DEMOGRAPHIC CHANGE AND THE HOUSING MARKET IN CANADA

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March 1995

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Demographic Change and the Housing Market in Canada

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ABSTRACT

This project uses aggregate annual data for Canada to estimate the income and rent elasticities of headship and ownership rates for different age groups and household types. These elasticities are then used to forecast changes in these headship and ownership rates over the period 1991-2003. We confirm that income and rent are important determinants of household formation and tenure choice, especially for non-family households; using current projections for income and rent, we show that projections of housing demand which ignore possible income-rents effects may differ from those which take them into account by as much as 20-30%.

Demographic Change and the Housing Market in Canada

EXECUTIVE SUMMARY

Introduction

- Reviews of empirical research on household formation and tenure choice in this report confirm that, at individual and aggregate levels, these decisions are responsive to changes in the economic environment in the manner predicted by economic theory. That is, headship rates and ownership propensities respond positively to income and negatively to housing prices.

- To account for the impact of changes in the economic environment on household formation and tenure choice, a technique is developed for projecting headship rates and ownership propensities, by household type and age group, on the basis of expected future changes in incomes, prices, rents and mortgage interest rates.

- An attractive feature of this technique is that it can be easily integrated into the current CMHC PHD Model to provide projections of future housing demand in Canada under various economic scenarios.

- The two ingredients required to make projections of headship rates and ownership propensities for Canada by household type and age group are the following ones:

  i) estimated headship rate and ownership propensity functions for family and non-family households, with heads in different age groups;

  ii) forecasts of per capita income, mortgage interest rates and price (CPI) inflation, as well as forecasts of markets rents and house prices.

- This project uses Statistics Canada-CMHC aggregate annual time-series data, for the sample period 1961-1991, to estimate headship rate and ownership propensity functions for family and non-family households with heads aged 15-24, 25-34, 35-64, and over 65. (While ten-year intervals are used for illustrative purposes, the same approach would apply in the case of five-year intervals.)

- Forecasts of per capita income, mortgage interest rates and expected price inflation are generated by the PEAP macro-econometric model at the University of Toronto; forecasts of markets rents and house prices are generated by econometric models of rents and prices that are estimated specifically for this project.

Findings

- The empirical results show that non-family household formation in Canada is more responsive to rent and income than is family household formation, and that younger age groups are similarly more responsive than older age groups.

- In the case of family households, the estimated impacts of rents and incomes on household formation based on the 1971-1991 sample period are generally smaller and less statistically significant than the corresponding estimates based on the earlier 1961-1981 sample period.

- In the case of non-family households, while rents and incomes both had significant effects on household formation in both periods, rents (incomes) seem to have had a greater effect during the later (earlier) period.

- Simulation exercises for the period 1991-2003 reveal that family headship rates for most age groups will not likely be even 5% higher by the year 2003 than would be indicated by projections based on non-economic considerations. Non-family headship rates, however, are projected to be between 20% and 30% higher.

- Using 1971-1991 data, estimated ownership propensity functions for Canada indicate that neither MLS house prices nor a user cost measure (implicit rental price) of owned housing services have a significant effect on the propensity to either own or rent. Positive income effects are observed. Further, the ownership propensities of non-family households are more responsive to income than are the ownership propensities of family households, and younger age groups are more responsive than older age groups.

- Simulation exercises for the period 1991-2003 indicate that family household ownership rates for most age groups will be between 0% and 4% higher by the year 2003 than would be indicated by projections based on non-economic considerations. Again, non-family ownership rates are more responsive and are projected to be as much as 20% higher by 2003.

Conclusions and Recommendations

- Economic variables are important determinants of household formation and tenure choice, especially for non-family households.

- Forecasts of headship and ownership rates should be based on economic analyses by age group, of the type performed in this study; extrapolation of either age-group or cohort histories can be justified only to the extent that the headship and ownership rates are driven by trend movements in factors which are unobservable and largely uncorrelated with the corresponding income and rent series.

- Further research should be undertaken: (i) re-estimate headship rate and ownership propensity functions for family and non-family households, with heads in different age groups, using a more detailed breakdown by province, with 5-year age intervals and with per capita income by age group; (ii) investigate sources of the apparent changes noted above in the pattern of income and rent elasticities over the 1961-1991 period.

L'effet des changements démographiques sur le marché de l'habitation canadien

RÉSUMÉ

Introduction

- L'examen de la recherche empirique sur la formation des ménages et le choix des modes d'occupation permet de confirmer l'influence des fluctuations économiques sur ces décisions aux niveaux individuel et global, comme le prédisait la théorie économique. C'est-à-dire que les taux de chef et les propensions à la propriété augmentent si le revenu est en hausse et diminuent à la suite d'une augmentation du prix des maisons.

- Nous avons donc élaboré une technique pour prévoir les taux de chef et les propensions à la propriété par types de ménages et par groupes d'âges à partir des fluctuations qui devraient se produire dans les revenus, les prix, les loyers et les taux d'intérêt hypothécaires, ce qui permet de tenir compte de ces fluctuations dans la formation des ménages et le choix des modes d'occupation.

- Cette technique a l'avantage de pouvoir être facilement intégrée au modèle PHD actuel de la SCHL, ce qui permet de prévoir la demande future en matière d'habitation au Canada à partir de différents scénarios économiques.

- Les données nécessaires à l'établissement de projections des taux de chef et de la propension à la propriété par types de ménage et par groupes d'âge au Canada sont:

    i) une estimation des fonctions taux de chef et propension à la propriété pour les ménages familiaux et non-familiaux répartis en divers groupes d'âge;

    ii) des prévisions du revenu per capita, des taux d'intérêt hypothécaires, de l'inflation (Index des prix à la consommation) des loyers du marché et du prix des maisons.

- Dans ce projet nous avons estimé les fonctions taux de chefs et propension à la propriété pour les ménages familiaux et non-familiaux répartis dans les groupes d'âges suivants : 15 à 24 ans, 25 à 34 ans, 35 à 64 ans, et plus de 65 ans, en utilisant des données tirées d'un ensemble de séries temporelles annuelles de Statistiques Canada et de la SCHL couvrant la période-témoin de 1961 à 1991. (À titre d'exemple nous avons utilisé des intervalles de dix ans, mais la méthode aurait été la même avec des intervalles de cinq ans.)

- Les prévisions de revenu per capita, de taux d'intérêt hypothécaires et d'inflation ont été produites par le modèle macro-économétrique PEAP de l'Université de Toronto; les prévisions des loyers du marché et du prix des maisons l'ont été à partir de modèles économétriques de loyers et de prix estimés spécifiquement pour ce projet de recherche.

Résultats

- Les résultats empiriques démontrent que les loyers et les revenus influent davantage sur la formation des ménages non-familiaux que sur la formation des ménages familiaux au Canada tout comme sur les premiers groupes d'âges que sur les derniers.

- Les répercussions estimées des loyers et des revenus sur la formation de ménages, dans la catégorie des ménages familiaux, pendant la période-témoin de 1971 à 1991 sont, en général, moins grandes et statistiquement moins importantes que celles qui ont été estimées pour la période-témoin antérieure, soit de 1961 à 1981.

- En ce qui concerne les ménages non-familiaux, bien que les loyers et les revenus aient eu une influence notable sur la formation des ménages durant les deux périodes-témoins, leur influence semble avoir été plus importante entre 1961 et 1981.

- Dans la catégorie des ménages familiaux, des exercices de simulation pour la période allant de 1991 à 2003, faites à partir de considérations économiques, indiquent que les taux de chef, dans la plupart des groupes d'âge, en 2003, n'excéderont même pas de 5 % les taux de chef projetés à partir de considérations économiques. Dans la catégorie des ménages non-familiaux, le même exercice indique que le taux de chef excédera de 20 % à 30 % celui projeté à partir de considérations économiques.

- Une estimation de la propension à la propriété pour le Canada à partir de données provenant de la période-témoin de 1971 à 1991 révèle que ni le prix des maisons publié par le service interagences, ni la mesure du coût pour l'utilisateur d'être propriétaire d'une maison (le prix implicite du loyer) n'ont d'effet déterminant sur la propension à acheter ou à louer. Ces données indiquent, cependant qu'une augmentation du revenu a un effet positif sur la propension à la propriété. De plus, le revenu influe davantage sur les propensions à la propriété des ménages non-familiaux que sur celles des ménages familiaux et sur les premiers groupes d'âges que sur les derniers.

- Des exercices de simulation basés sur des considérations économiques pour la période allant de 1991 à 2003 indiquent que le nombre de ménages familiaux qui deviendront propriétaires, en 2003, dans la plupart des groupes d'âges, sera de 0 % à 4 % plus élevé que celui projeté à partir de considérations non-économiques. Tout comme dans le cas de l'estimation du taux de chef, le même exercice révèle que les considérations économiques influent davantage sur les ménages non-familiaux dont le nombre de propriétaires, en 2003, pourrait être jusqu'à 20 % celui projeté à partir de considérations non-économiques.

Conclusions et recommandations

- Les variables économiques ont une influence déterminante sur la formation des ménages et le choix du mode d'occupation, principalement dans le cas des ménages non-familiaux.

- Les prévisions de taux de chef et du nombre de ménages qui deviendront propriétaires devraient s'appuyer sur des analyses économiques par groupe d'âge du même type que celles qui ont été faites au cours de ce projet de recherche; des extrapolations à partir d'un groupe d'âge ou d'un autre ou des historiques de cohortes ne se justifient que dans la mesure ou les taux de chef et le nombre de personnes qui accèdent à la propriété dépendent de mouvements de tendance dans des facteurs non observables et ayant peu de corrélation avec les séries temporelles de revenus et de loyers correspondantes.

- Une recherche additionnelle devrait être entreprise pour : (i) ré-estimer les fonctions de taux de chef et de propension à la propriété pour les ménages familiaux et non-familiaux répartis en différents groupes d'âge, en utilisant des distributions par province plus détaillées, des intervalles de cinq ans et le revenu per capita par groupe d'âge; (ii) examiner l'origine des changements apparents dans le schéma des élasticités des revenus et des loyers pendant la période-témoin de 1961 à 1991 qui ont été mentionnés auparavant.

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DEMOGRAPHIC CHANGE AND THE HOUSING MARKET IN CANADA

1. Introduction

Growth in population is one of the fundamental determinants of growth in demand for housing, but the connection is not a simple or direct one. The objective of this monograph is to deepen our understanding of how demographic change affects the housing market.

1.1 Framework

A framework for analyzing the connection between population and housing demand is provided by the Potential Housing Demand (PHD) Projection Model, developed by Canada Mortgage and Housing Corporation (CMHC). The model has three main components: a population projection model, a household projection model, and a tenure-choice projection model (CMHC, 1993a). The PHD model begins from a base population and projects the population by age over each of the next 25 years. Then household formation and tenure choices are projected for this population over the 25 years. The model can be used to project the effects on housing demand of major demographic changes such as the baby boom or an increase in immigration.

The population projection model begins from a base population, specified by sex and single year of age for the most recent census year. For ages 1 and above, the basic projection method consists of multiplying the base population by age-specific and sex-specific survival rates to project the population surviving a given twelve month period. Then are added the net number of migrants by age and sex projected for the same period (a number which may be positive or negative). To project age zero, the model uses seven age-specific fertility rates (for women aged 15-19, ... 45-49). A fertility rate is the number of children born in a year to 1,000 women of a certain childbearing age. Total projected births are split into male and female groups. Therefore, the population by age and sex is projected using data on survival rates, net migration and fertility.

The household projection model takes the output of the population model and projects the number of family and non-family households. A household for census purposes consists of a person or group of persons occupying one dwelling unit. This model, therefore, deals with the process by which a given population organizes itself into groups (or households) to

acquire housing. A family consists of either a husband-wife couple with or without never-married children at home, or a lone-parent with at least one never-married child at home. A family household must include at least one family. A non-family household is composed of one or more unrelated (non-family) persons living together. Anyone living alone must be a non-family household. In 1981, 75 percent of private households were family households and 25 percent were non-family households (outside of private households, some individuals live in collective households, such as nursing homes). Two-thirds of households were families living alone and one-fifth were persons living alone (Miron, 1988, p. 26). By definition, every person is a member of a household and the number of private households equals the number of occupied dwelling units.

The household model takes the population projections by 13 five-year age groups (15-19, 20-24 ... 75+) and applies projected family and non-family headship rates by five-year group. A headship rate is the number of households headed by persons of a certain age group per 1,000 persons of the same age group. The model provides historical family and non-family headship rates and the user of the model can either use the existing headship rates of the base year or project changes in headship rates.

The model can calculate average household size by dividing the total projected population by the number of projected households.

The tenure choice projection model projects tenure choice for each age group of family and non-family households using ownership propensities. Projections are done for ten-year age groups (15-24, 25-34 ... 75+) for the two household types. The ownership propensity is the ratio of the number of owning households of a given type and age of head to the total number of owning plus renting households of that type and age of head. The model provides historical ownership propensities and the user can either use current propensities or project changes in ownership propensities.

In summary, the PHD model begins from a base population; then projects population, household formation and tenure choice for the next 25 years. Throughout, population, households and tenure choices are disaggregated by age group reflecting the importance of the lifecycle in both demographic and housing market analysis. Young women are more likely to have children than middle aged women, headship rates differ by age group and

similarly ownership propensities differ by age group. The model is suited to analyzing the effect on housing demand of predictable changes in the age structure of the population, such as those caused by the baby boom.

The PHD model presents a useful framework for thinking about demography and housing demand. A final needed step would be to project the quantity of housing services demanded for each household type, by tenure. The model focuses on the processes of household formation and tenure choice, as well as pointing out the importance of fertility, mortality and net migration. The model could be used to analyze the effects of the baby boom, assuming headship rates and ownership propensities do not change or that they change in the manner projected by the model user.

It must be recognized, however, that much is subsumed under the projected headship rates and ownership propensities. We lose considerable insight into the relationships between demography and housing markets by not analyzing these more explicitly. This point can be illustrated through the following thought experiments. Let us assume that headship rates and ownership propensities are determined by sociological forces, that they are exogenous to the housing market. The projections of headship rates and ownership propensities in the PHD model would be projections of these exogenous sociological forces. The housing market outcome, for example the price of housing, would logically follow after these demand projections. However, the literature on household formation and tenure choice (discussed in Appendices A and B) reveals that these are not determined solely by sociological factors. Headship rates and ownership propensities are determined, in part, by the price of housing and the relative price of owning versus renting housing. They are also influenced by income. But housing prices are themselves influenced by changes in population, headship rates and ownership propensities. Therefore, household formation and tenure choice are endogenous to the housing market. Consider a projected increase in the population aged 25-34 because of the baby boom. Using historical headship rates, the number of households could easily be projected. However, the increase in housing demand caused by the baby boom will increase housing prices and thereby reduce headship rates. In these circumstances, extrapolating historical headship rates would yield inaccurate forecasts of the numbers of future households.

Table 1.1
Population, Households and Tenure Choice
1951-1991

Year	Population	Households	Persons Per Household	Percentage Home Owners
1951	14,009,429	3,409,300	4.11	65.6
1961	18,238,247	4,546,800	4.01	66
1971	21,568,310	6,041,300	3.57	60.3
1981	24,343,180	8,281,530	2.94	62.1
1991	27,296,855	10,018,270	2.72	62.8

