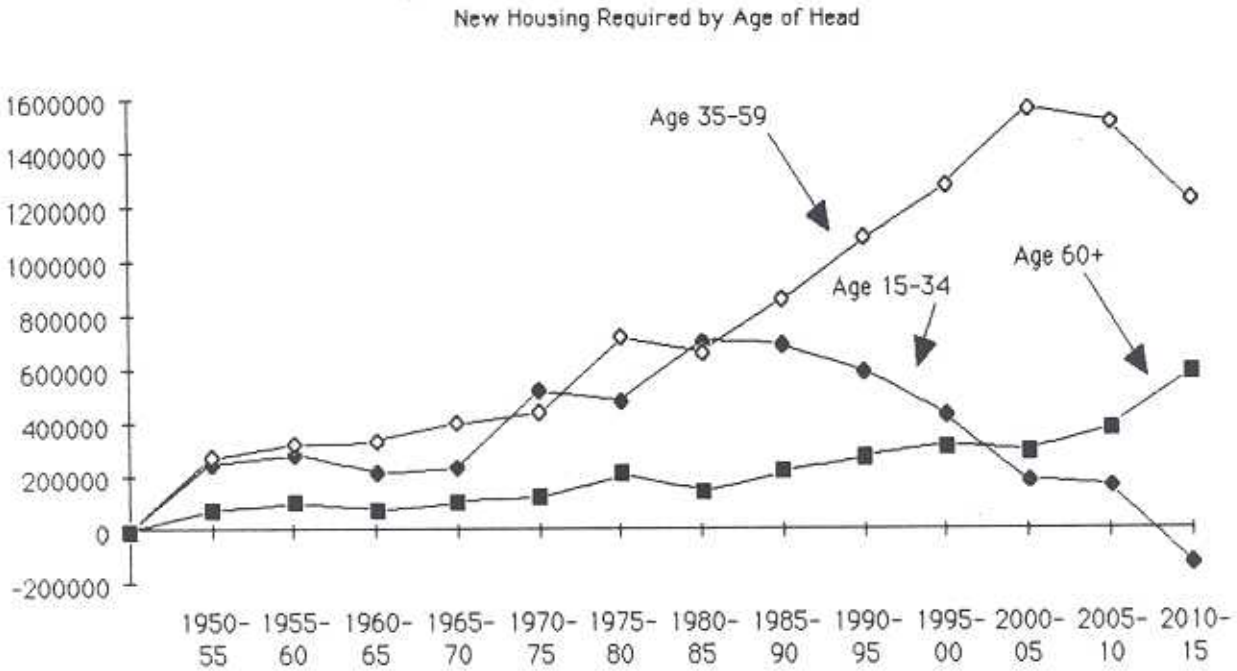

New Housing Required by Age of Head
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
-200000
Age 35-59
Age 15-34
Age 60+
1950-55
1955-60
1960-65
1965-70
1970-75
1975-80
1980-85
1985-90
1990-95
1995-00
2000-05
2005-10
2010-15