Figure 1.1

NUMBER OF LIVE BIRTHS PER YEAR 1951-1991

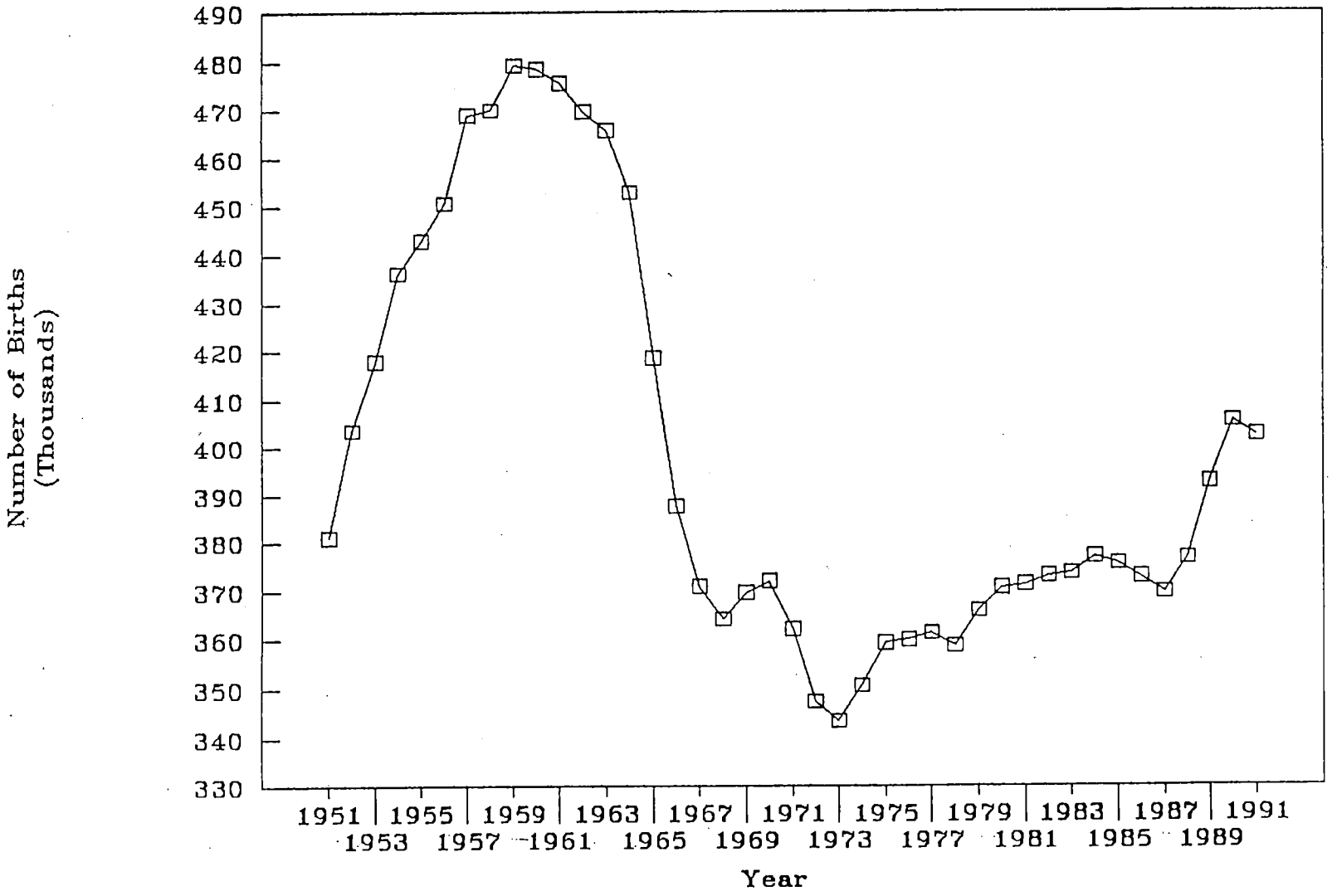

Figure 1.2

AGE DISTRIBUTION OF POPULATION

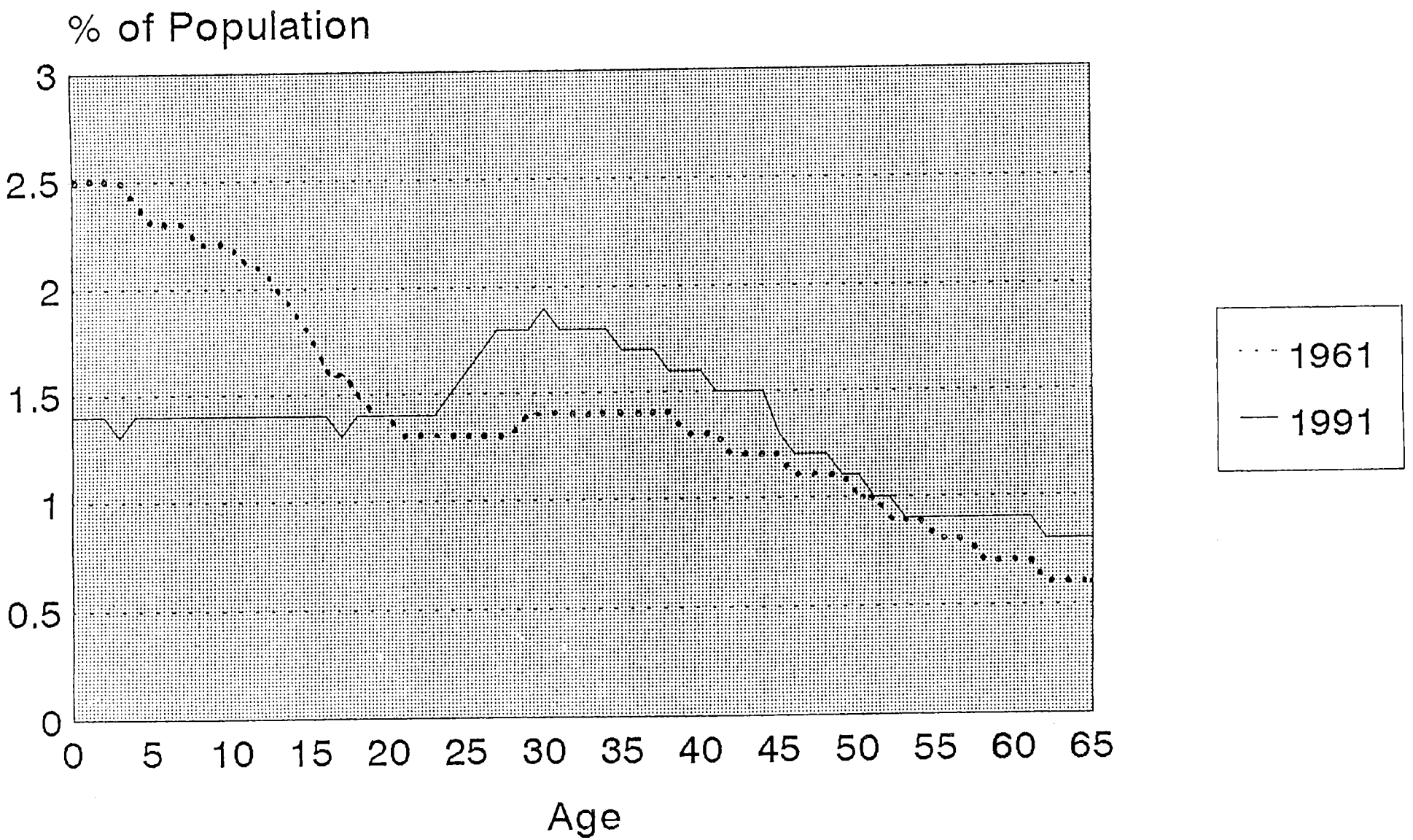

Table 1.2
Age-Specific Fertility Rates **(births/1000)**
1921-1990

	Age Group of Women						
Year	15-19	20-24	25-29	30-34	35-39	40-44	45-49
1921	38	165.4	186	154.6	110	46.7	6.6
1930	30.5	143	176	148	106.7	46.6	5.5
1940	29.3	130.3	152.6	122.8	81.7	32.7	3.7
1950	46	181.3	200.6	141.3	87.9	30.8	3
1960	59.8	233.5	224.4	146.2	84.2	28.5	2.4
1970	42.8	143.3	147.2	81.8	39	11.3	0.9
1980	27.6	100.1	129.4	69.3	19.4	3.1	0.2
1990	26.6	85.5	132.2	88.1	28.8	4	0.1

population growth and a cause of changes in the age distribution.

Population growth, the baby boom and the regularly evolving age structure of the population are the fundamental underlying demography of the housing market. The population projection component of the PHD model projects the population and its age structure over the next 25 years. The main stylized fact is the movement of the baby boom hump through the age distribution. In 25 years, the age distribution will have a peak at age 55. For most purposes, and certainly for the purposes of housing analysis, this demography can be taken as exogenous.

There are two other fundamental exogenous forces to consider when reviewing the historical pattern of headship rates and ownership propensities and when projecting these into the future: real per capita disposable income and real mortgage interest rates. The economics literature on household formation and tenure choice indicate that both income and interest rates are important determinants. Real per capita personal disposable incomes grew rapidly over the postwar era, but the rate of increase declined markedly over the recent census period: real per capita incomes grew over 30 percent from 1961-71, and over 40 percent from 1971-81 but only grew about 16 percent from 1981-91. (See Figure 1.3) Real mortgage interest rates varied considerably from year to year, but two stylized facts stand out: real mortgage rates were very low during much of the 1970s and very high during much of the 1980s and early 1990s. (See Figures 1.4a and 1.4b; the market rate minus the expected rate of inflation approximately equaled 0% and 3% in 1975 and 1980, respectively, and 7% and 8% in 1985 and 1990, respectively.)

Table 1.1 showed how household size declined over the postwar period. Tables 1.3, 1.4 and 1.5 provide more detail. The number of households almost tripled from 1951 to 1991, although the population only doubled (Table 1.1). Table 1.3 reveals that the greatest growth was of non-family households. Family households increased about 2.4 times, while non-family households were more than 7.2 times greater in number. Table 1.3 also shows clearly the movement of the baby boom through the lifecycle. The number of households headed by persons aged 15-24 increased to 1981 and then declined; the number headed by persons aged 25-34 increased continuously. (The Table also shows the aging of our population with households headed by persons over 65 growing 38 percent from 1981 to 1991.)

Figure 1.3

PERSONAL DISPOSABLE INCOME 1961-1993 + FORECAST 1994-2003

(Per Capita, 1986-k$)

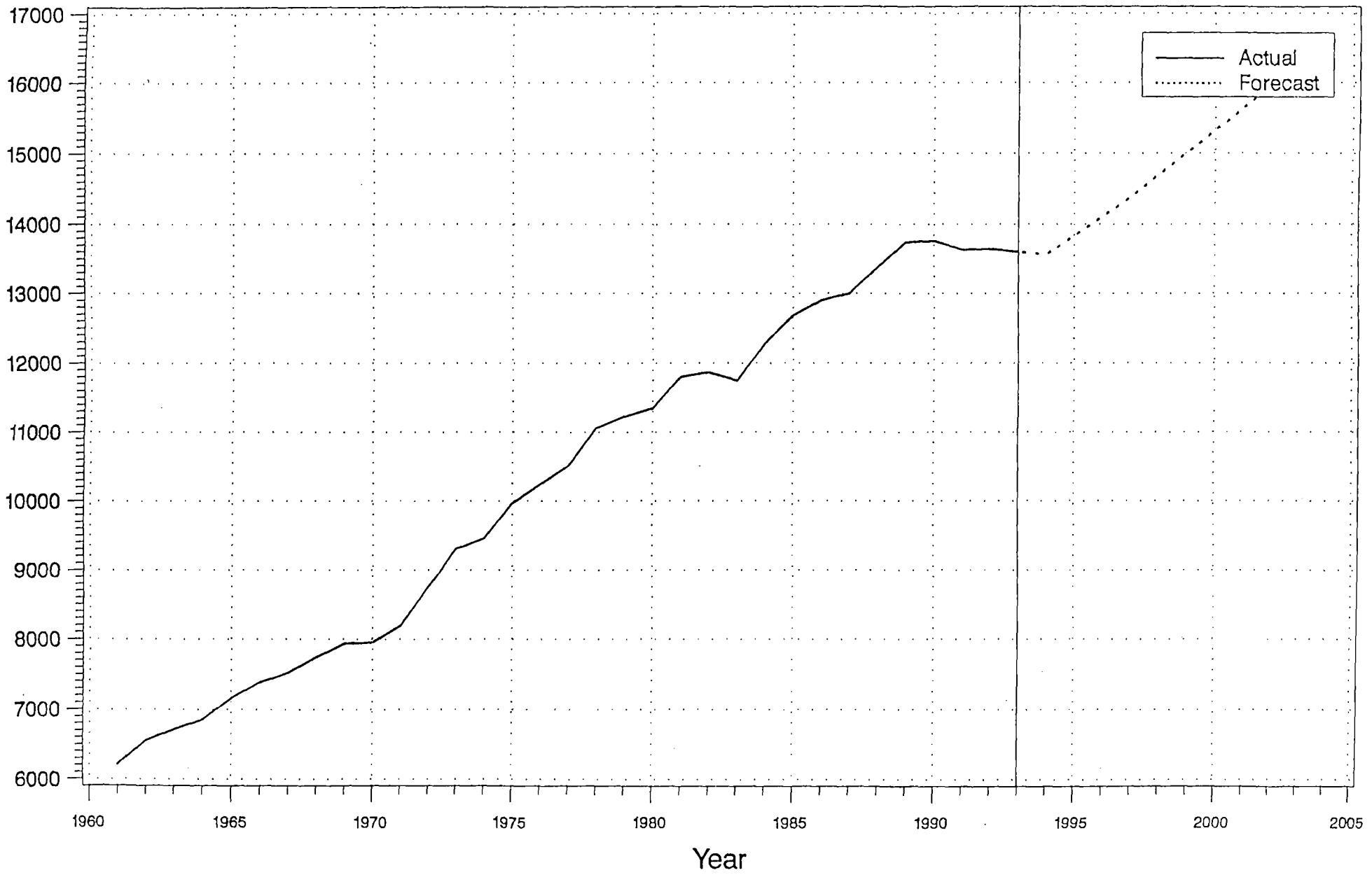

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Figure 1.4a

CONVENTIONAL MORTGAGE RATE 1961-1993 + FORECAST 1994-2003

(Percent)

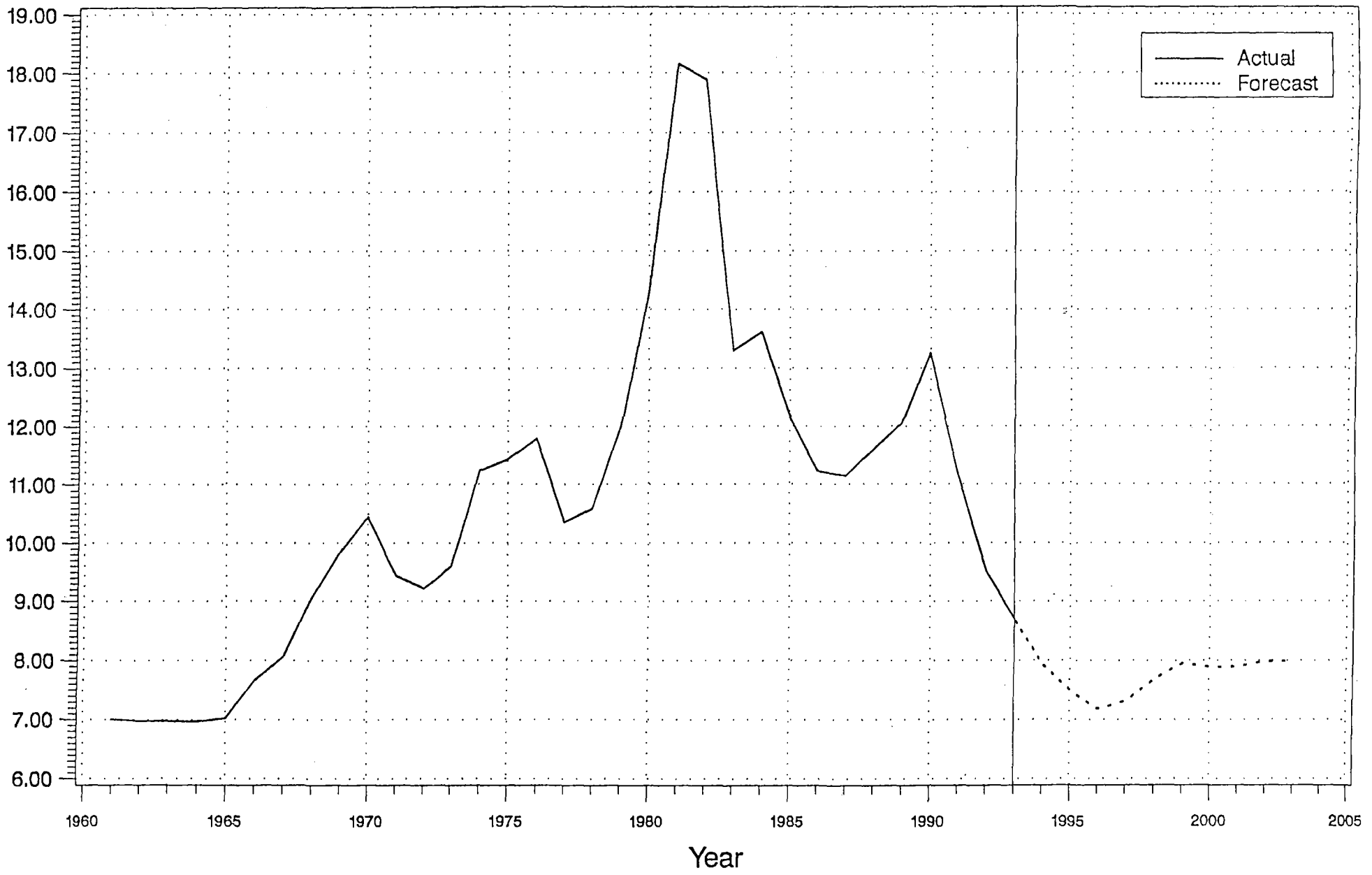

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Figure 1.4b

INFLATION RATE EXPECTATION

(annual, In %; expectation from previous period)

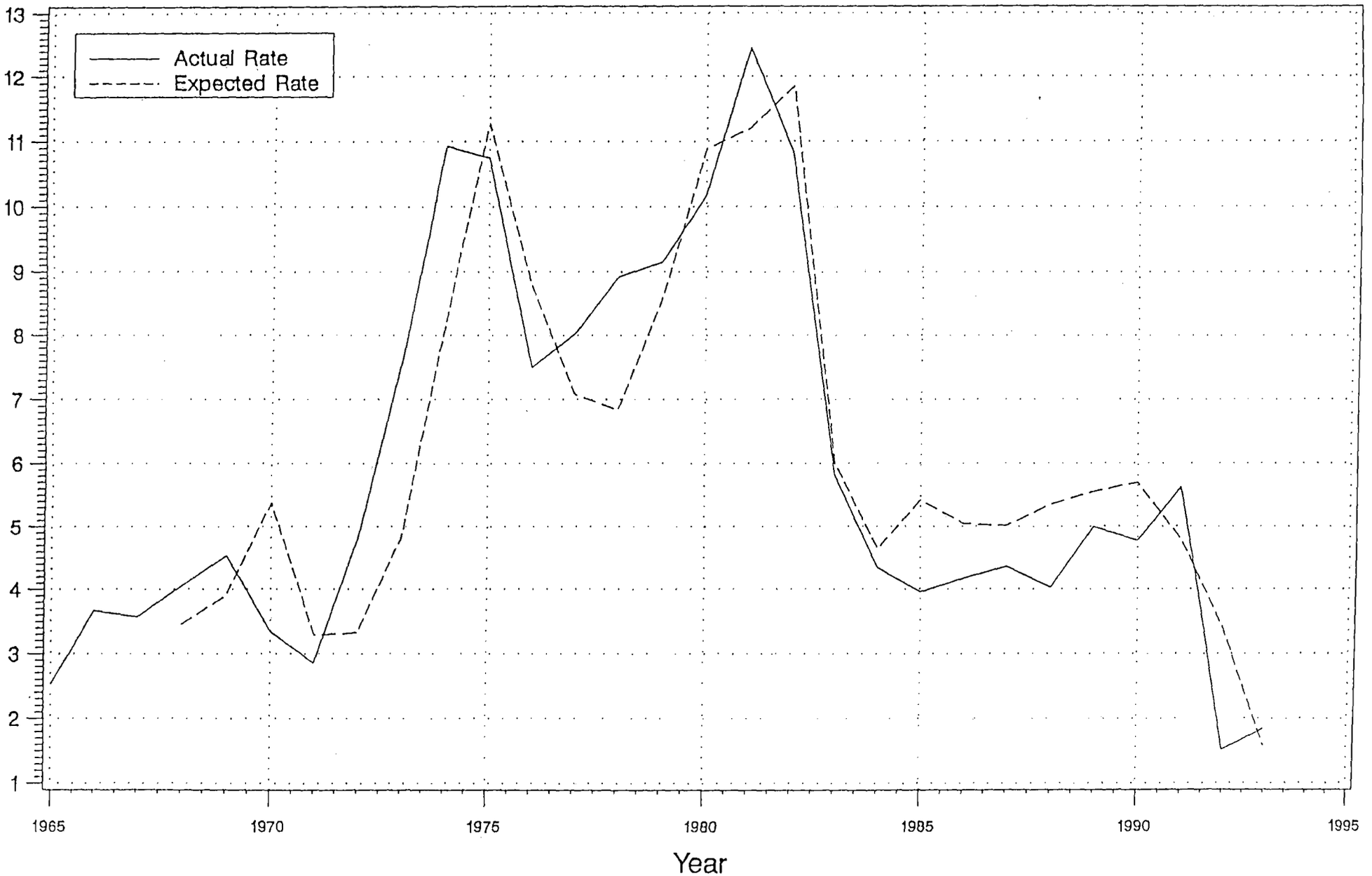

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Table 1.3
Households by Age of Head (In Thousands)
1951-1991

Family Households
Age of Head

Year	15-24	25-34	35-64	65+
1951	733.5		1872.3	418.5
1961	147.4	877.2	2412.7	511.6
1971	284.6	1118.6	2939.2	585.7
1981	374.5	1599.3	3506	751.8
1991	241.2	1629.9	4347.7	1016.4

Nonfamily Households
Age of Head

Year	15-24	25-34	35-64	65+
1951	49.4		190.8	144.7
1961	32.3	61.2	277.1	235.2
1971	129	143.7	439.4	394.3
1981	300.3	437.1	670.1	642.4
1991	225	590.1	1061.6	906.3

Table 1.4
Households by Size (In Thousands)

Household Size

Year	1	2	3	4	5	6+
1951	252.4	711.1	688	645.5	1112.3	672.3
1961	424.8	1012.1	809.2	836.9	604.3	867.6
1971	811.8	1525.4	1046.1	1063	720.7	874.2
1981	1681.1	2397.5	1450.2	1544.2	753.1	455.4
1991	2297.1	3144.2	1743.6	1768.8	731.4	333.2

The size distribution of households changed dramatically over the postwar period (Table 1.4). The number of households with five or more people declined, whereas the number of single-person households increased by over nine times. Two-person households increased over four times.

These changes in the mix of family and non-family households and in the size distribution of households were in part due to the evolving age structure of the population. The numbers of people (and share of the population) rose in the young age groups where there is a higher propensity to form non-family, small households. But there was much more at work. The age-specific headship rates were also changing (Table 1.5). Age-specific family household headship rates were relatively stable but non-family headship rates increased very significantly, most especially for households headed by persons aged 15-24 and 25-34.

These increasing non-family headship rates are due, in part, to sociological factors including earlier home leaving, postponing of marriage, lower incidence of marriage, increased divorce rates and postponing of children. For older households, they are due to increased longevity and improved housing options. They are also due to economic factors, especially increased incomes, as well as housing factors, that is, by the relative price of owning versus renting housing.

The heterogeneity of housing services makes it very difficult to measure the price of housing services in the rental market and to measure how the price has changed over time. Also, we cannot directly observe the price of housing services; we observe the actual rent paid which is the product of the price of housing services and the quantity of housing services yielded by the dwelling unit, and dwelling units are very heterogeneous. Measurement of the price of housing services to home owners is even more difficult. There is the same heterogeneity problem, but in addition we cannot even observe the value of the annual flow of housing services yielded by the house. We can directly observe the sale price of a house, but this is a sale of housing stock not housing services, and again it is the product of the price of stock and the quantity of stock.

There is considerable controversy about how Statistics Canada calculates the price of housing services for renters and for home owners as part of the Consumer Price Index. But,

Table 1.5
Age-Specific Headship Rates
1951-1991

Family Households
Age of Head

Year	15-24	25-34	35-64	65+	Total
1951	17.0		43.00	38.50	31.00
1956	18.9		42.90	37.70	31.90
1961	5.60	35.40	43.40	36.80	32.80
1966	6.00	37.50	44.30	35.50	32.60
1971	7.10	38.70	44.90	33.60	32.40
1976	7.90	38.90	45.70	33.70	33.00
1981	8.00	37.90	46.00	31.80	33.00
1986	6.90	35.50	45.60	31.90	33.30
1991	6.30	33.50	44.70	32.10	33.50

Nonfamily Households
Age of Head

Year	15-24	25-34	35-64	65+	Total
1951	1.1		4.40	13.40	3.90
1956	1.4		4.40	14.40	4.20
1961	1.20	2.50	5.00	16.90	5.00
1966	2.20	3.40	5.60	19.80	6.00
1971	3.20	5.00	6.70	22.60	7.30
1976	5.10	7.50	7.50	25.20	8.90
1981	6.50	10.40	8.80	27.30	10.90
1986	5.90	11.40	9.70	28.20	11.80
1991	5.90	12.10	10.90	28.60	12.90

Total Households
Age of Head

Year	15-24	25-34	35-64	65+	Total
1951	18.1		47.40	51.90	34.90
1956	20.3		47.30	52.10	36.10
1961	6.90	37.80	48.40	53.70	37.80
1966	8.20	40.90	49.90	55.30	38.60
1971	10.30	43.70	51.60	56.20	39.70
1976	13.00	46.40	53.20	58.90	41.90
1981	14.50	48.30	54.80	59.10	43.90
1986	12.80	46.90	55.30	60.10	45.10
1991	12.20	45.60	55.60	60.70	46.60

the CPI is the best starting point for analysis of the postwar period. The Consumer Price Index contains a rental accommodation index, an owned accommodation index and an overall housing index which combines these as well as an index for water, fuel and electricity. These indices can be converted to approximate real price indices, deflating by the total CPI.

The real overall housing price index (Figure 1.5) shows some variation, but little significant change over the period 1951-91. It varies no more than three percent above and below the long-run average price. However, this combined index hides the significant differences between the rental and ownership markets. The index of real rental accommodation rose until about 1956, then declined continuously until 1982, falling over 70 percent (Figure 1.6). It seems reasonable to assume that young households and small, non-family households would tend to rent and therefore that falling real rents would encourage formation of such households. Since 1982, real rents have been almost constant. The index of real owned accommodation behaved entirely differently (Figure 1.7). The index rose continuously from 1951 to 1973, increasing almost 60 percent. This likely discouraged the formation of family households. The index then dipped slightly for two years and rose sharply for another two. Since 1977, it has varied up and down about four percent.

There are, however, a number of theoretical and empirical issues to be discussed about the measurements of the price of housing services, especially in the context of tenure choice. When a household chooses its housing tenure, it is choosing whether to acquire its housing services through rental or ownership of housing stock.

The cost to a household of acquiring rental accommodation is clear: the monthly rent. The only problem in creating a rent index is to be sure that the price of constant-quality accommodation is measured. The cost of ownership accommodation is less clear. The CPI (Figure 1.7) measures ownership costs as mortgage interest, depreciation, maintenance, insurance and property taxes. But a more comprehensive measure would include the opportunity cost of equity and accrued capital gains; this more comprehensive measure is called the user cost of homeownership. Empirically developing a user-cost series always involves compromise. One index (defined in Section 7) is plotted in Figure 1.8. It is much more volatile than the CPI ownership index and does not exhibit the same upward trend. (The upward trend of CPI-measured ownership costs has been on average offset by

Figure 1.5

REAL HOUSE PRICE INDICES 1950-1991

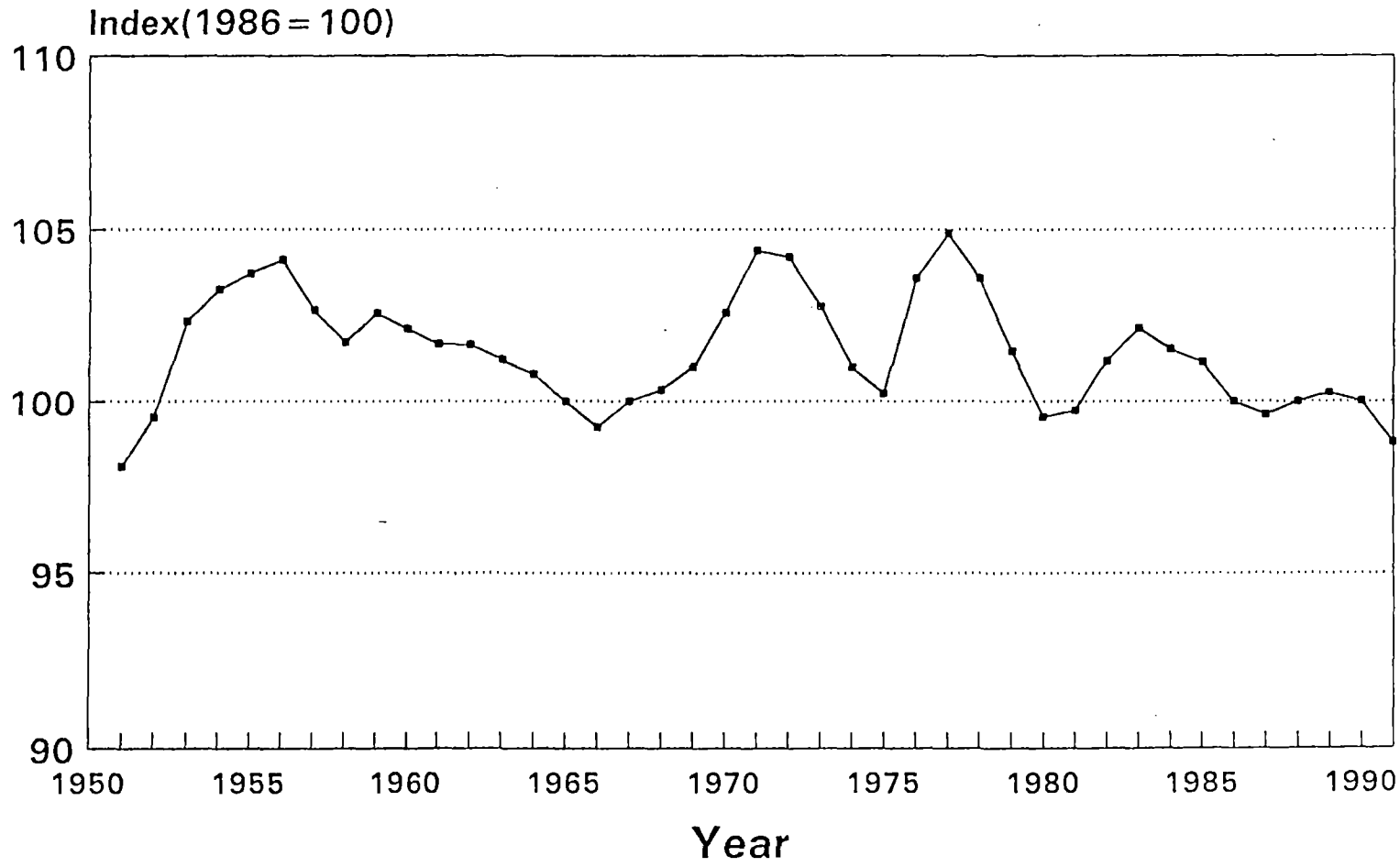


Figure 1.6

REAL RENT INDICES 1950-1991

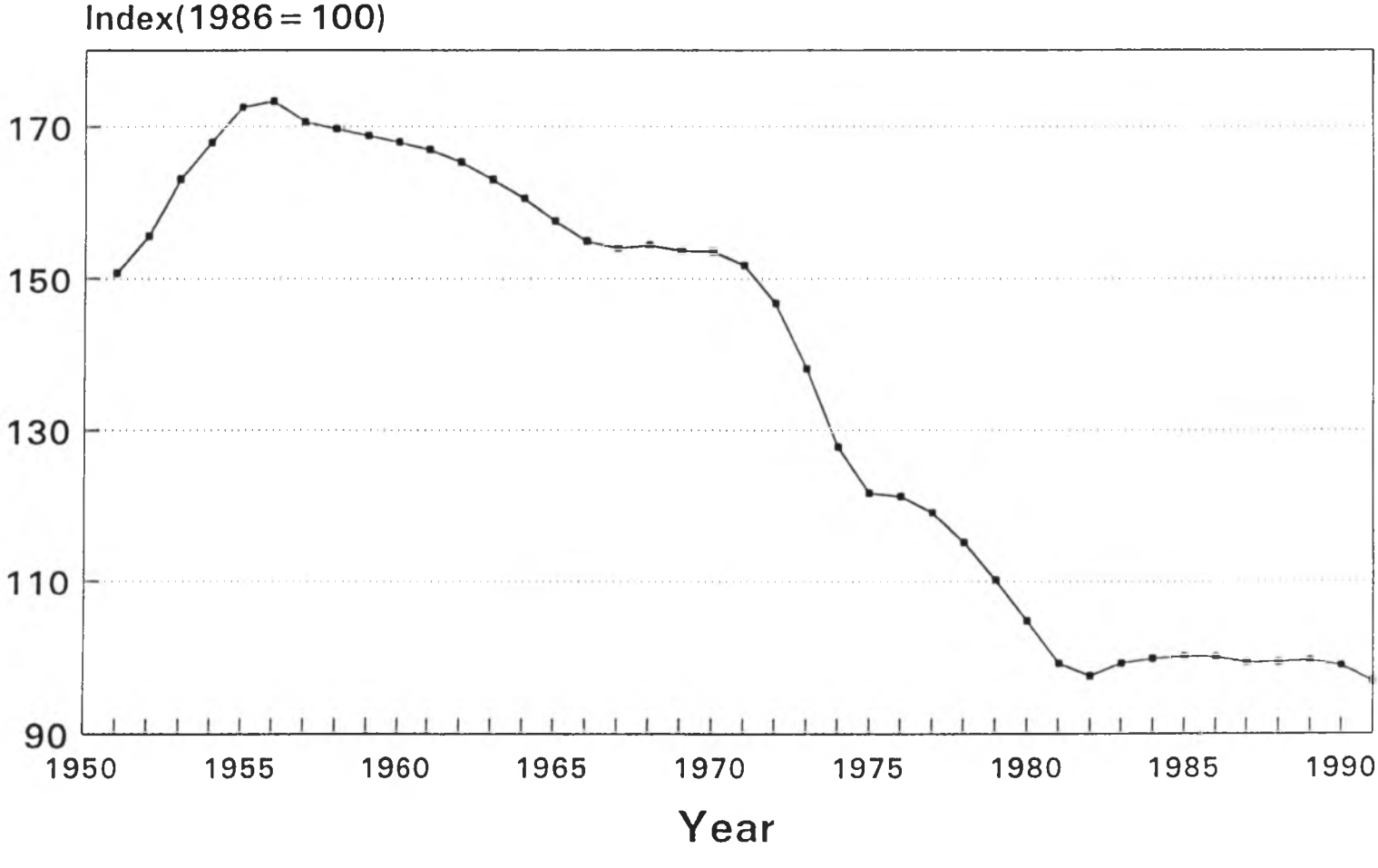


Figure 1.7

REAL OWNED ACCOMODATION 1950-1991

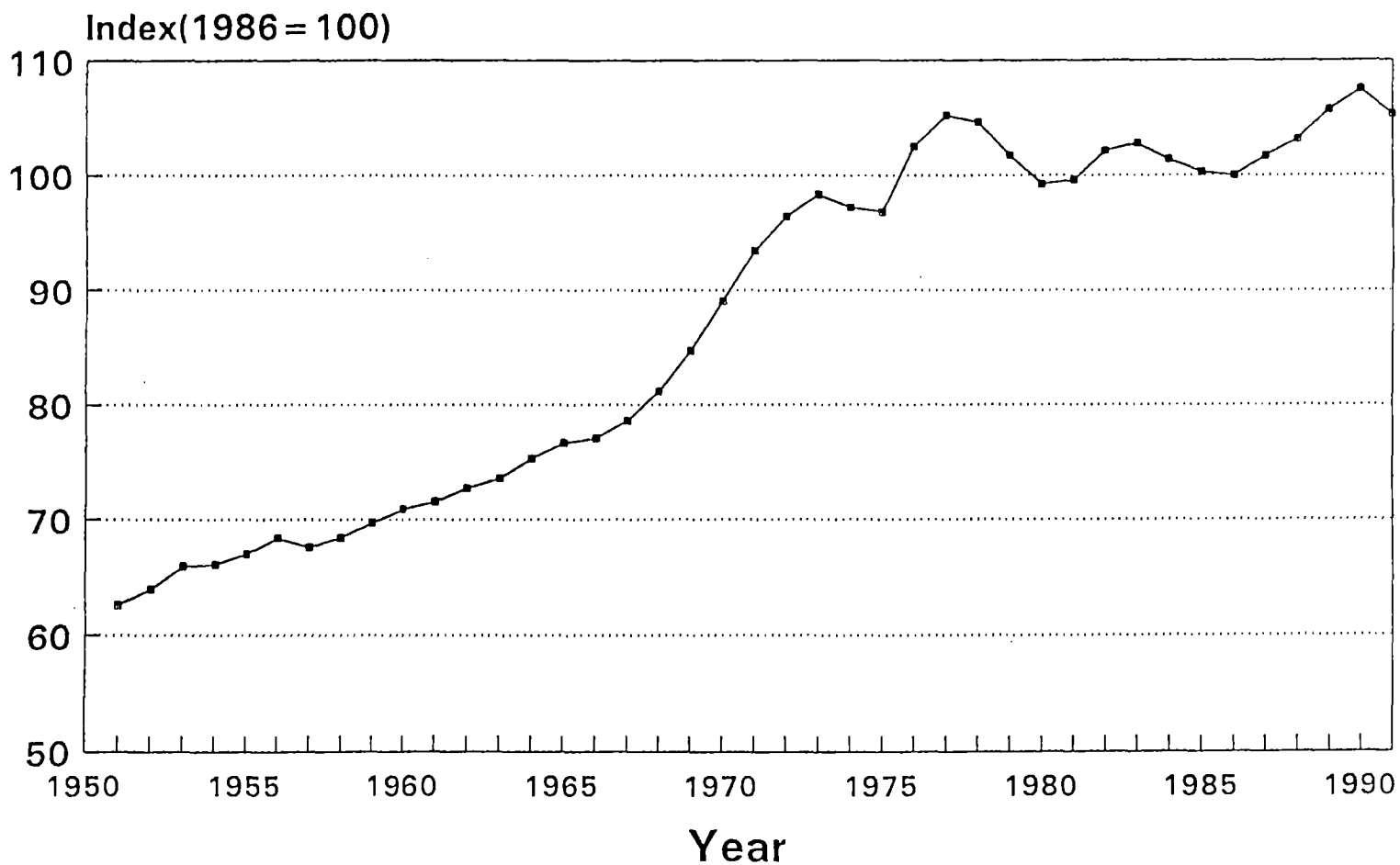
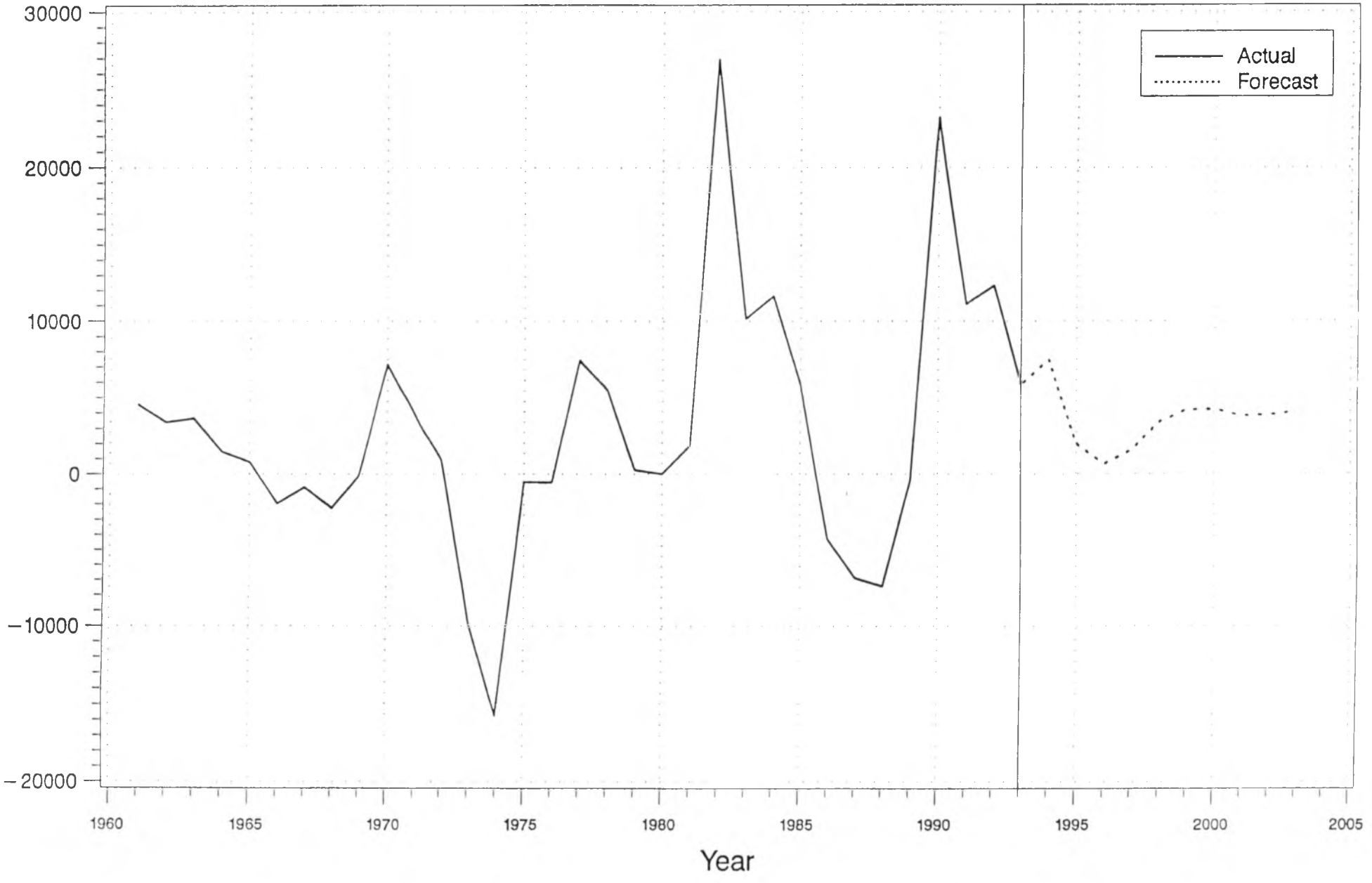


Figure 1.8

USER COST 1961-1993 + FORECAST 1994-2003

(Based on MLS Property, 1986-$)



SAS/GRAPH

capital gains.) The user cost measure recognizes that owning a house is both a consumption decision and an investment decision. The income tax treatment of mortgage interest, investment income and capital gains will be important in both decisions. In order to make a housing investment, a household must save a downpayment. If downpayments are a constant fraction of house prices, then the real price of housing stock will measure the "price" of entering the ownership market. Figure 1.9 shows that real house prices doubled from 1961 to 1991. This would make it more difficult for households to buy their first house.