Figure 2:3

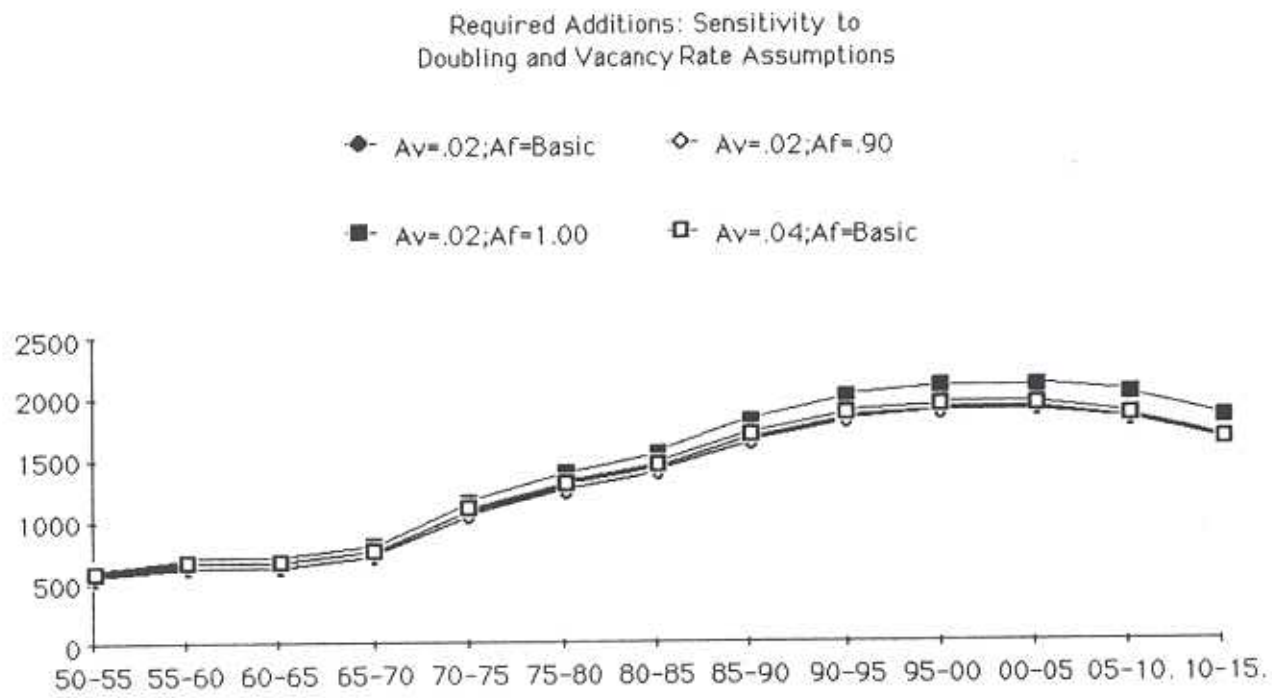

Required Additions: Sensitivity to
Doubling and Vacancy Rate Assumptions
Av=.02;Af=Basic
Av=.02;Af=.90
Av=.02;Af=1.00
Av=.04;Af=Basic
2500
2000
1500
1000
500
0
50-55 55-60 60-65 65-70 70-75 75-80 80-85 85-90 90-95 95-00 00-05 05-10. 10-15.

Figure 2:4

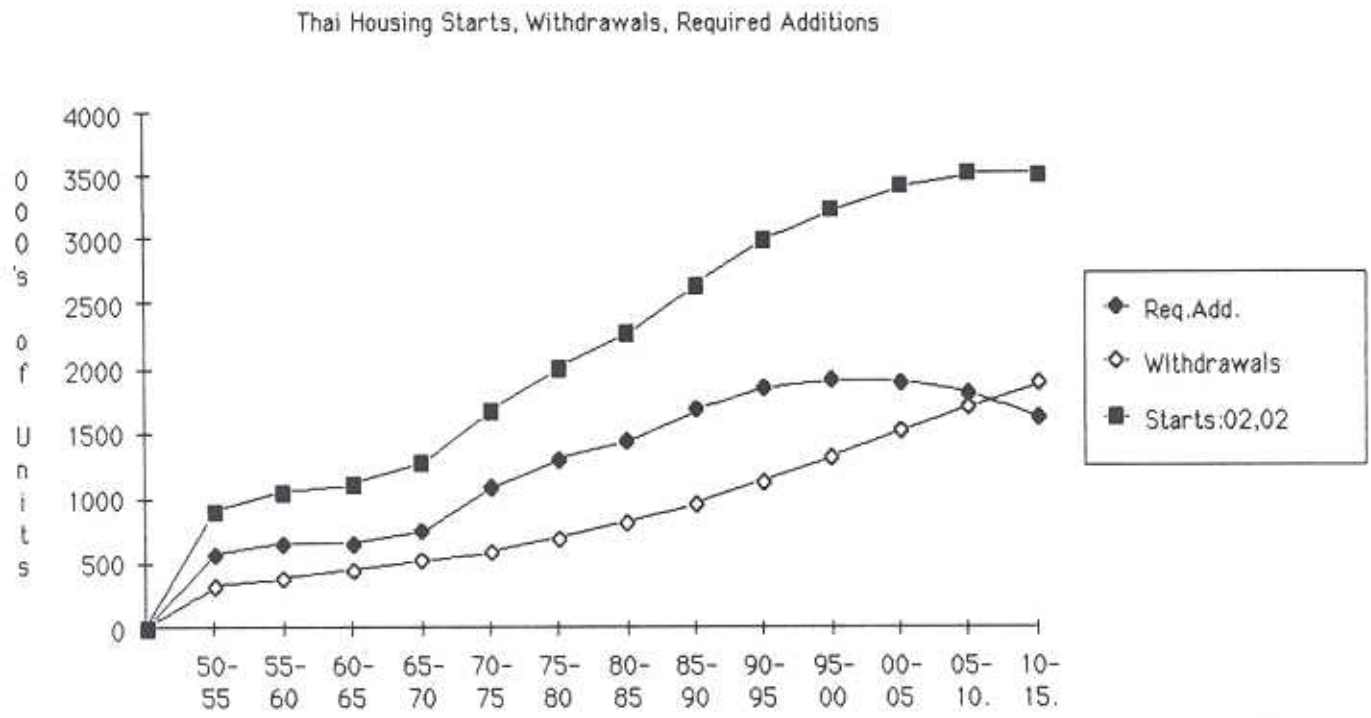

Thai Housing Starts, Withdrawals, Required Additions
000's of Units
4000
3500
3000
2500
2000
1500
1000
500
0
50-55
55-60
60-65
65-70
70-75
75-80
80-85
85-90
90-95
95-00
00-05
05-10.
10-15.
Req.Add.
Withdrawals
Starts:02,02