These stylized facts show that, over the last 30 years, the price of renting has declined relative to owning; yet the percentage of households which own has remained quite stable (Table 1.1). The changing age structure of the population and rising real incomes would help to explain the stability of the rate of ownership.

2. Household Formation, Tenure Choice and the Housing Market

In this section we propose a technique for projecting headship rates and tenure propensities that are responsive to economic variables. These projected values can then be used as inputs to CMHC's PHD Model to project potential housing demand. Later sections of this report empirically implement this technique.

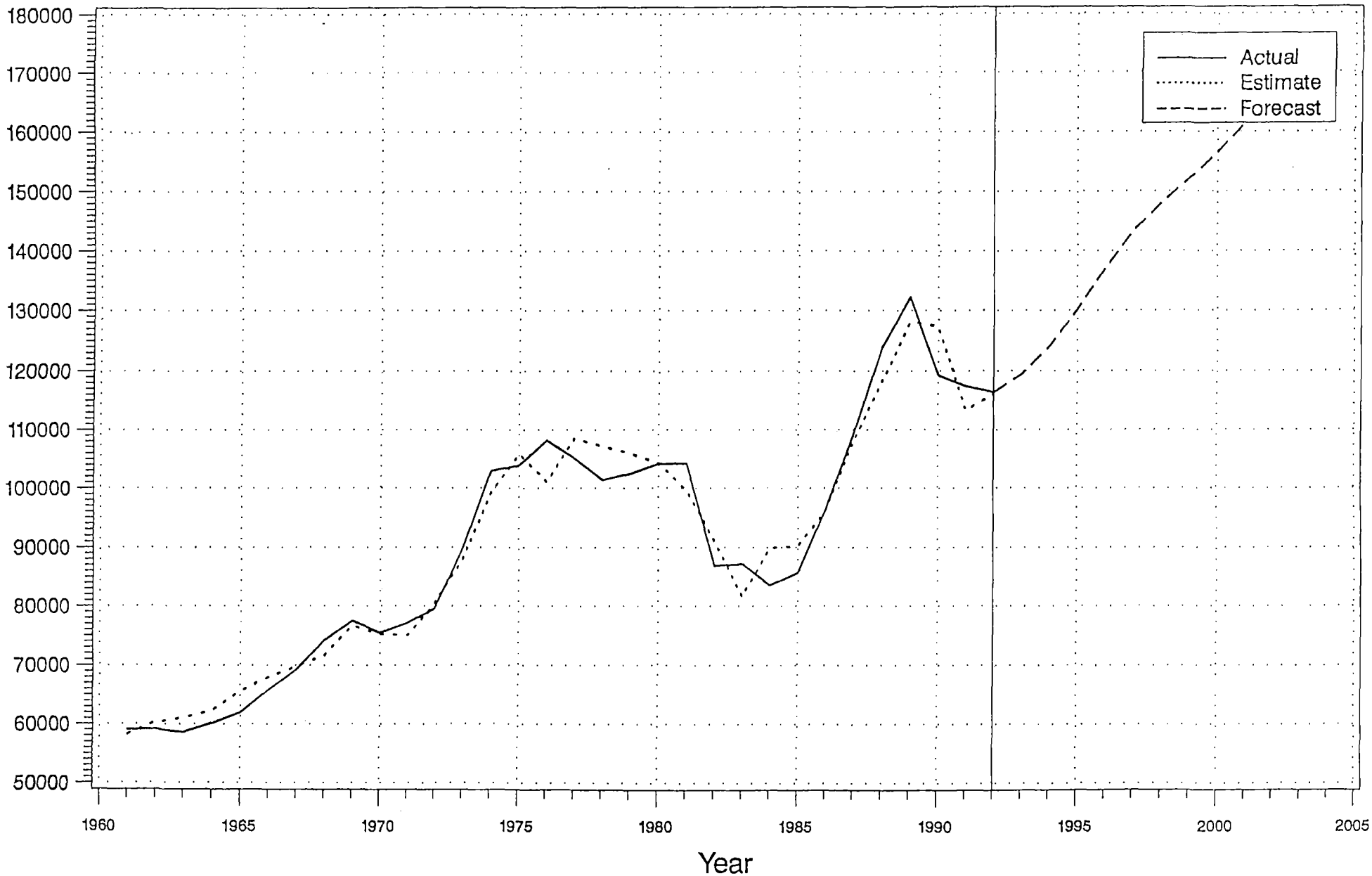
2.1 Introduction

The process by which the population separates into households largely determines the demand for housing. In turn, household growth depends on population growth, the age distribution of the population, the tastes of the population about marital status and living arrangements, real income growth, and the real price and availability of housing. The latter three factors help explain why large numbers of individuals today opt to form non-family households who would have chosen to be submembers of family households in an earlier period. These non-family households result from young individuals setting up their own households, from delaying marriage, from the uncoupling of existing households by divorce, and from the preference of surviving elderly spouses to retain independent living quarters. The resulting surge in non-family households in each age group in the population, as documented in Table 1.3, has created a substantial increase in the demand for housing.

Figure 1.9

HOUSING PRICE 1961-1992 + FORECAST 1993-2003

(Total MLS Property, 1986-$)



SAS/GRAPH

Population age distribution is translated formally into households through a "headship rate". The headship rate for a household type (either family or non-family) equals the ratio of the number of household heads of that type in a particular age group to the population in that age group. Specifically,

$$HH_{ij} = hh_{ij}*POP_j$$

where HH_{ij} is the number of household of type i in age group j, hh_{ij} is the corresponding headship rate and POP_j is the population in age group j.

Ignoring migration, POP_j is effectively predetermined over the next 15 years (i.e., we are restricting attention to individuals 15 years and older), and so the major source of uncertainty concerning the demand for housing units is the projection of headship rates. Recent empirical research on household formation and headship rates is summarized in Appendix A. While this research identifies many different determinants of headship rates, the three key driving variables are (i) real income per capita (as well as the redistribution of this income among household types), (ii) the real rental and user costs of operating a housing unit and (iii) the demand for privacy (which proxies for the many different factors that account for postponed marriages and increased divorces).

A description of headship rates as a function of these economic and sociological factors is as follows:

$$hh_{ij} = f_{ij}(Y,R/P,A(i-{}^{A}\pi^{e})/P,S)$$

where Y denotes real income, R denotes the rental price of housing, P is the price level (CPI), A is the ownership (asset) price of housing stock, i is the market (mortgage) rate of interest and ${}^{A}\pi^{e}$ is the expected rate of growth of A (i.e., ignoring taxes and maintenance costs, $A(i-{}^{A}\pi^{e})/P$ represents the real user cost of housing), and S represents other factors including sociological forces as well indicators of the availability of public housing and subsidies to first-time buyers. Conventional economic models of household decision making suggest that headship rates, hh_{ij}, are increasing functions of income and decreasing functions of the real rental price and user cost, and hence an increasing (decreasing) function of the expected rate of price appreciation (mortgage interest rate).

Household formation affects demand in both the ownership and rental markets. The

outcome of a household's tenure-choice decision is a decision to consume either owned or rented housing services, and hence to either buy or rent a housing unit; recent literature on ownership propensities is surveyed in Appendix B. Letting op_{ij} denote the probability that a household of type i in age group j chooses to own, the corresponding demand for ownership housing units equals $op_{ij}*hh_{ij}*POP_j$. It is anticipated that op_{ij} will be an increasing function of income and a decreasing function of the relative user price of owned housing, $A(i-{}^{A}\pi^{e})/R$; correspondingly, the rental propensity, $1-op_{ij}$, should be a decreasing function of Y and an increasing function of $A(i-{}^{A}\pi^{e})/R$.

We begin with an examination of the role of headship rates in a market setting and later return to a discussion of tenure choice.

2.2 A Simple Model of the Housing Market

Projections of housing demand require projections of both population growth and headship rate changes. Population growth depends on income and other economic variables to the extent that fertility rates depend on these same variables. Whether or not the latter effects are quantitatively important, they are likely to be operative only over the longer run. This implies that we can take population growth to be predetermined in the short run (recall, we ignore migration issues throughout). Headship rates, on the other hand, can potentially vary substantially over the course of a business cycle. Projecting headship rates thus amounts to predicting the future temporal patterns of the determinants of headship rates.

The determinants of headship rates described earlier can be grouped into two sets. The first set, {Y,P,i,S}, consists of real income, the price level, the market rate of interest, and sociological and institutional determinants of headship rates. The key property common to these variables is that they are determined outside of the housing market and largely independent of developments in that market. A conventional macro-simulation model can be used to generate estimates of {Y,P,i} over time. The range of possible sociological and institutional factors that influence household formation is broad, running from the relaxation of social norms and laws concerning divorce to the availability of subsidized housing for the elderly. Changes in these factors that are responsive to incomes and rents will be implicitly taken into account; as argued later below, however, those factors responding to non-

economic variables can be ignored.

The remaining set of variables, $\{R,A,{}^{A}\pi^{e}\}$, contains the equilibrium prices in the rental and ownership markets and the expected rate of change of the equilibrium price in the ownership market. Projections of headship rates thus requires projections of the equilibrium prices in these markets.

The analysis which follows below will abstract from many features of the housing market; these features would otherwise complicate the exposition without providing additional insight (later, some of these features are reintroduced). To start, suppose that all housing is rental housing (i.e., suppose that there is no ownership market for housing). This implies that there is no tenure decision to be made and, further, that $\{A,i,{}^{A}\pi^{e}\}$ do not impact household formation. Suppose also that all members of the population are in the same age group and that all households are of the same type; under these assumptions, there is no need to distinguish age-specific and household-type specific headship rates. Finally, supposing that each household requires one unit of housing, we can ignore the effects of $\{Y,R\}$ on the demand for housing per household. In these circumstances, and after setting $P=1$, the aggregate demand for housing is given by

$$H^{d} = hh*POP = f(Y,R)POP.$$

That is, the demand for housing equals the number of households, which is an increasing function of income and population and a decreasing function of the real rental price.

Notice that while the headship rate introduced above is explicitly a function only of real income and real rent, we are notationally suppressing but not ignoring possible sociological and/or institutional influences. To see this, suppose instead that $hh = f(Y,R,S)$ and, in particular, f is linear so that $hh = a+bY+cR+dS$. Here, S denotes those sociological factors that are not responsive to income and rents; the influences of any sociological factors that are responsive to income and rents are already implicitly imbedded in the coefficients of Y and R. In this case, a change in hh is generally attributable to changes in Y, R and S, i.e., $\Delta hh = b\Delta Y+c\Delta R+d\Delta S$. However, for the time horizons we consider in this study, no change in S is anticipated and so $\Delta S=0$ and $\Delta hh = b\Delta Y+c\Delta R$ (more to the point, since it is unclear which sociological factors are independent of economic

influences and which non-economic variables would drive S, estimation and forecasting are necessarily problematic). In these circumstances, there is no loss in writing hh as $a+bY+cR$, or $f(Y,R)$, with the understanding that S is embedded in the constant term. This formulation, on an age-household type basis, is certainly consistent with the notions both that sociological forces influence people differently at different ages and that these forces change relatively slowly.

We shall not model the supply side of the housing market in any detail. Nonetheless, as an empirical matter, we recognize that the elasticity of supply (i.e., the responsiveness of supply to rental-price changes) will be an increasing function of the time horizon being contemplated. In the very short run, for example, supply is simply fixed and unresponsive to price changes; the result is a vertical or perfectly inelastic supply function. In the medium run, however, the supply function is upward sloping, indicating that supply is at least somewhat responsive to price movements; and in the long run, it may be actually be quite flat. For illustrative purposes, however, we begin by considering the empirically uninteresting case where supply is perfectly price-elastic in the short run.

2.2.1 Perfectly Elastic Supply

Consider a situation where data are collected in period 1 (say, a census year) which is then used to forecast headship rates and housing demand in future periods 2,3.. etc.. To begin, suppose that the supply of housing, H^s, is perfectly elastic at the rental price R^*, in both the short and long runs. See Figure 2.1. The data collected in period 1 correspond to the equilibrium of demand and supply depicted at E. We consider two cases; in the first, income is fixed and any changes in demand are due only to population changes, and in the second case, income and population can both change.

Suppose that income is fixed, i.e., income equals $\underline{Y}$ in all periods. Population in period t equals POP_t. The headship rate measured at E, hh_1, is given by

$$hh_1 = H_1^d/POP_1 = f(\underline{Y},R^*)POP_1/POP_1 = f(\underline{Y},R^*).$$

Using this observed headship rate, we predict demand next period to be $f(\underline{Y},R^*)POP_2$, where POP_2 is the predictable population in period 2. Of course, combining the demand function

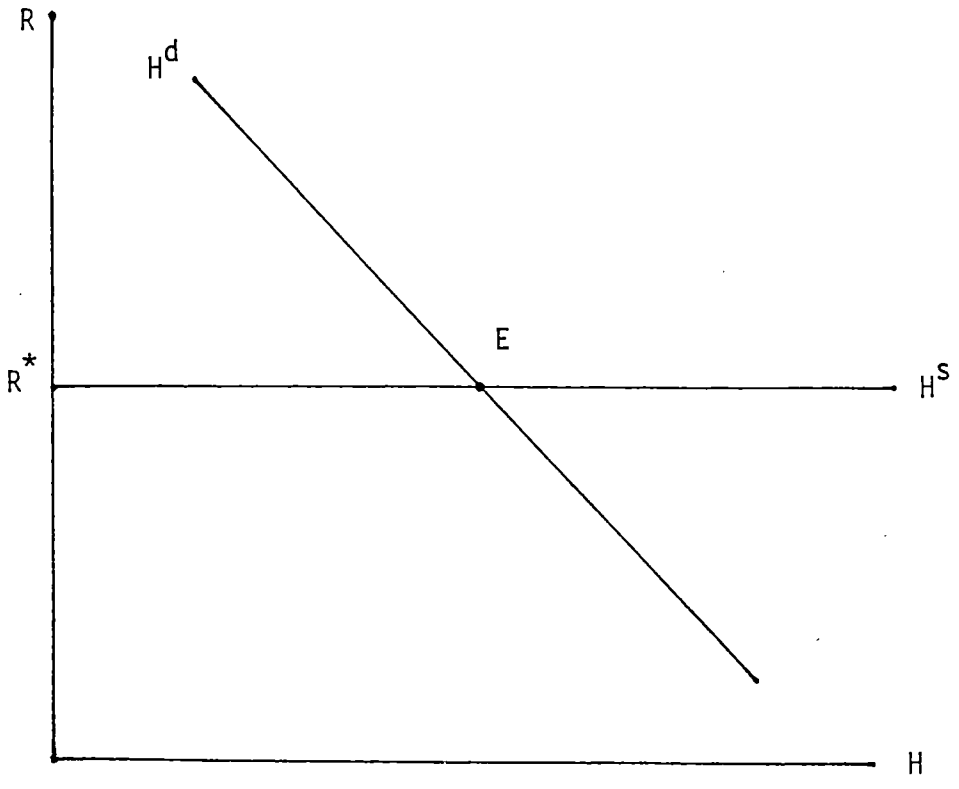


Figure 2.1

for period 2, $H_2^d=f(\underline{Y},R)POP_2$ with the supply function in Figure 2.1, determines the second-period equilibrium rental price to be R^* again, and so the headship rate observed in period 1, hh_1, is an accurate predictor of the equilibrium headship rate in period 2. In fact, with income fixed, hh_1 is the appropriate predictor of the headship rates in all future periods. Moreover, given that $Y=\underline{Y}$ and $R=R^*$, we can make these predictions without any specific knowledge of the headship rate function.

Suppose now that income and population in period t are, respectively, equal to Y_t and POP_t. The headship rate measured at E, hh_1, is given by

$$hh_1 = H_1^d/POP_1 = f(Y_1,R^*).$$

Unlike the previous case, this observed headship rate is generally a poor predictor of next period's headship rate. We need to introduce a correction factor. Letting Y_t^e denote the expected income in period t, define the correction factor $K_t = f(Y_t^e,R^*)/f(Y_1,R^*)$. The expected headship rate for period t equals hh_1*K_t. Combining the demand function for period 2, $H_2^d=f(Y_2^e,R)POP_2$, with the supply function in Figure 2.1, determines the second-period equilibrium rental price to be R^*; hence the corrected first-period headship rate, hh_1*K_2, accurately predicts the equilibrium headship rate in period 2, hh_2.

Thus, even when supply is perfectly elastic, we cannot make predictions of future demand conditions when income varies without some knowledge of the headship rate function, f(,).

2.2.2 Correcting the Headship Rate Function

Before proceeding, it will be useful to elaborate further on the use of correction factors. Suppose that the headship rate function can be written as follows:

$$hh = f(Y,R) = AY^{\alpha}R^{\beta},$$

where A is a constant. With this particular functional form, α and β respectively measure the income and rent elasticity of the headship rate, i.e., a 1% change in Y causes an α% change in hh, and a 1% change in R causes a β% change in hh; this functional form is often employed in empirical research (see Appendix A). The correction factor corresponding to

this equation is given by $K_t = f(Y_t^e,R^*)/f(Y_1,R^*) = (Y_t^e/Y_1)^\alpha$. If, instead, the headship rate is a linear function of $\{Y,R\}$,

$$hh = A + \alpha Y + \beta R ,$$

an additive correction factor should be used. In this case, the t-th period headship rate would be estimated by $hh_1+\alpha Y_t^e-\alpha Y_1$; once again, however, only α is required.

2.2.3 Perfectly Inelastic Short-Run Supply

Having dealt with the case of a perfectly elastic supply curve, we now consider the opposite extreme of a perfectly inelastic short-run supply curve, as depicted in Figure 2.2; R^* here represents the long-run average equilibrium rental price corresponding to the underlying perfectly elastic long-run supply curve. Once again, we collect data in period 1 that are generated by the equilibrium at E. In this case, the initial headship rate is H_1^d/POP_1, which equals $f(Y_1,R_1)$. At this point, there are many different questions that one can ask and, in each case, the corresponding answer exploits the information provided by $f(Y_1,R_1)$ in a different way. We will examine three specific issues using the exponential headship rate function introduced earlier.

(1) The first exercise is also the easiest: Describe future housing demand under the assumption that the rental price remains fixed at R_1. Given forecasts of income and population for period t, Y_t^e and POP_t, the demand for housing at price R_1 in period t is $hh_1(Y_t^e/Y_1)^\alpha POP_t$. These numbers tell us by how much the demand function shifts at price R_1 over time. However, they can be very misleading indicators of future market outcomes. Further, the assumption that the rental price remains fixed at R_1 is unreasonable in a setting where the presumed average market price, R^*, is not equal to R_1.

(2) Supposing that next period's housing supply remains unchanged at H^s, describe the resulting price and quantity. This exercise is also straightforward. Given the first-period observations expected second-period income, $\{hh_1,Y_1,R_1,Y_2^e\}$, the anticipated second-period demand function is given by

$$H_2^d(R) = hh_1(Y_2^e/Y_1)^\alpha(R/R_1)^\beta POP_2 .$$

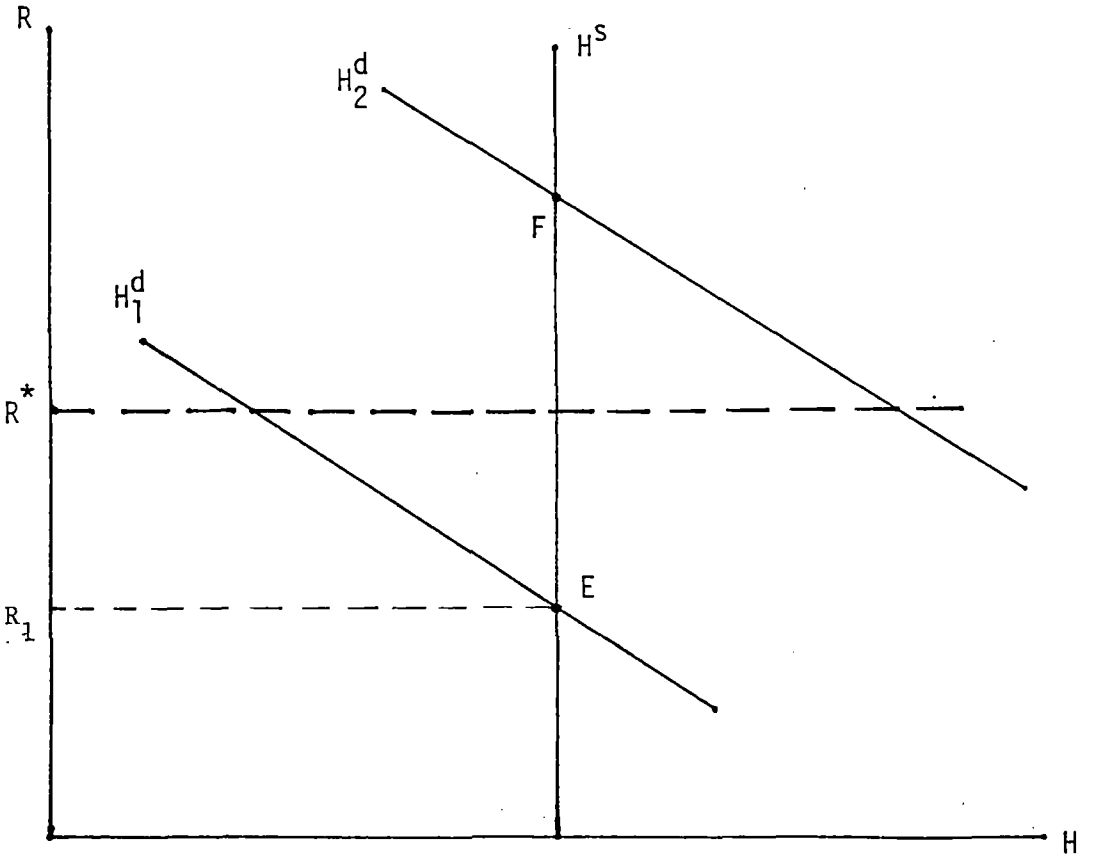


Figure 2.2

Observe that in this case, because we anticipate that both income and rent will adjust, the multiplicative factor used to correct hh_1 is $(Y_2^e/Y_1)^\alpha(R/R_1)^\beta$. Equating demand and supply gives the equilibrium price at F in Figure 2.2.

(3) Suppose that future supply responds to deviations of the current rental price from the long-run average price. Specifically, writing demand in period t as a function of the rental price, $H_t^d=H_t^d(R)$ where $H_t^d(R)=hh_1(Y_t^e/Y_1)^\alpha(R/R_1)^\beta POP_t$, suppose that supply in period t+1 is a weighted average of supply and demand evaluated at the long-run equilibrium price $R=R^*$. That is,

$$H_{t+1}^s = \theta H_t^s + (1-\theta)H_t^d(R^*) = H_t^s + (1-\theta)[H_t^d(R^*)-H_t^s] ,$$

and so supply next period equals current supply plus an adjustment for any long-run excess demand. Since demand evaluated at the short-run equilibrium price always equals supply (as R is presumed to adjust until $H_t^s=H_t^d(R)$), short-run excess demand is zero and $H_t^d(R^*)-H_t^s$ is a measure of long-run excess demand at $R=R^*$. In the special case where $\theta=1$, supply does not adjust, as in situation (2) above. Otherwise, when $0<\theta<1$, it is easy to check that $R_t>R^*$ yields $H_{t+1}^s>H_t^s$, and $R_t<R^*$ yields $H_{t+1}^s<H_t^s$; thus, as seems appropriate, supply elasticity increases with time. Now, given first-period outcomes, $\{hh_1,Y_1,R_1\}$, and an anticipated population growth pattern (POP_2, POP_3, etc.), we can solve for the sequence of future supplies using the above adjustment equation, and then sequentially solve, $H_t^s=H_t^d(R)$, for the equilibrium price and headship rate in period t. To implement this scheme, however, we need estimates of two demand-side parameters, $\{\alpha,\beta\}$, and one supply-side parameter, θ.

2.2.4 An Alternative Characterization of Equilibrium

The last part of the previous subsection described a simple way to determine a sequence of housing market equilibria. While the adjustment process for supply described therein certainly has intuitive appeal, it is nevertheless ad hoc. Further, when both the rental and ownership markets are involved, the joint adjustment processes quickly become rather complex. In this subsection we sketch an alternative approach.

Equating demand and supply allows us to solve for the equilibrium price as a function of the exogenous determinants of demand, population and income, and supply;

$R_t=F(Y_t,POP_t,H_t^s)$. As before, suppose that current supply can be written as a function of the previous period's supply and economic state, $H_t^s=G(Y_{t-1},POP_{t-1},H_{t-1}^s)$. Hence $R_t=F(Y_t,POP_t,G(Y_{t-1},POP_{t-1},H_{t-1}^s))$. After recursively substituting $H_i^s=G(Y_{i-1},POP_{i-1},H_{i-1}^s)$ for i=t-1,t-2,... , R_t can be written as a function of the current values and entire past histories of income and population; $R_t=R(\{Y_i,POP_i\}:i=t,t-1,t-2,..)$.

A special but often used example of this type of forecasting function is

$$R_t = a_0R_{t-1} + a_1Y_t + a_2POP_t .$$

That is, the current equilibrium price is a function of last period's price and the current economic state; estimates of this type of function appear in Hamilton (1991). Now, given the first-period observations, $\{hh_1,Y_1,R_1\}$, the anticipated second-period equilibrium demand will be given by

$$H_2^d = hh_1(Y_2^e/Y_1)^{\alpha}([a_0R_1+a_1Y_2^e+a_2POP_2]/R_1)^{\beta}POP_2 .$$

Indeed, the equilibrium headship rate and demand in each future period can likewise be estimated from any sequences of future incomes and populations by recursively solving the above rental equation. To implement this scheme, we again need estimates of the two demand-side parameters, $\{\alpha,\beta\}$, but now also require the coefficients of the price-forecasting equation, $\{a_0,a_1,a_2\}$.

2.3 Tenure Choice

Most of the analysis thus far has assumed, to simplify, that all housing is rental housing. In fact, the connection between population and housing demand also involves tenure choice: households choose to acquire housing services either through owning or renting. The Potential Housing Demand model projects tenure choices for ten-year age groups for both family and non-family households. The distribution of households is translated into owning and renting households through an "ownership propensity". The ownership propensity for a household type (family or non-family) equals the ratio of the number of home-owning households of a given type and age of head to the total number of owning plus renting households of that type and age of head. Specifically,

$$OH_{ij} = op_{ij}*HH_{ij} ,$$

where OH_{ij} (op_{ij}) is the number (proportion) of home-owning households of type i in age group j.

The recent literature on tenure choice is summarized in Appendix B. It is quite diverse, focusing on issues beyond tenure choice per se. The key variables that are identified as influencing the ownership propensity include: (i) household (permanent) income, HY, (ii) the price of renting housing relative to the price of owning, and (iii) the individual's financial wealth, W. That is, dropping the ij subscripts,

$$op = op(HY,R,A(i+m-{}^{A}\pi^{e}),W,T)$$

where m denotes maintenance costs as a percentage of the house price and T is a vector of tax parameters. The demographic determinants of homeownership would be captured by having a different ownership propensity function for each household type and age group.

The methodology introduced earlier can be applied straightforwardly when ownership and rental markets are distinct and, in consequence, households make tenure decisions. Now, total population, POP, is transformed into households through application of a headship rate, HH=hh*POP; and households are transformed into demands in the rental and ownership markets, H^{dr} and H^{do}, through application of the rent and ownership propensities to households:

$$H^{dr} = (1-op)*hh*POP , \quad H^{do} = op*hh*POP .$$

Notice that while the ownership propensities examined in Appendix B and sketched in the previous paragraph describe individual decision making (and are estimated with micro data), we are using op above as a description of the proportion of the population of households that opts to own; as a consequence, and anticipating our own empirical work later in Section 7, we consider this ownership propensity to be a function of aggregate variables.

To complete this description of the housing markets, we thus suppose that the headship rate and the ownership propensity can be written, respectively, as hh=f(Y,R) and op=op(Y,R,A,r), where A denotes the real price of houses and $r=i-{}^{P}\pi^{e}$ denotes the real mortgage interest rate as ${}^{P}\pi^{e}$ is the expected rate of price inflation (the wealth and tax variables in op( ) are suppressed as we are unlikely to be successful in forecasting these

variables). Further, we suppose that both of these functions take Cobb-Douglas forms; after observing $\{hh_1,op_1\}$ and $\{Y_1,R_1,A_1,r_1\}$ during the first period, the anticipated headship rate function and rent propensity in period t are given by:

$$hh_t = hh_1(Y_t^e/Y_1)^{\alpha}(R/R_1)^{\beta}POP_t ,$$

$$op_t = op_1(Y_t^e/Y_1)^{\lambda}(R/R_1)^{\mu}(A/A_1)^{\delta}(r_t^e/r_1)^{\phi}POP_t ,$$

where r_t^e is the expected real rate in period t; there are now two sets of parameters to identify, $\{\alpha,\beta\}$ and $\{\lambda,\mu,\delta,\phi\}$. We suppose that house prices can be forecast using

$$A_t = b_0A_{t-1} + b_1Y_t + b_2POP_t + b_3r_t .$$

Englehardt and Poterba (1991) and Hendershott (1991) provide estimates of this type of price function.

(In an efficient housing market, there is a precise equilibrium relationship between prices and rents. Specifically, the arbitrage condition for housing assets ensures that the path of house prices will adjust so that in all periods the rent equals the operating cost of owning a house minus any anticipated capital gains; $R_t = wA_t - (A_{t+1}-A_t)$, where w denotes the operating cost that includes the opportunity cost of capital, property taxes, maintenance and depreciation. If this arbitrage condition is always satisfied, the parameters of the forecasting equations for rents and prices must be related. In fact, almost all empirical studies of efficiency in the housing market reject this hypothesis. This implies that, as a practical matter, the forecasting equations for rents and prices may be estimated independently.)

Thus, given first-period observations $\{hh_1,op_1\}$ and $\{Y_1,R_1,A_1,r_1\}$, and forecasts for $\{POP_t,Y_t,r_t\}$, we can determine an equilibrium sequence of headship rates, rent and ownership propensities. To do so requires four sets of parameters; $\{\alpha,\beta\}$ for the headship rate function, $\{\lambda,\mu,\delta,\phi\}$ for the rent propensity function, $\{a_0,a_1,a_2\}$ for the rent forecasting equation, and $\{b_0,b_1,b_2,b_3\}$ for the price forecasting equation.

Returning to the general case in which there are different age groups and household types, the same methodology can be used to undertake the same exercise at a disaggregate level. Suppose that there are N age groups and 2 household types. Then, given first-period observations $\{(hh_{1ij},op_{1ij})$: i=1,..,N; j=1,2$\}$ and $\{Y_1,R_1,A_1,r_1\}$, and forecasts for

$\{POP_t, Y_t, r_t\}$, we can determine an equilibrium sequence of headship rates and rent propensities $\{hh_{tij}, op_{tij}\}$ and a pair of housing demands $\{H^{dr}_{tij}, H^{do}_{tij}\}$ for i=1,..,N, j=1,2 and t=2,... . To do so requires four sets of parameters; $\{\alpha_{ij}, \beta_{ij}\}$ for each age-type specific headship rate function, $\{\lambda_{ij}, \mu_{ij}, \delta_{ij}, \phi_{ij}\}$ for each age-type specific rent propensity and, as before, $\{a_0, a_1, a_2\}$ for the rent forecasting equation, and $\{b_0, b_1, b_2, b_3\}$ for the price forecasting equation.

2.4 Modifying CMHC's PHD Model

The aim of the CMHC PHD Model is to project potential housing demand that is driven by household formation. The base-case version of that model can be expressed in terms of our notation as follows (ignoring age-type subscripts): given the initial observations $\{hh_1, op_1\}$, household formation in period t equals $hh_1 POP_t$, while the own and rent demands equal $op_1 hh_1 POP_t$ and $(1\text{-}op_1) hh_1 POP_t$, respectively. Further, as argued in Section 2.2.1, these are also equilibrium outcomes when both market supplies are perfectly elastic and real income and the real interest rate are constant.

An alternative version of the PHD Model allows the user to substitute projected headship rates and tenure propensities for the constant (1991) base-case values. The preceding subsections outline a technique for projecting headship rates and tenure propensities that are responsive to economic variables. As inputs, this technique requires: (i) headship rate function and tenure propensity function parameters (see Sections 4 and 7), (ii) forecasts of income, interest rates and price inflation (generated from the PEAP macro-econometric model at the University of Toronto), and (iii) forecasts of rents and house prices from the rent-price econometric models we propose to estimate (see Sections 5 and 7).

3. Age-Group Versus Cohort Analysis

The empirical studies of headship rates reviewed in Appendix A focus on the responsiveness of headship rates within age groups to various economic variables. The current economic literature does not consider headship rates by birth cohort. This raises an important question: Are age-group or birth-cohort histories better predictors of the future housing decisions of specific age groups? More specifically, should expectations formed in

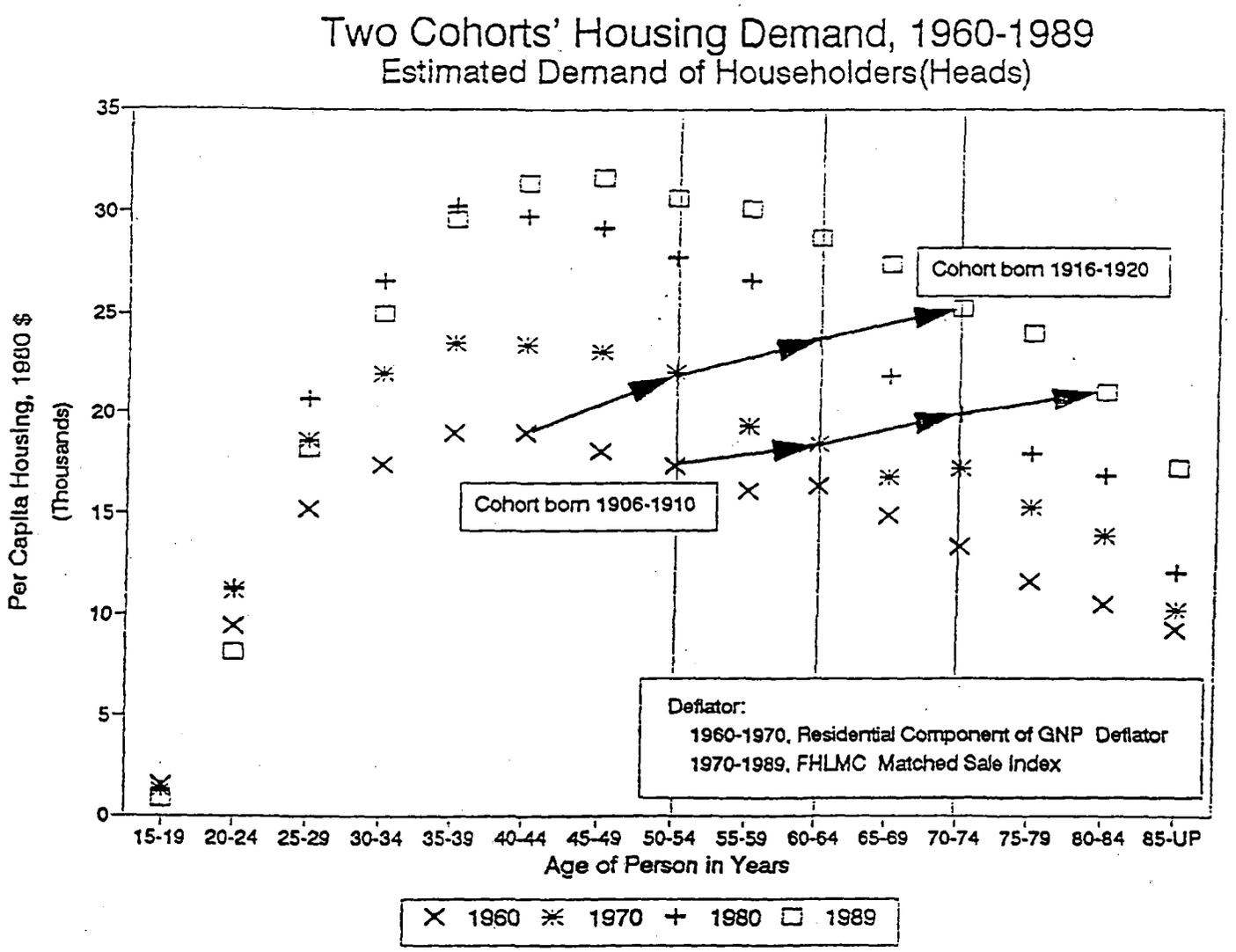
period t concerning the future headship rate in period t+1 of age-group i be based on the past experiences of age-group i individuals or of individuals in the cohort that would be age i in period t+1? For example, concerning the headship rates of 40-44 year-olds in 1996, which of the following histories is more informative: the headship rates of 40-44 year-olds in 1991, 1986, 1981 .., etc., or the headship rates of 35-39 year-olds in 1991, 30-34 year-olds in 1986, 25-29 year-olds in 1981, .., etc..