Figure 2:5

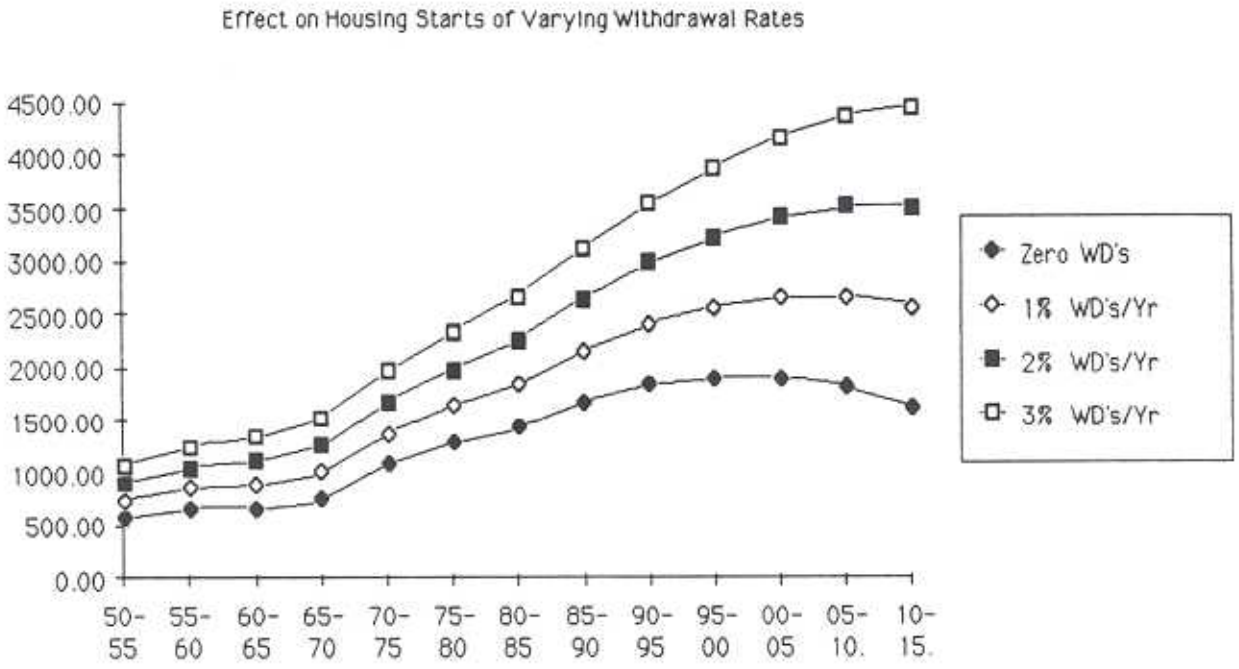

Effect on Housing Starts of Varying Withdrawal Rates
4500.00
4000.00
3500.00
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
50-55
55-60
60-65
65-70
70-75
75-80
80-85
85-90
90-95
95-00
00-05
05-10.
10-15.
Zero WD's
1% WD's/Yr
2% WD's/Yr
3% WD's/Yr

Figure 2:6

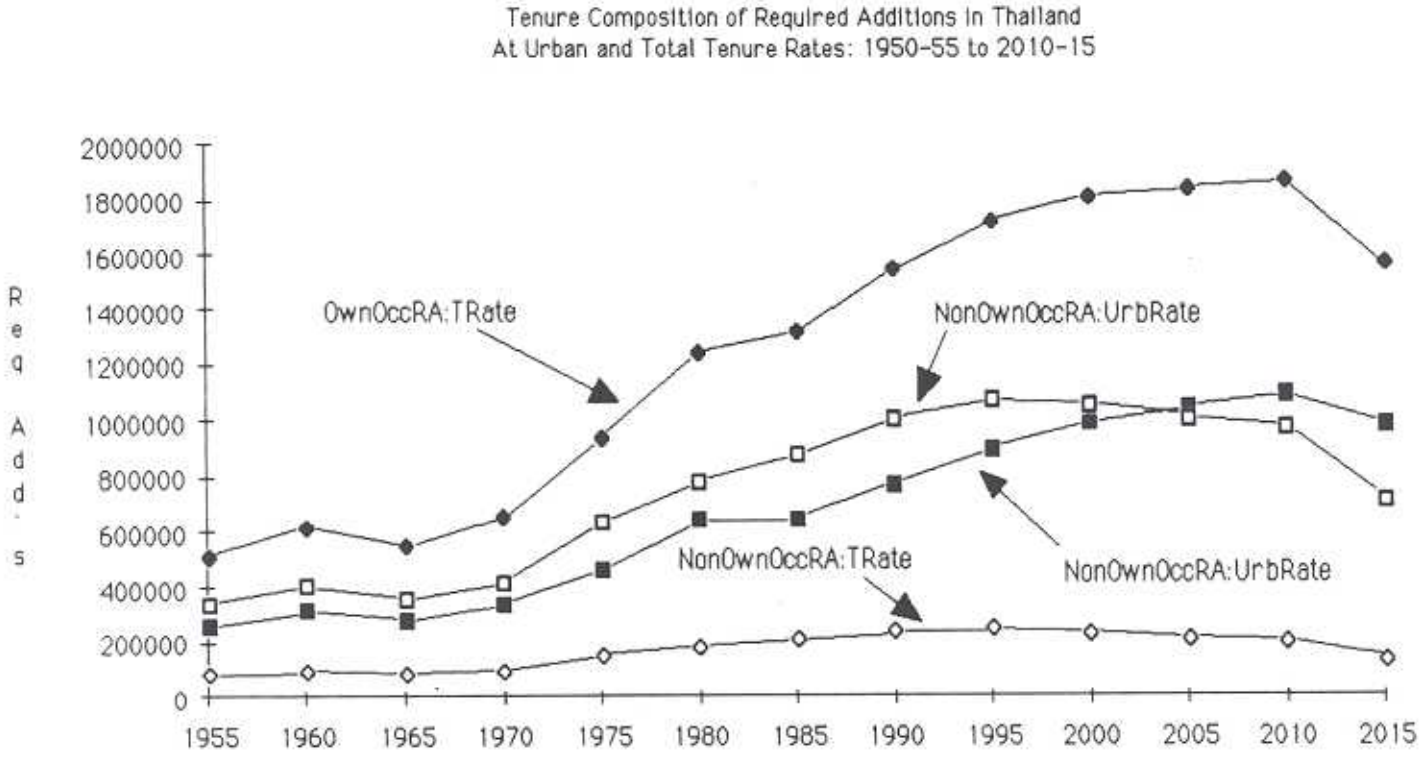

Tenure Composition of Required Additions in Thailand
At Urban and Total Tenure Rates: 1950-55 to 2010-15
Req Adds
2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
OwnOccRA:TRate
NonOwnOccRA:UrbRate
NonOwnOccRA:TRate
NonOwnOccRA:UrbRate

Figure 3:1

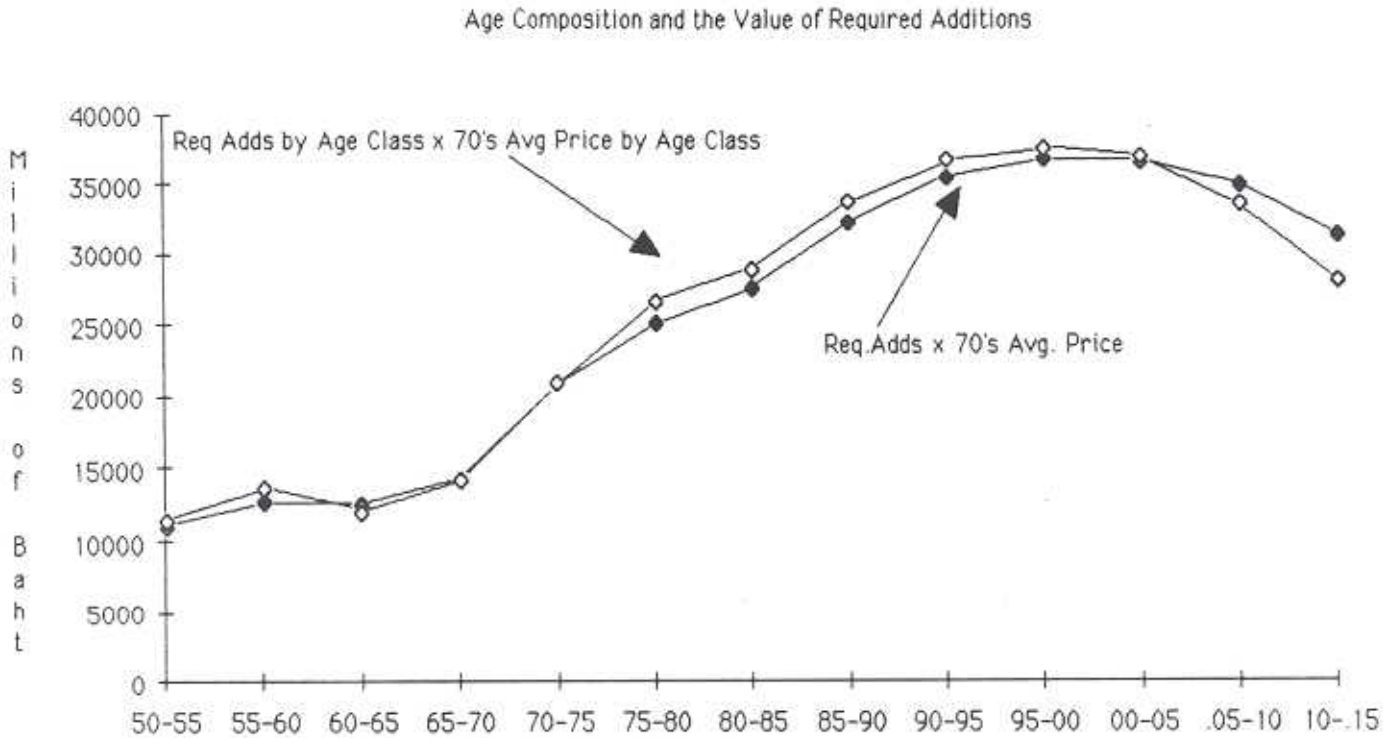

Age Composition and the Value of Required Additions
Millions of Baht
40000
35000
30000
25000
20000
15000
10000
5000
0
Req Adds by Age Class x 70's Avg Price by Age Class
Req.Adds x 70's Avg. Price
50-55
55-60
60-65
65-70
70-75
75-80
80-85
85-90
90-95
95-00
00-05
.05-10
10-.15