A recent paper by Pitkin and Myers (1993) asserts that the notion that age-to-age differences describe the behavior of any generation as it ages is incorrect, and concludes that a cohort analysis is appropriate. Their basic "argument" is illustrated in Figure 3.1 (this figure appears as Exhibit A in the Pitkin-Myers piece). It depicts data from four different periods showing that at a point in time per capita U.S. housing consumption rises to about ages 40-45 and declines thereafter, but that over time per capita housing consumption of a typical cohort continues to rise after ages 40-45. From these observations they conclude that from the perspective of 1980, extrapolating the per capita values of consumption in 1960, 1970 and 1980 of the cohort born in years 1906-1910 (1916-1920,1926-1930) to 1989 gives a much better predictor of the per capita housing consumption of age-group 80-84 (70-74,60-64) than does the observed consumption of age-group 80-84 (70-74,60-64) in 1980.

Though seemingly persuasive, this evidence is perfectly consistent with the alternative view that economic analyses by age group, rather than extrapolations of age-group or cohort behaviour, should be used to forecast headship rates by age group. To see why this is the case, consider the prototypical economic problem faced by an individual aged i: given the economic environment faced by this individual, denoted by E (prices, income, interest rates, etc.), choose a consumption vector C to maximize the payoff (utility) function $U_i(C)$ subject to the (lifetime budget) constraint that C satisfies $g_i(C,E)=0$; housing consumption is an element of C and is not distinguished notationally. In this problem we have indexed the payoff and constraint functions by the individual's age to recognize that individuals of different ages have different planning horizons and hence face different decision problems.

The outcome of this problem is a decision function or rule, $C=h_i(E)$, that describes the individual's decisions as a function of the economic environment she faces; the decision rule is itself indexed by age because two individuals of different ages who face the same

Figure 3.1


Two Cohorts' Housing Demand, 1960-1989
Estimated Demand of Householders(Heads)
Per Capita Housing, 1980 $
(Thousands)
35
30
25
20
15
10
5
0
Cohort born 1916-1920
Cohort born 1906-1910
Deflator:
1960-1970, Residential Component of GNP Deflator
1970-1989, FHLMC Matched Sale Index
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85-UP
Age of Person in Years
1960
1970
1980
1989

economic environment will make different decisions because they have different payoff and constraint functions. This type of age-group analysis can be easily employed to forecast the behaviour of different age groups in the future. To forecast the consumption (housing) decisions of individuals in age group i in the future, we need only determine the expected economic environment faced by these individuals, E^e; given E^e and the decision rule $h_i(\ )$, their expected future consumption is $h_i(E^e)$. This line of argument was also the basis for our earlier discussion in Section 2.

From this economic perspective, the explanation for the data in Figure 3.1 is straightforward: For any given economic environment (i.e., for any given year), the decision rules of different age groups prescribe that housing consumption generally rises (falls) with age before (after) ages 40-45; for example, the *'s corresponding to 1970, could have been predicted by substituting a description of the economic environment in 1970, E_{1970}, into a series of age-group functions, $h_{15\text{-}19}(\ )$, $h_{20\text{-}24}(\ )$, $h_{25\text{-}29}(\ )$, ... etc.. The explanation for the generally rising per capita housing consumption of each age group over time is simply that the economic environment itself changed over time; E_{1989} is different from E_{1980}, which is different from E_{1970}, etc. Since, in general, real per capita income has risen and real rents have fallen over time, we would have expected housing demand (and headship rates) to rise in each age group. Indeed, divorce rates and the propensity of single seniors to live alone both respond positively to rising income and falling rents.

Looking back at Figure 3.1, one has to suspect that had Pitkin and Myers been concerned with estimating housing consumption in 1991, during the recent recession, rather than in 1989 at the peak of the last expansion, their cohort analysis would not have performed very well at all.

What then is a cohort effect? A cohort effect should capture some set of events that affect the current behaviour of individuals in some age group that depends on when they were born. Hypothetically, if the economic environment faced by, say, 20 year olds in 1985 and 20 year olds in 1990 is exactly the same but they make different decisions in each of these years, we could attribute (part of) the difference to a cohort effect, the fact that one group was born in 1965 and the other was born in 1970. Of course, the year of birth is not an explanation but rather a proxy for a distinct economic history. For example, since we

know that career earnings are affected by the stage of the business cycle during which an individual enters the workforce, we expect that a 20 year old who enters in 1985 during an expansion and a 20 year old who enters in 1990 during a contraction will have different real earnings when each is 30 years old, in 1995 and 2000 respectively, even if the overall economic environments in 1995 and 2000 are the same.

Individuals' current housing decisions are determined by current and expected future incomes and prices. The fact that an individual's income at a particular age differs from what would have been expected may be attributed to a cohort effect. Nevertheless, the relationship between her housing decisions and her income should not differ by cohort and, in this sense, a cohort analysis of housing decisions is inappropriate.

A cohort effect may, however, be observed when there are data limitations. For example, if the only available annual measure of income is aggregate per capita income, with no breakdown by age group, a cohort analysis may partially explain the relative income of a particular cohort over time as it moves though different age groups, and hence may partially explain the difference between its housing decisions over time and the decisions that would be expected from an age-group analysis. In our view, introducing cohort effects may usefully supplement an age-group analysis but cannot supplant such an analysis; the extrapolations suggested by Pitkin and Myers have no logical basis and are bound to miss individuals' responses to changes in their economic circumstances.

4. Estimated Headship Rate Functions

Our review of empirical research on headship rate functions in Appendix A confirmed that headship rates generally respond to economic variables in the manner predicted by conventional economic theory, i.e., household formation responds negatively to the price of housing services and positively to individual or per capita income. This research also showed that, while the estimated coefficients vary, the overall pattern of income and price sensitivities appears to have been the same for different time periods, both in the aggregate and at the individual level.

Beyond offering some perspective on earlier work, a goal of our review was to identify parameter values from estimated headship rate functions that could subsequently be

used for simulation purposes. More specifically, an estimated headship rate function such as $hh = \alpha + \beta X$, where hh is the headship rate and X is an explanatory variable, provides values for α and β; any forecasted change in X, ΔX, can then be used to predict the corresponding headship rate change, $\Delta hh = \beta \Delta X$. Thus, given some value for β, a sequence of forecasted X values can be transformed into a sequence of forecasted headship rate values.

To undertake this type of simulation exercise, we must be able to forecast the same variable as was employed in the study from which the value of β is drawn. Since we interested in Canada and are restricted to using Statistics Canada-CMHC data, i.e., annual, aggregate time series data, we are effectively forced to restrict attention to two studies, Smith (1984) and Smith et al (1984). As these studies use data from the 1961-1981 period, however, it was unclear whether or not their reported parameter estimates would be appropriate for making projections into the 1990's and beyond. In consequence, we sought to update these studies using more recent data. The remaining portions of this section describe our results.

4.1 The Original Smith Studies

The basic equation estimated in Smith (1984) is:

$$\log(hh_t) = \alpha + \beta^* \log(R_{t-1}/Y_t) \,, \qquad (1)$$

where R_t denotes the real rent in period t and Y_t denotes real per capita personal disposable income (PDI) in period t. (Since the headship rate in period t is determined jointly with the rental price of housing services in period t, the lagged (rather than current) value of real rents is introduced to avoid simultaneity problems.) In this equation, β represents the elasticity of the headship rate with respect to the lagged-rent to income ratio, i.e., a 1% change in R_{t-1}/Y_t induces a β% change in hh_t. Using the same right-hand-side variables, a different equation is estimated for four different age groups (15-24,25-34,35-64,65+) and for family and non-family households. That is, eight different β's are estimated altogether. The elasticities reported in Smith (1984) appear in Column A of Table 4.1. As noted earlier, these numbers show that the non-family household formation rate is more sensitive to rent

TABLE 4.1

HEADSHIP RATE FUNCTIONS
Estimated Coefficients of log (R_{-1}/Y)

AGE GROUP	Smith (1984) (A)	1961-1981 (B)	1971-1991 (C)	1961-1991 (D)
FAMILY				
15-24	-0.19*	-0.20**	-0.03	-0.17**
25-34	-0.03*	-0.04**	0.08*	0.01
35-64	-0.04*	0.04**	-0.01	-0.03**
65+	0.01	0.06**	0.05**	0.09**
NONFAMILY				
15-24	-1.06*	-1.11**	-0.73**	-1.14**
25-34	-0.91*	-0.97**	-0.96**	-1.12**
35-64	-0.33*	-0.34**	-0.42**	-0.49**
65+	-0.29	-0.30**	-0.25**	-0.35**

* = significant at the 5% level
** = significant at the 1% level

and income than is the family household formation rate, and that younger age groups are similarly more responsive than older age groups.

The basic equation estimated in Smith et al (1984) is:

$$\log(hh_t) = \alpha + \beta 1 * \log(R_{t-1}) + \beta 2 * \log(Y_t) , \qquad (2)$$

In this equation, $\beta 1$ represents the elasticity of the headship rate with respect to lagged real rent, i.e., a 1% change in R_{t-1} induces a $\beta 1$% change in hh_t; $\beta 2$ represents the elasticity of the headship rate with respect to real per capita PDI. The age-specific elasticities reported by Smith et al appear in Columns A1 and A2 of Table 4.2; only one set of estimates was produced for the entire population using data that did not distinguish family and non-family households. These numbers have the anticipated signs, and have relative magnitudes that are comparable to those in Column A of Table 4.1.

In Subsection 4.3 below we describe the estimated elasticities corresponding to models (1) and (2) that result when using more recent data. We do not claim that either (1) or (2) provides the best explanation for headship rates, but instead propose that these models can deliver reasonable estimates of the price and income elasticities. Still, it should be noted that as a consequence of omitting possible additional explanatory variables, the estimated variance of these elasticities will be larger than otherwise, and so we are less likely to accept a value as being statistically significant; i.e., in judging whether or not an economic variable is important we will err on the conservative side.

Before proceeding, it should be noted that Tables 4.1 and 4.2, and 7.2 and 7.3 later below, do not report R^2 values. We omit them because they are relatively uninformative in the present situation. For example, the 32 numbers presented in Table 4.1 result from estimating 32 different equations all with the same explanatory variable, $\log(R_{-1}/Y)$. It turns out that those equations in which the estimated elasticity is significant at the 1% level generally have higher R^2 values (in the .5 to .98 range) than those equations in which the estimated elasticity is significant at the 5% level (R^2 in the .2 to .8 range), and the latter in turn have higher R^2 values than the remaining equations (in the .01 to .65 range). Moreover, recognizing that factors other than income and rents likely influence household

TABLE 4.2

HEADSHIP RATE FUNCTION COEFFICIENT ESTIMATES

AGE GROUP	Smith et al. (1984)		1971-1991		1961-1991		1961-1991		
	log R_{-1} (A1)	log Y (A2)	log R_{-1} (B1)	log Y (B2)	log R_{-1} (C1)	log Y (C2)	log R_{-1} (D1)	log Y (D2)	UN (D3)
			FAMILY						
15-24	-0.80*	2.12*	-0.35	-0.49	-0.06	0.21	-0.61*	0.36*	-0.09**
25-34	-0.93*	1.62*	-0.10	0.35**	0.10	0.02	-0.17	0.06	-0.04**
35-64	-0.21*	0.70	-0.08	-0.07	-0.01	0.04	-0.08*	0.05*	-0.01**
65+	-0.25*	0.50	0.08	-0.04	0.03	0.15**	0.08	-0.16**	0.01
AGE GROUP			NONFAMILY						
15-24			-0.97**	0.39	-0.48	1.67**	-1.39**	2.05**	-0.17**
25-34			-0.99**	0.90**	-0.74**	1.48**	-1.06**	1.66**	-0.06**
35-64			-0.15	0.80**	-0.23	0.77**	-0.16	0.80**	0.01
65+			-0.24**	0.25**	-0.10	0.57**	-0.24*	0.64**	-0.03**

* = significant at the 5% level
** = significant at the 1% level

formation, we are more interested in determining whether or not the income-rent effects are significant than we are in determining whether or not they are the primary factors influencing household formation.

4.2 Data Sources

Before presenting the various elasticity estimates using more recent data, it may be helpful to first review the data sources employed.

Annual per capita PDI is available from Statistics Canada data. The rent component of the CPI is used as the rental price of housing services, and is also available on an annual basis from Statistics Canada. Real per capita PDI and the real rent are equal to their corresponding nominal values divided by the CPI. Since annual headship rate data is unavailable, Smith used data from the 1961, 1966, 1971, 1976 and 1981 census years and interpolated to construct an annual series. Given that $hh_t=HH_t/POP_t$, where HH_t denotes the number of households in period t and POP_t denotes the population, Smith interpolated the HH_t census data to generate an annual household series, interpolated the POP_t census data to generate an annual population series, and then determined annual ratios to get hh_t. A moving quadratic was used to perform these interpolations.

There are, of course, many different possible interpolation techniques. For example, Statistics Canada generates intercensal estimates of various variables by assuming that the intercensal growth rate of a series is constant between consecutive census years (i.e., given X_t and X_{t+5}, solve $X_{t+5}=(1+n)^5X_t$ for the growth rate n, and then approximate intercensal values by $X_{t+i}=(1+n)^iX_t$ for i=1,2,3,4). The advantage of this technique is that it is inconsequential whether one interpolates hh directly or, instead, interpolates HH and POP and subsequently determines a sequence of ratios. In consequence, this is the technique we opted to use in our investigations of both headship rates and ownership propensities.

4.3 New Results

To start, we re-estimated Smith's model (1) using the 1961-1981 headship rate data reported in his paper, while applying the 'constant growth' interpolation technique sketched above. The resulting estimated headship rate elasticities are reported in Column B of Table

4.1. These results are similar though not identical to those in Column A. The differences are explained by the facts that, first, we employed a different interpolation technique and, second, Statistic Canada revised its rent and income series for 1961-1981. Nevertheless, the basic pattern of β's is essentially unchanged and still accords with economic intuition.

The remaining coefficients reported in Columns C and D of Table 4.1 are the result of having estimated model (1) using data from different sample periods; the numbers in Column C are based on data from the more recent sub-period 1971-1991 while those in Column D are based on interpolated data from the sample period 1961-1991; the corresponding census year numbers were reported earlier in Section 1. Table 4.2 reports elasticity estimates corresponding to model (2).

In the case of family households, it is clear comparing columns {A,B,D} of Table 4.1 with column {C} of the same table that the impacts of rents and incomes on household formation are generally smaller and less significant than had been the case during the earlier 1961-1981 period. The results on family headship rates in Columns {B1,B2} and {C1,C2} of Table 4.2 likewise indicate that, separately, neither rents nor per capita PDI explain headship rates to any significant degree. We think that this is an important observation that itself merits further study; while the source is unclear, something changed during the period which apparently attenuated the impacts of income and rents.

In the case of non-family headship rates, however, the results are somewhat different. Comparing Columns C and D in Table 4.1 with Column B, we see that, in all sample periods, the rent-to-income ratio has a significant negative impact on household formation; further, this impact declines with the age. Columns {B1,B2} and {C1,C2} of Table 4.2 show that, separately, rent and income each influence non-family headship formation. Notice that the rent variable seems to have had a greater impact during the more recent 1971-1991 period while the income variable had a greater impact during the initial subperiod.

We experimented with an additional model which added one variable to the right-hand-side of (2):

$$\log(hh_t) = \alpha + \beta 1 * \log(R_{t-1}) + \beta 2 * \log(Y_t) + \gamma * UN_t \,, \qquad (2')$$

where UN_t is a 8-year moving average of the unemployment rate. Estimated values of $\{\beta 1,\beta 2,\gamma\}$ appear in Columns {D1,D2,D3} of Table 4.2. These results again confirm that, for all age groups, non-family headship rates are more responsive to economic variables than are family headship rates.

5. Income and Rent Forecasts

Section 6 below uses rent and income elasticities and the corresponding forecasted real rent and per capita PDI series to forecast headship rates to the year 2003. The income series was generated by the PEAP Macro simulation model at the University of Toronto. Figure 5.1 depicts the actual real per capita PDI series for the period 1961-1993 and the forecasted series for the period 1993-2003; the latter forecast is representative of a series made under alternative hypotheses concerning the future paths of Canadian policy and export demand. Since the PEAP model does not generate detailed forecasts of housing-sector variables, it was necessary to estimate a forecasting equation for real rents. After some experimentation with different functional forms, we chose to employ the following estimated equation:

$$\begin{array}{lccccccc} R_t = & 46.193 & + & 1.0997R_{t-1} & - & 0.3092R_{t-2} & - & 0.0008y_t - 0.5045U_t - 0.657{}^{P}\pi_t^e \\ & (5.18) & & (10.48) & & (-3.54) & & (-4.38) \quad (-2.72) \quad (-5.84) \end{array} \qquad (3)$$

where R_{t-1} denotes real rent lagged 1 year, R_{t-2} denotes real rent lagged 2 years, y_t is real GDP per capita (1986 \$'s), U_t denotes the unemployment rate (%), and ${}^{P}\pi_t^e$ denotes the expected rate of price inflation (1 year ahead); the latter variable is the percentage rate of growth of the PEAP forecast for the price level. The t-statistics in brackets show that all of these coefficients are significant. To use (3) as a forecasting equation, we need to forecast $\{y_t,U_t,{}^{P}\pi_t^e\}$; the PEAP model was again used to generate these series. Figure 5.2 depicts the actual, estimated and forecasted real rent series.

6. Forecasting Household Formation

Headship rates are forecast using the methodology described earlier in Section 2.