Figure 3.2

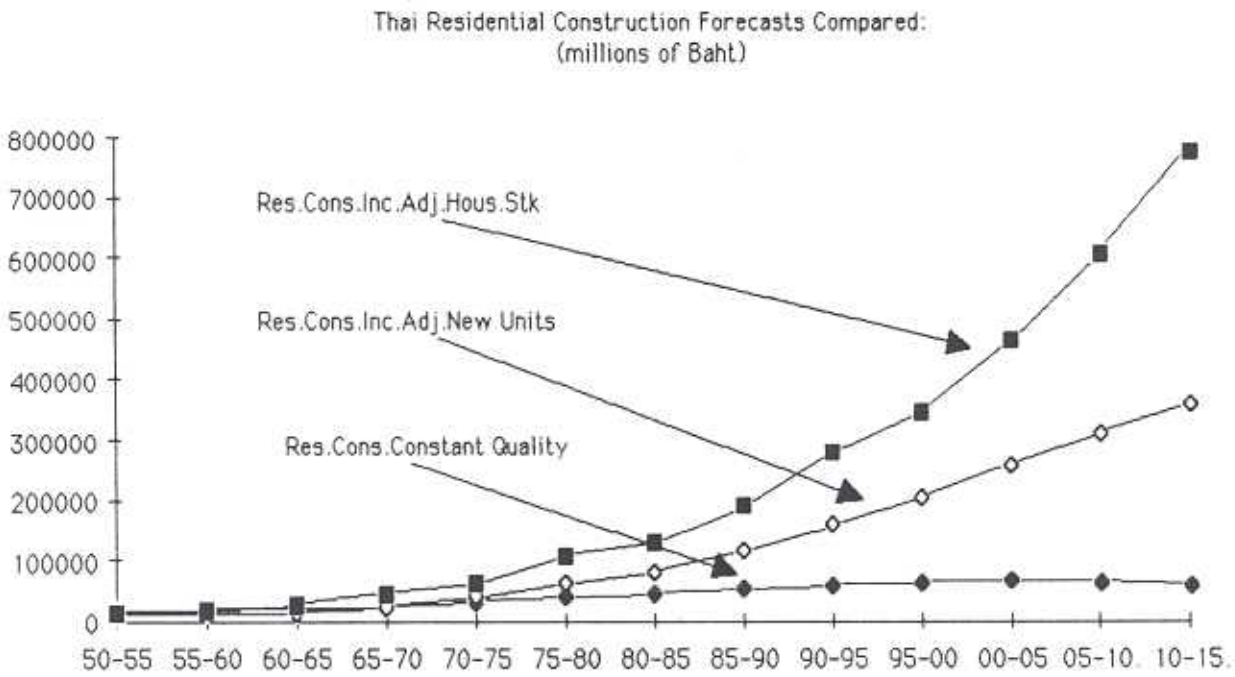

Thai Residential Construction Forecasts Compared:
(millions of Baht)
800000
700000
600000
500000
400000
300000
200000
100000
0
Res.Cons.Inc.Adj.Hous.Stk
Res.Cons.Inc.Adj.New Units
Res.Cons.Constant Quality
50-55
55-60
60-65
65-70
70-75
75-80
80-85
85-90
90-95
95-00
00-05
05-10
10-15