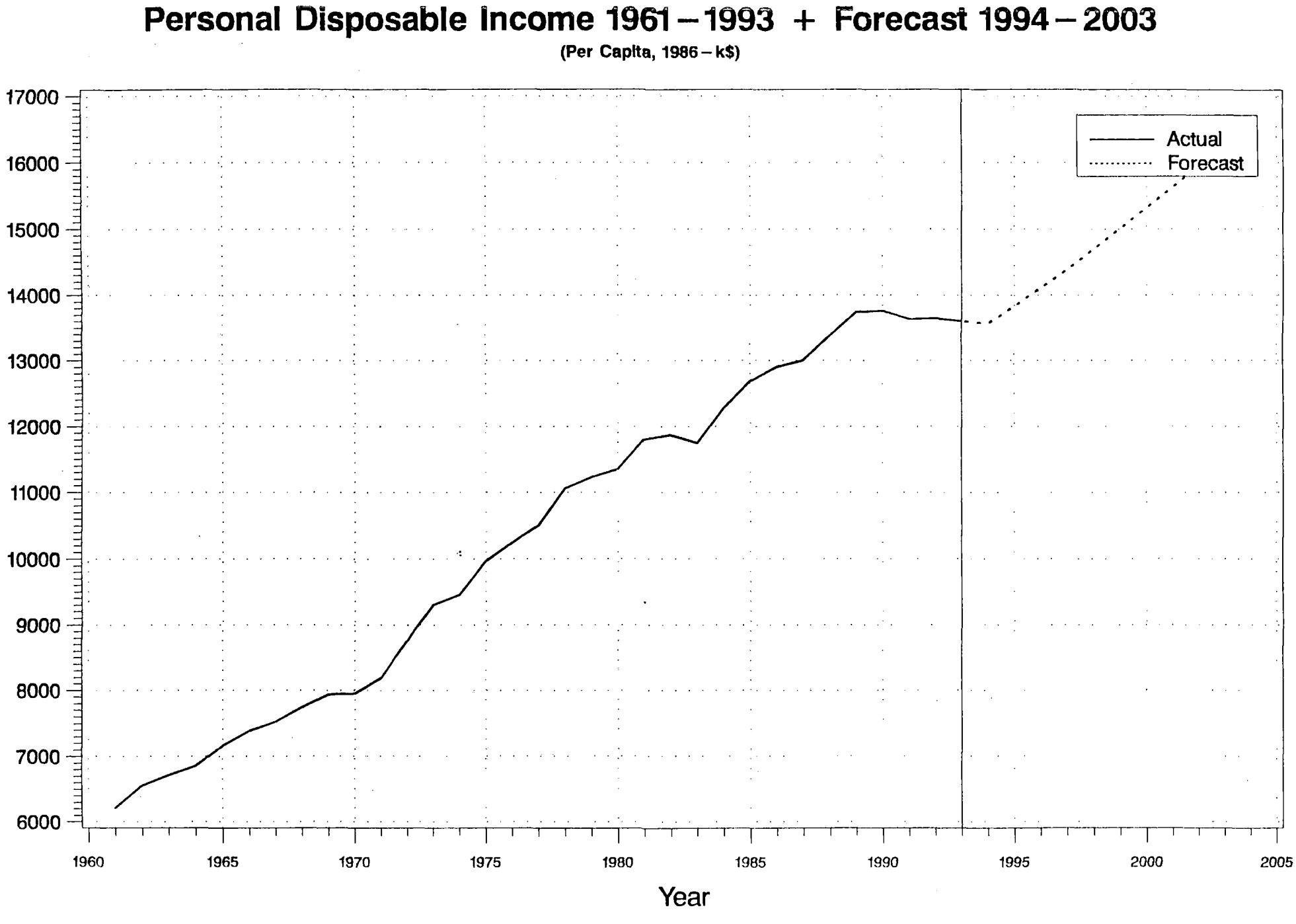

Personal Disposable Income 1961 – 1993 + Forecast 1994 – 2003
(Per Capita, 1986 – k$)
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
Actual
Forecast
SAS/GRAPH

FIGURE 5.1

Housing Price Index 1961 – 1993 + Forecast 1994 – 2003

(Rented Accomodation, 1986 = 100)

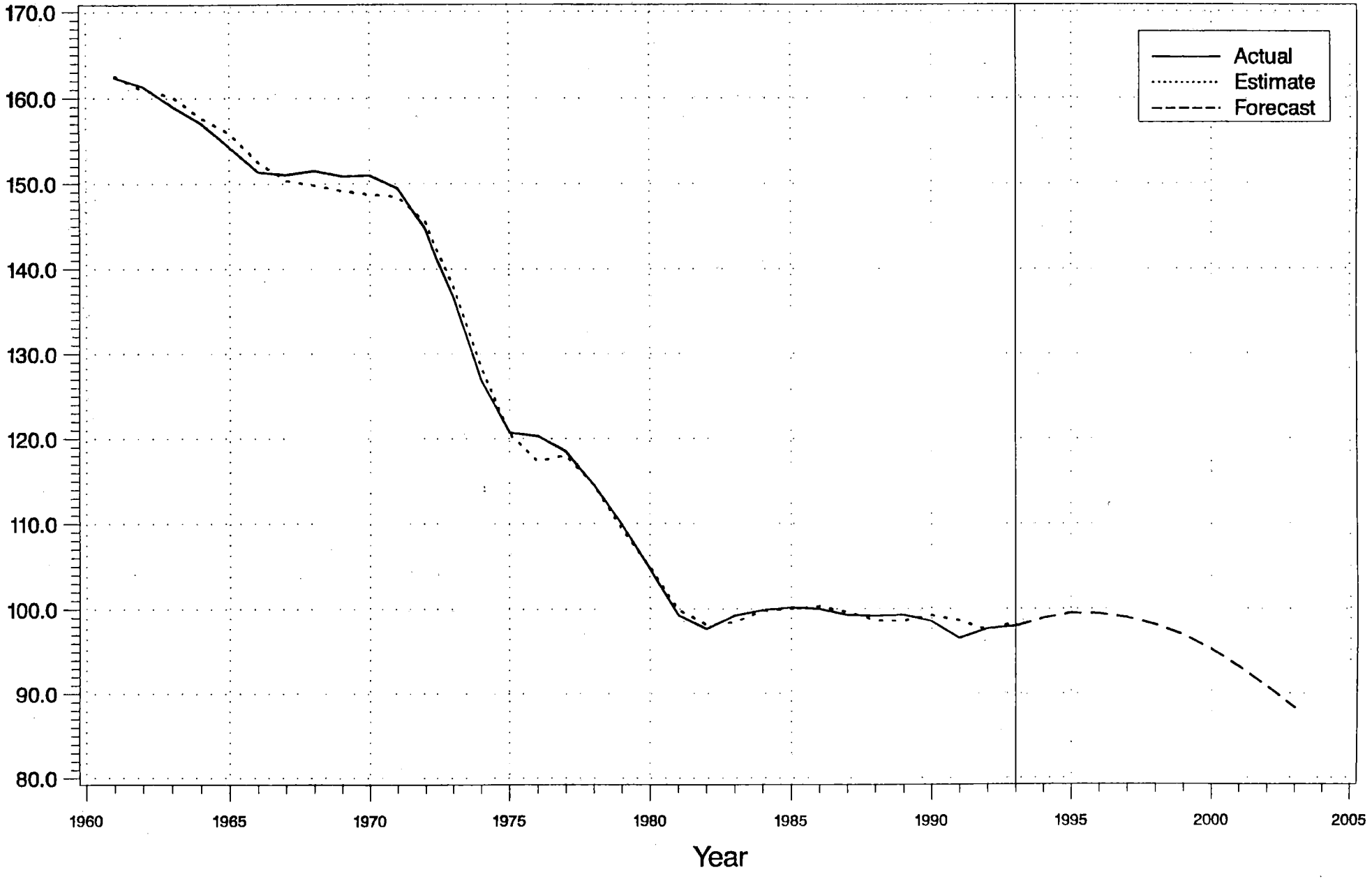


FIGURE 5.2

Letting hh_{91} denote an observed headship rate in 1991, the corresponding headship rate in year t is estimated to be:

$$hh_t = hh_{91}[R_t/R_{91}]^{\beta 1}[Y_t/Y_{91}]^{\beta 2}, \quad t=92,93,\ldots,\text{etc.},$$

where $\{R_{91}, Y_{91}\}$ are the real rent and per capita PDI values observed in 1991, $\{R_t, Y_t\}$ are the values forecast for year t, and $\beta 1$ and $\beta 2$ are the rent and income elasticities, respectively. Since the actual levels of hh_{91} and hence hh_t are not especially interesting, we instead examine

$$K_t = hh_t/hh_{91} = [R_t/R_{91}]^{\beta 1}[Y_t/Y_{91}]^{\beta 2}.$$

The correction factor K_t measures the combined impact of rents and incomes on household formation. Of course, in the base case where $\beta 1=\beta 2=0$, $K_t=1$ in all periods, and so the net impact of these variables is nil.

To isolate the effects of rent and income, we begin by considering two special cases: (i) when $\beta 2=0$ and headship rates do not respond to changes in real per capita PDI and (ii) when $\beta 1=0$ and headship rates do not respond to changes in the real rental rate. Figures 6.1 and 6.2 depict the corresponding simulations of K_t using the rent-income projections described earlier. Table 6.1 reports the numerical values of K_t corresponding to the simulations in Figures 6.1-6.7.

Figures 6.1 and 6.2 are very informative. From Figure 6.1 we see that, conditional on the income elasticity being equal to zero and given the projected rent series, the resulting headship rate is essentially constant to about the year 2000, and grows slowly thereafter. Further, the net impact by the year 2003 is not very sensitive to the rent elasticity. On the other hand, when the rent elasticity is equal to zero, Figure 6.2 shows that the projected income series begins to impact headship rates by 1994, and that the net impact by 2003 is very sensitive to the income elasticity; as $\beta 2$ ranges from 0.2 to 1.0, hh_{03}/hh_{91} ranges from 103.7 to 119.7 .

Rather than simulate all possible headship rates, by age group and family status, using

TABLE 6.1

NUMERICAL SIMULATION RESULTS

YEAR	$\beta1=-1.0$ $\beta2=0$	$\beta1=-0.5$ $\beta2=0$	$\beta1=-0.2$ $\beta2=0$	$\beta1=0$ $\beta2=1.0$	$\beta1=0$ $\beta2=0.5$	$\beta1=0$ $\beta2=0.2$	$\beta1=-0.1$ $\beta2=0.5$	$\beta1=-0.2$ $\beta2=0.5$	$\beta1=-0.5$ $\beta2=0.5$
1991	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1992	102.1	101.0	101.0	100.1	100.0	100.0	100.2	100.4	101.1
1993	100.9	100.4	100.4	99.8	99.9	100.0	100.0	100.1	100.3
1994	100.6	100.3	100.3	99.5	99.7	99.9	99.8	99.9	100.0
1995	99.6	99.8	99.8	101.4	100.7	100.3	100.7	100.6	100.5
1996	99.0	99.5	99.5	103.5	101.7	100.7	101.6	101.5	101.2
1997	99.1	99.6	99.6	105.5	102.7	101.1	102.6	102.5	102.2
1998	99.6	99.8	99.8	107.8	103.8	101.5	103.8	103.7	103.6
1999	100.4	100.2	100.2	110.0	104.9	101.9	104.9	105.0	105.1
2000	101.7	100.8	100.8	112.4	106.0	102.4	106.2	106.4	106.9
2001	103.5	101.7	101.7	114.6	107.1	102.8	107.4	107.8	108.9
2002	105.8	102.9	102.9	117.0	108.1	103.2	108.8	109.4	111.2
2003	108.5	104.2	104.2	119.7	109.4	103.7	110.3	111.2	114.0

YEAR	$\beta1=-0.1$ $\beta2=1.0$	$\beta1=-0.2$ $\beta2=1.0$	$\beta1=-0.5$ $\beta2=1.0$	$\beta1=-0.1$ $\beta2=2.0$	$\beta1=-0.2$ $\beta2=2.0$	$\beta1=-0.5$ $\beta2=2.0$	$\beta1=-1.0$ $\beta2=0.5$	$\beta1=-1.0$ $\beta2=1.0$	$\beta1=-1.0$ $\beta2=1.5$	$\beta1=-0.7$ $\beta2=0.7$	$\beta1=-0.3$ $\beta2=0.3$
1991	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1992	100.3	100.5	101.1	100.3	100.5	101.2	102.1	102.1	102.2	101.5	100.6
1993	99.9	100.0	100.2	99.6	99.7	100.0	100.8	100.6	100.5	100.4	100.2
1994	99.6	99.6	99.8	99.1	99.1	99.3	100.3	100.1	99.8	100.1	100.0
1995	101.4	101.4	101.3	102.9	102.8	102.7	100.4	101.1	101.8	100.7	100.3
1996	103.4	103.3	103.0	106.9	106.8	106.5	100.7	102.5	104.2	101.7	100.7
1997	105.4	105.3	105.0	111.1	111.0	110.7	101.8	104.5	107.3	103.1	101.3
1998	107.7	107.7	107.5	116.1	116.1	115.9	103.4	107.3	111.4	105.1	102.1
1999	110.1	110.1	110.3	121.1	121.2	121.3	105.3	110.5	115.9	107.2	103.0
2000	112.6	112.7	113.3	126.5	126.7	127.3	107.8	114.2	121.1	109.8	104.1
2001	115.0	115.4	116.6	131.8	132.3	133.7	110.8	118.6	127.0	112.7	105.3
2002	117.6	118.3	120.3	137.6	138.4	140.7	114.4	123.7	133.8	116.1	106.6
2003	120.7	121.7	124.7	144.6	145.7	149.4	118.8	130.0	142.2	120.1	108.2

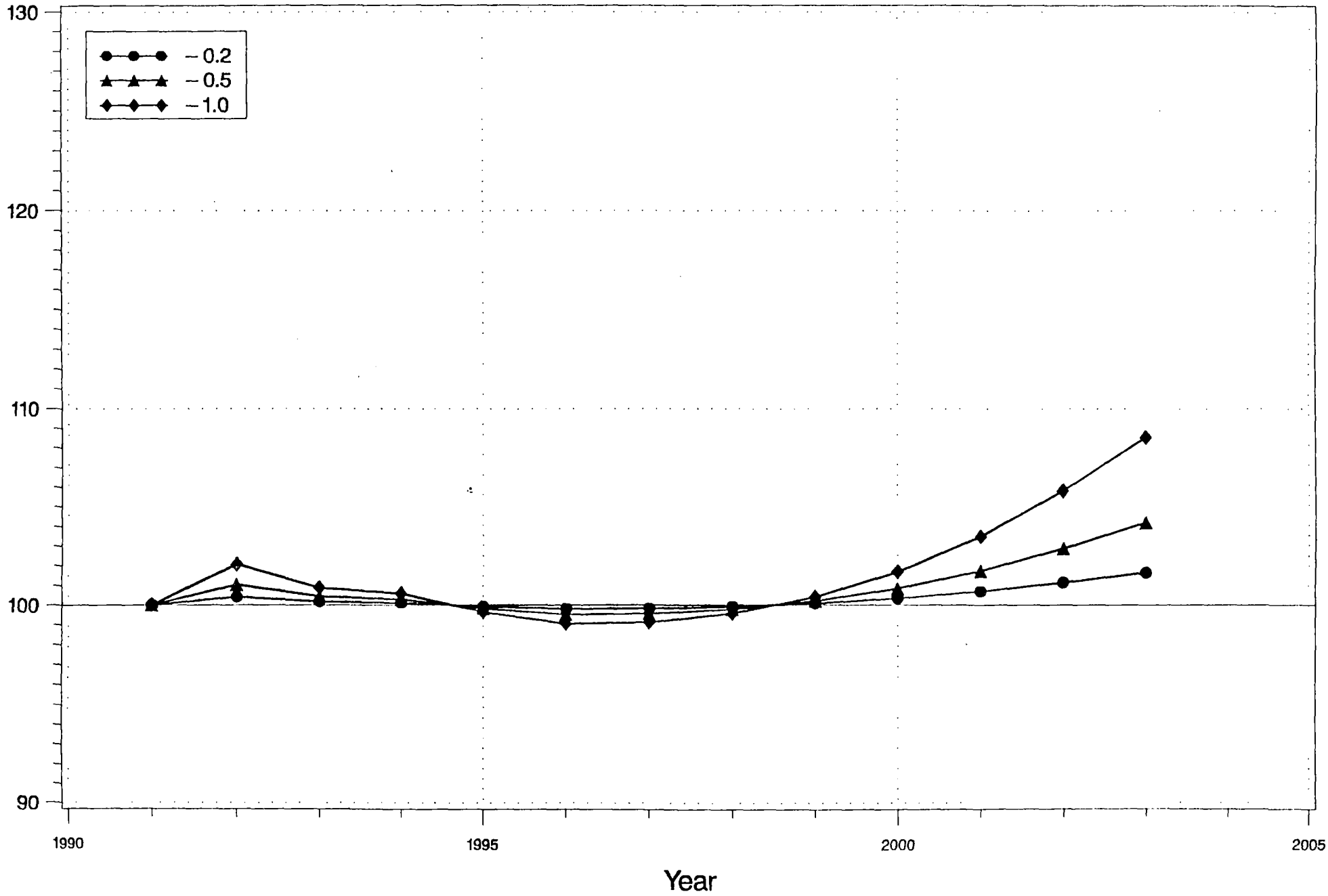

Simulation 1991 – 2003
By Rent – Price Elasticity, With Income Elasticity = 0, 1991 = 100
– 0.2
– 0.5
– 1.0
130
120
110
100
90
1990
1995
2000
2005
Year

FIGURE 6.1

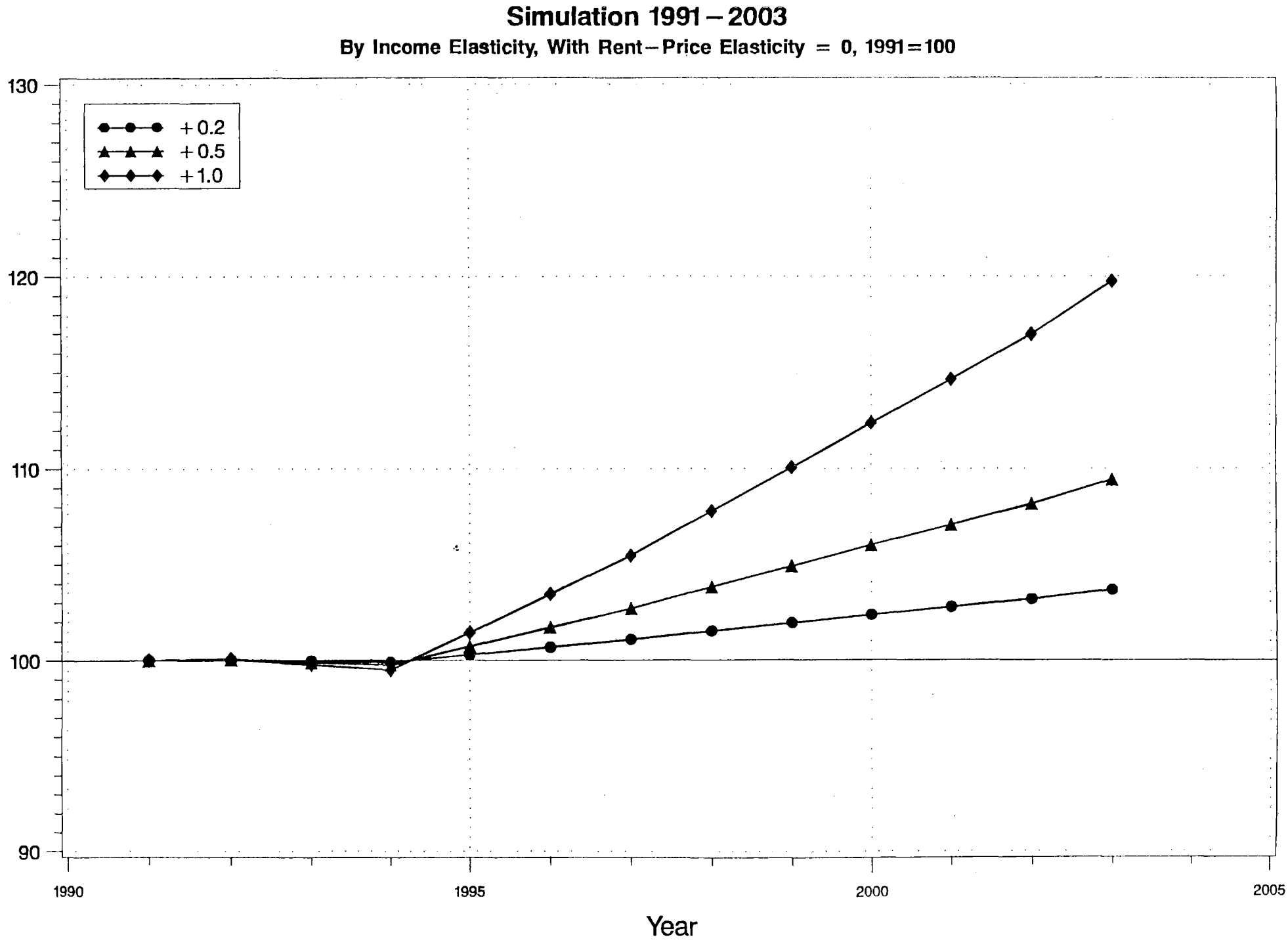

Simulation 1991 – 2003
By Income Elasticity, With Rent – Price Elasticity = 0, 1991 = 100
+0.2
+0.5
+1.0
130
120
110
100
90
1990
1995
2000
2005
Year

FIGURE 6.2

the estimated elasticities in Tables 4.1 and 4.2, we instead ran simulations only for certain hypothetical combinations of rent and income elasticities. These are depicted in Figures 6.3-6.7. It is easy to use the numbers in Tables 4.1 and 4.2 to identify the populations whose household formation behaviour is best approximated by some particular hypothetical combination of rent and income elasticities.