Figure 3:3

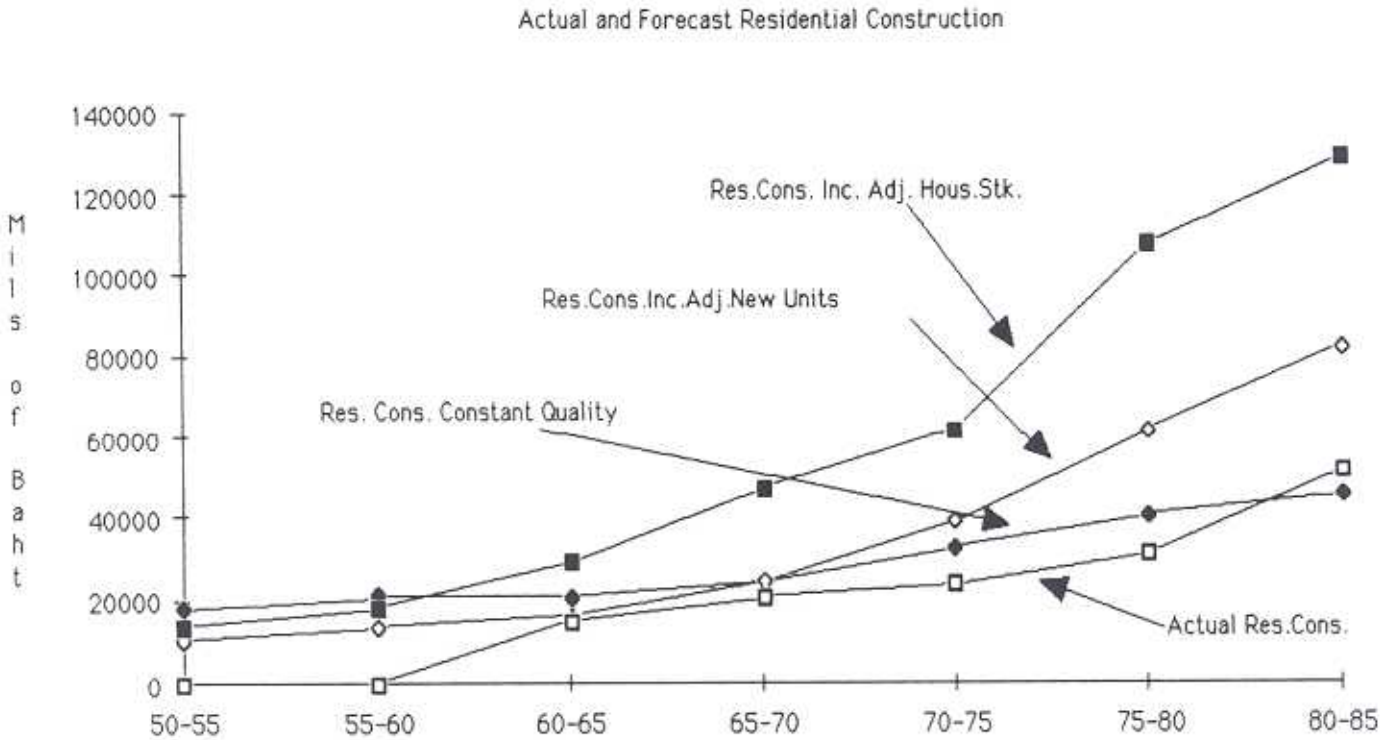

Actual and Forecast Residential Construction
Mils of Baht
140000
120000
100000
80000
60000
40000
20000
0
50-55
55-60
60-65
65-70
70-75
75-80
80-85
Res.Cons. Inc. Adj. Hous.Stk.
Res.Cons.Inc.Adj.New Units
Res. Cons. Constant Quality
Actual Res.Cons.

Figure 3:4a

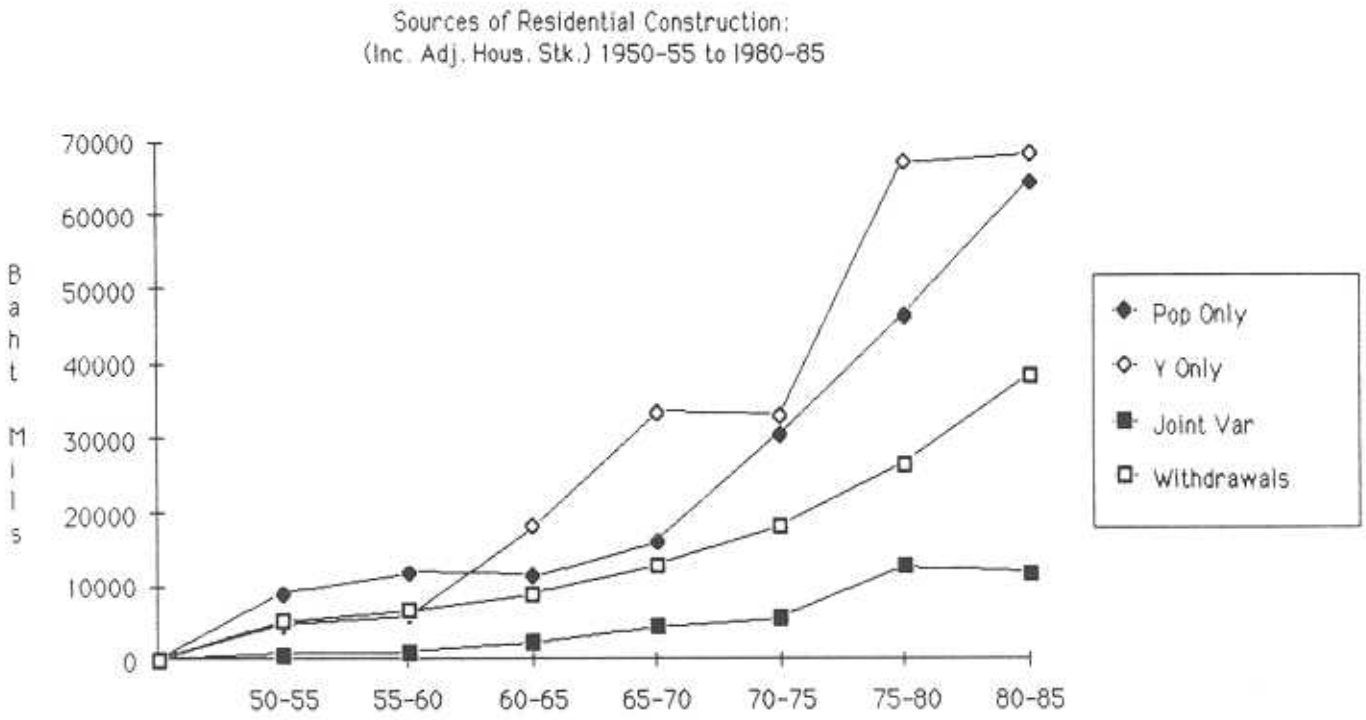
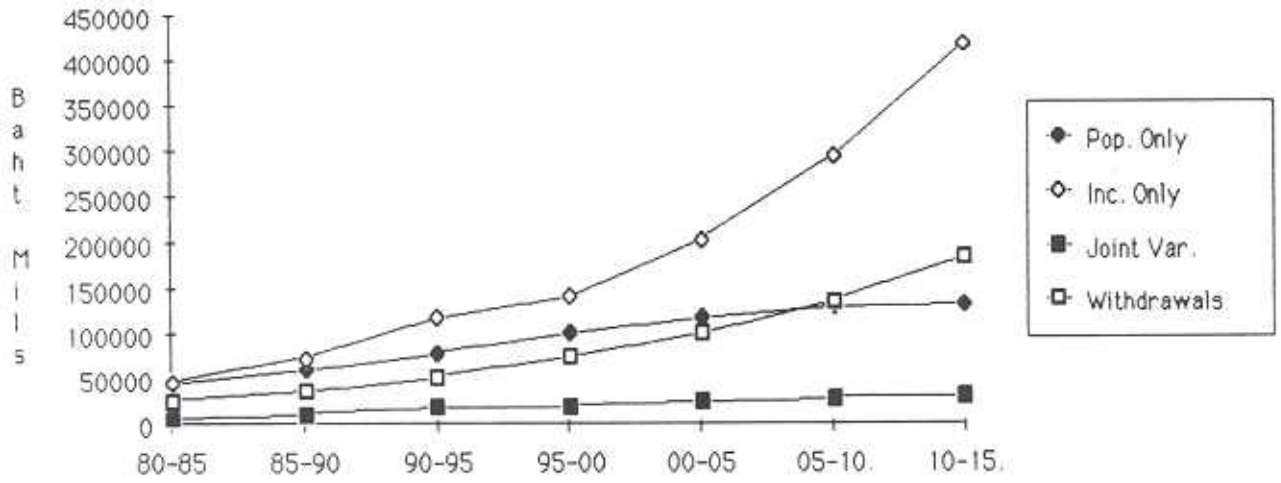

Sources of Residential Construction:
(Inc. Adj. Hous. Stk.) 1950-55 to 1980-85
Baht Mils
70000
60000
50000
40000
30000
20000
10000
0
50-55
55-60
60-65
65-70
70-75
75-80
80-85
Pop Only
Y Only
Joint Var
Withdrawals

Figure 3:4b

Sources of Residential Construction
(Inc. Adj. Hous. Stk) 1980-85 to 2010-15



Source: See text p. ; based on Table 3:1

Figure 3:5

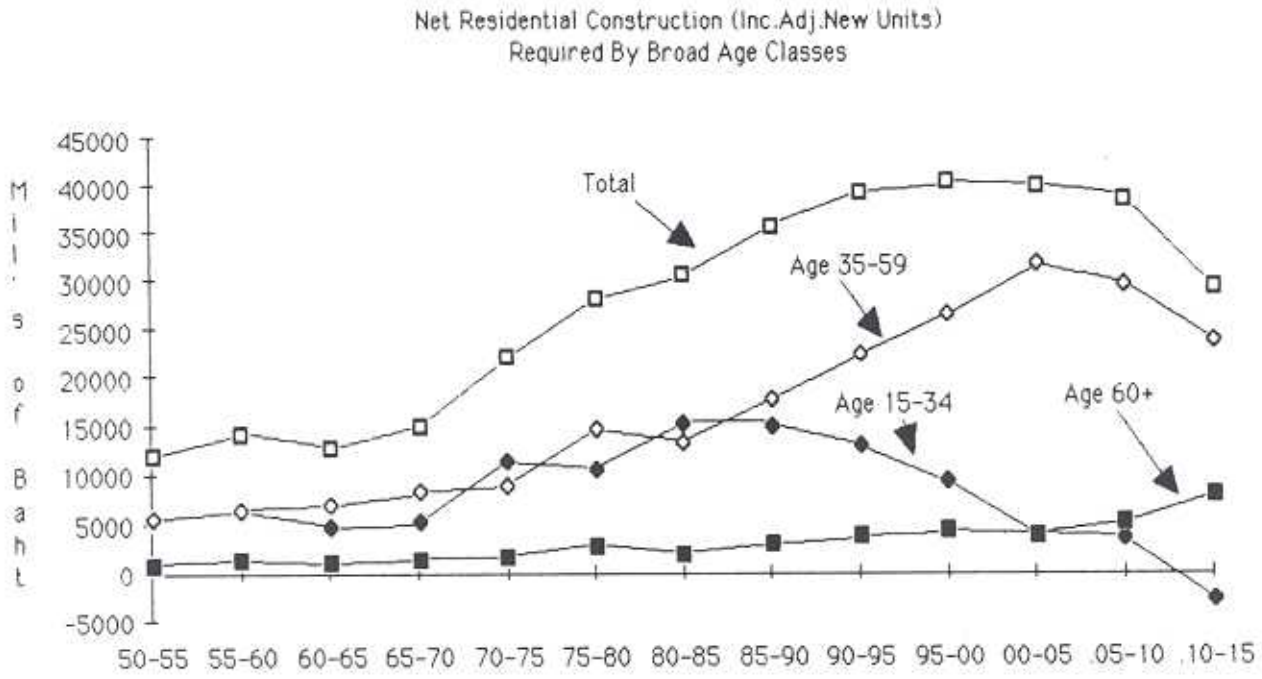
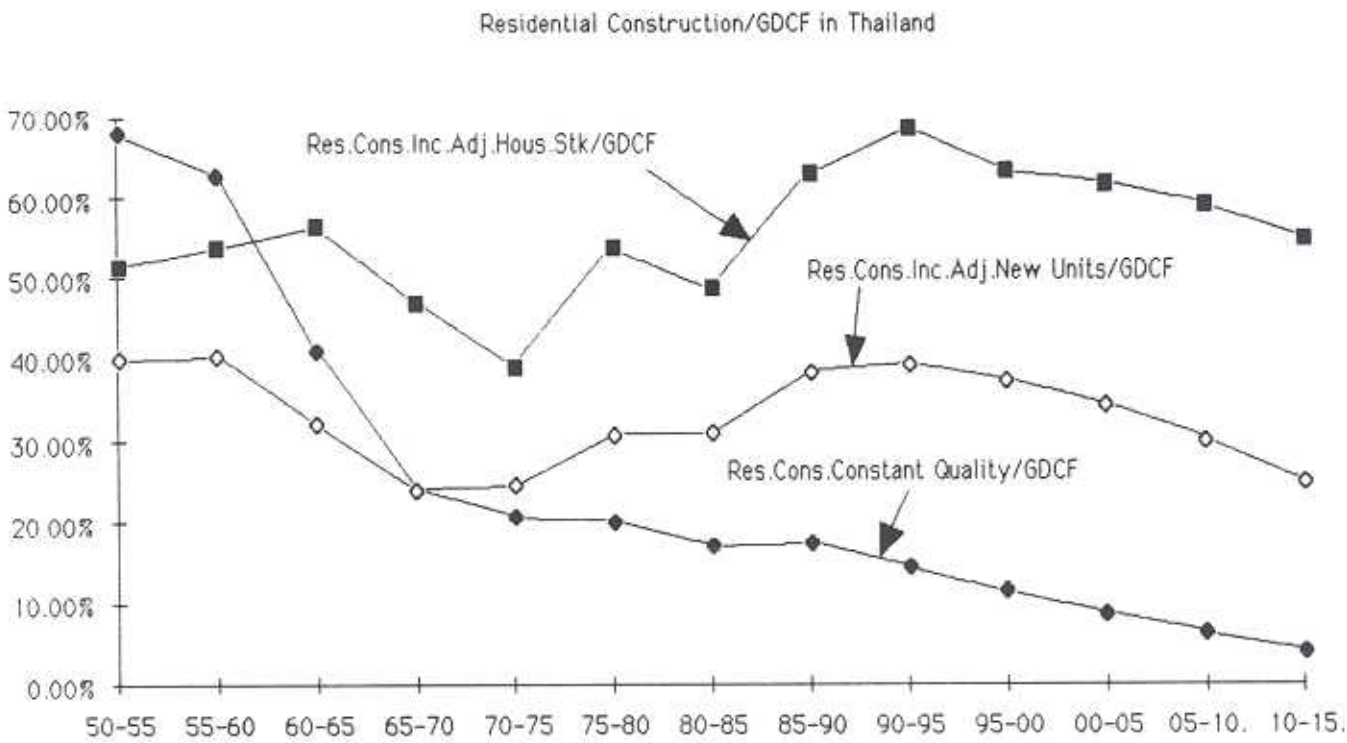

Net Residential Construction (Inc.Adj.New Units)
Required By Broad Age Classes
Mil's of Baht
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
Total
Age 35-59
Age 15-34
Age 60+
50-55
55-60
60-65
65-70
70-75
75-80
80-85
85-90
90-95
95-00
00-05
05-10
10-15

Figure 3.8


Residential Construction/GDCF in Thailand
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Res.Cons.Inc.Adj.Hous.Stk/GDCF
Res.Cons.Inc.Adj.New Units/GDCF
Res.Cons.Constant Quality/GDCF
50-55
55-60
60-65
65-70
70-75
75-80
80-85
85-90
90-95
95-00
00-05
05-10.
10-15.