Each of Figures 6.3-6.7 plot $K_t=hh_t/hh_{91}$ for three different combinations of rent and income elasticities. In Figure 6.3, an income elasticity of 0.5 ($\beta 2=0.5$) is combined with three different rent elasticities, $\beta 1=-0.1$, $\beta 1=-0.2$, $\beta 1=-0.5$; in Figures 6.4 and 6.5, income elasticities of 1.0 and 2.0, respectively, are combined with these same three rent elasticities; in Figure 6.6, a rent elasticity of -1.0 ($\beta 1=-1.0$) is combined with three different income elasticities, .5, 1.0 and 1.5; and in Figure 6.7, two examples with equal (in magnitude) rent and income elasticities are depicted.

As before, it is apparent from these figures that, for the given forecasted real rent and income series, household formation is dominated by the effect of PDI per capita and so the income elasticity is especially important. The range of possible outcomes depicted here is really quite large, from $K_{2003}=110.3$ when $\beta 1=-0.1$ and $\beta 2=0.5$ to $K_{2003}=149.4$ when $\beta 1=-0.5$ and $\beta 2=2.0$. That is, after 12 years, the headship rate is anywhere from 10% to 50% higher than would have been predicted by ignoring the impacts of rents and incomes.

These results can be employed to make headship rate projections for family and non-family populations in specific age groups. Consider, for example, the non-family population aged 25-34. In Table 4.1, the estimated rent-to-income elasticities for this group range from -.91 to -1.12. This case thus be approximated by one in which the rent-to-income elasticity equals -1.0; and this is formally equivalent to a situation where, separately, the rent elasticity equals -1.0 and the income elasticity equals +1.0 . Relative to 1991, the corresponding plot in Figure 6.6 and results in Table 6.1 indicate that the non-family headship rate for 25-34 year olds will be about 2% higher by 1996, but then grow by about 3% per year; by 2003, the headship rate is projected to be about 30% higher than the 1991 value. Another illustrative example is the non-family 35-64 year olds in Table 4.2. Using 1971-1991 data, we estimated $\beta 1=-0.15$ and $\beta 2=0.8$. Hence the closest simulated case is $\beta 1=-0.1$ and $\beta 2=1.0$, as depicted in Figure 6.4. In this situation, the headship rate grows

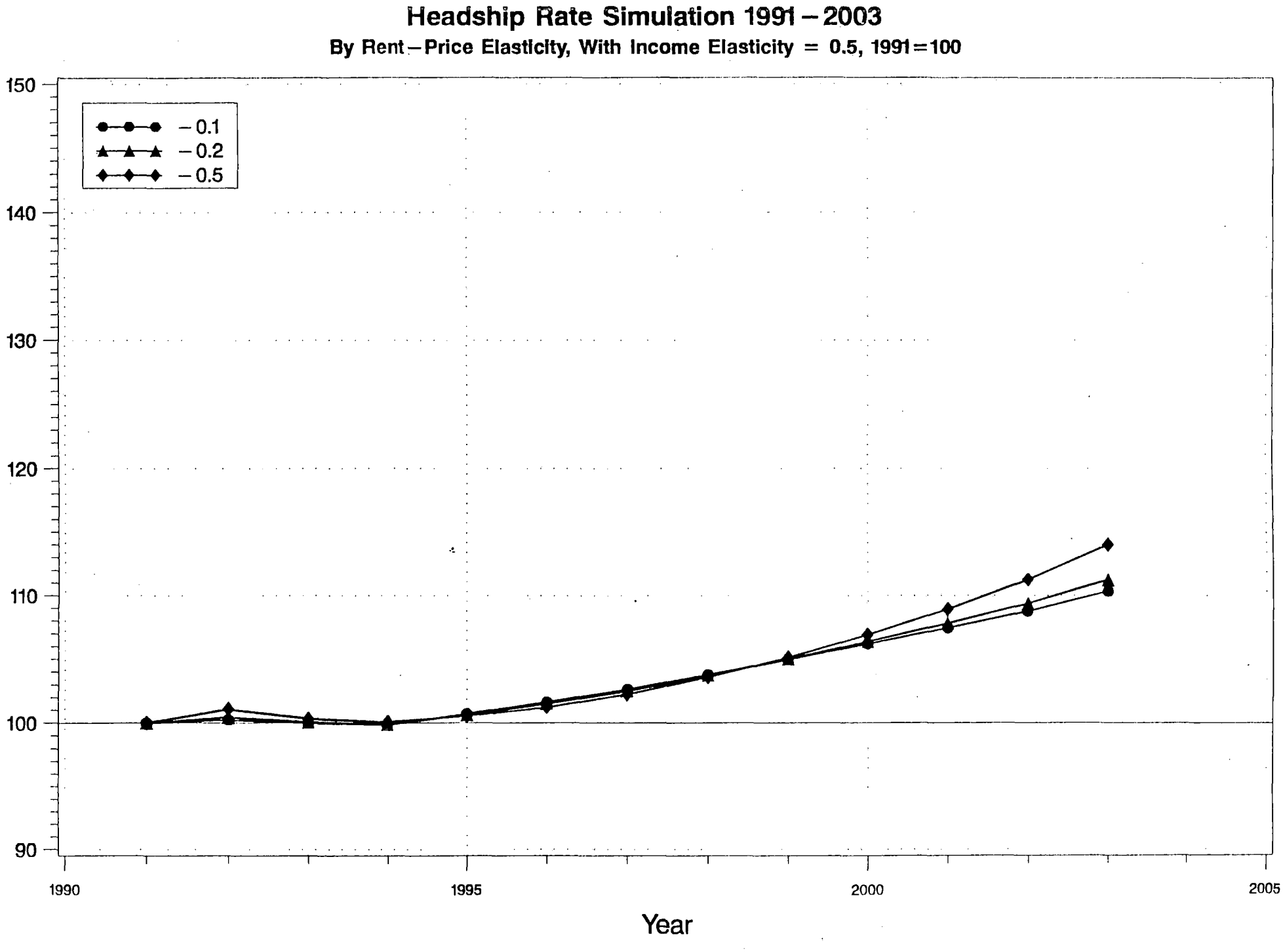

Headship Rate Simulation 1991 – 2003
By Rent – Price Elasticity, With Income Elasticity = 0.5, 1991 = 100
– 0.1
– 0.2
– 0.5
150
140
130
120
110
100
90
1990
1995
2000
2005
Year

FIGURE 6.3

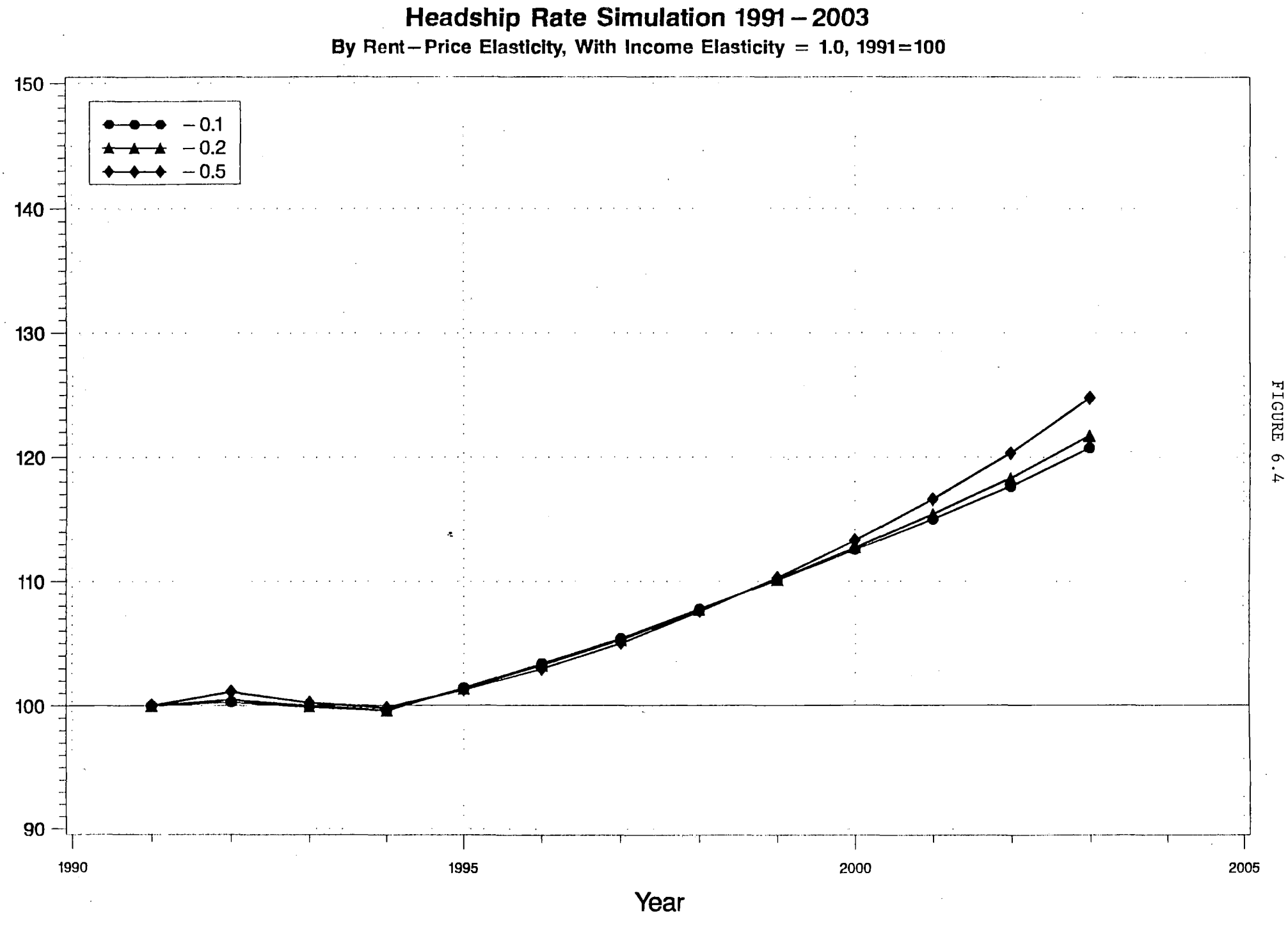

Headship Rate Simulation 1991 – 2003
By Rent – Price Elasticity, With Income Elasticity = 1.0, 1991=100
– 0.1
– 0.2
– 0.5
150
140
130
120
110
100
90
1990
1995
2000
2005
Year

FIGURE 6.4

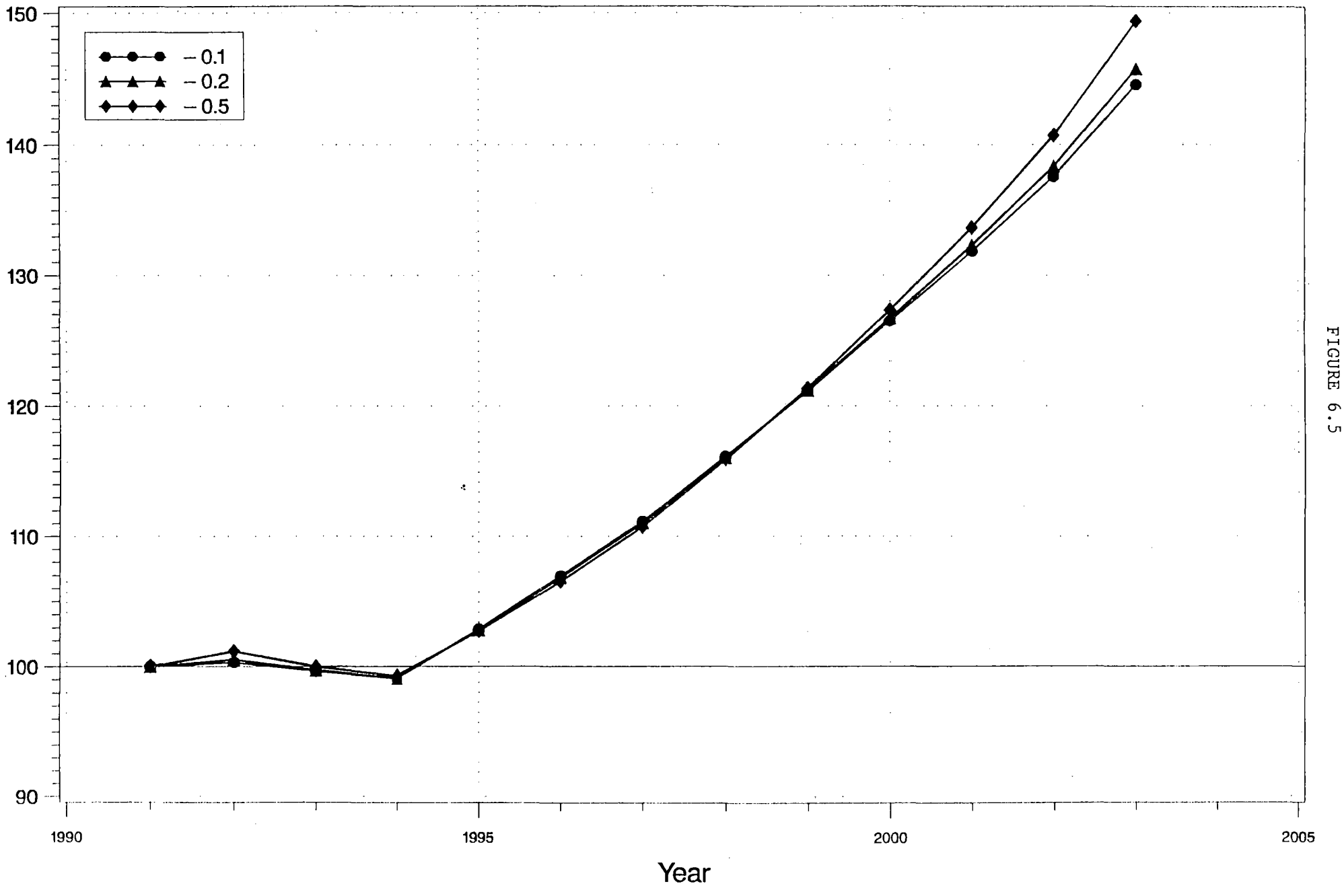

Headship Rate Simulation 1991 – 2003
By Rent – Price Elasticity, With Income Elasticity = 2.0, 1991 = 100
– 0.1
– 0.2
– 0.5
150
140
130
120
110
100
90
1990
1995
2000
2005
Year

FIGURE 6.5

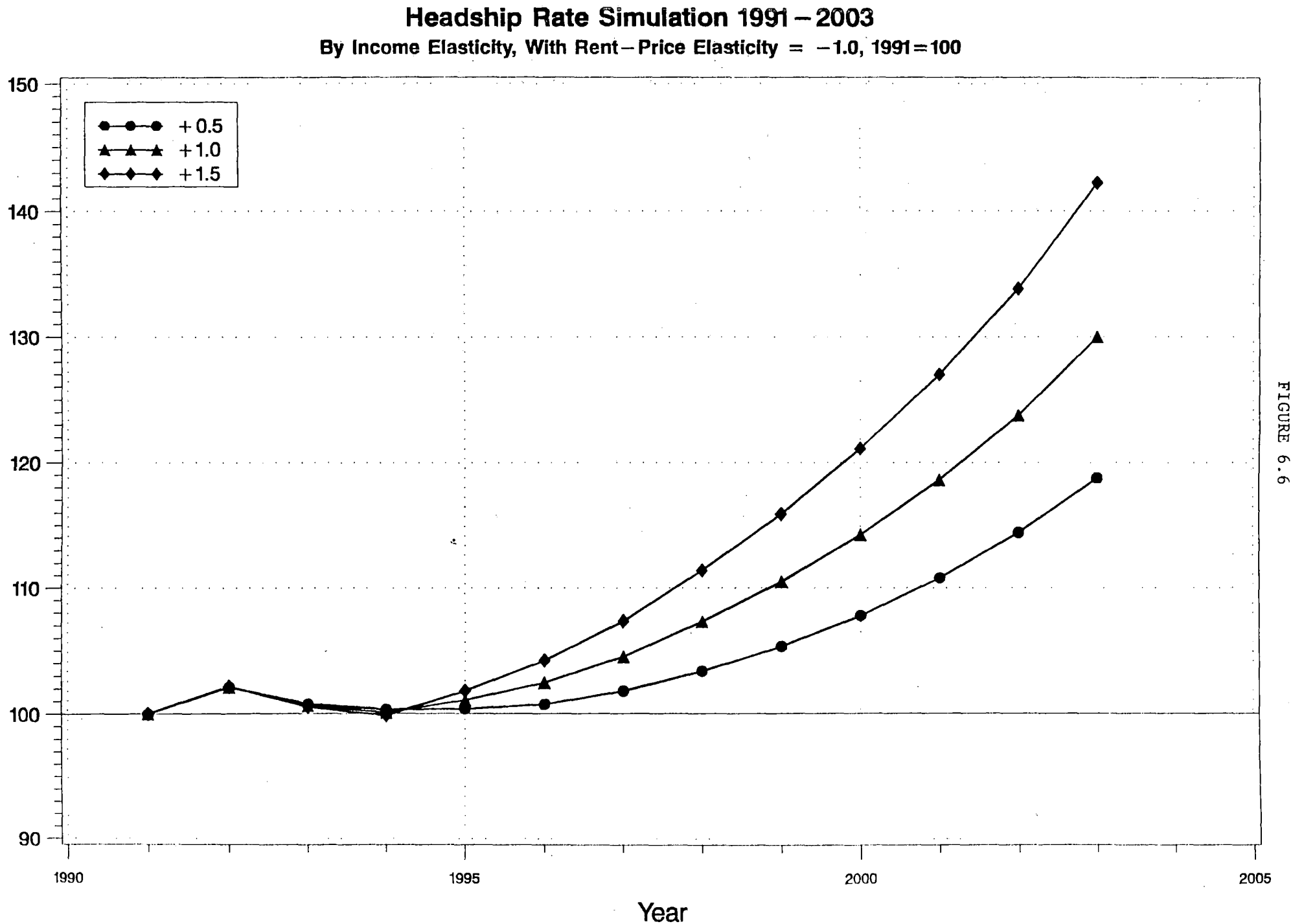

Headship Rate Simulation 1991 – 2003
By Income Elasticity, With Rent – Price Elasticity = –1.0, 1991 = 100
+0.5
+1.0
+1.5
150
140
130
120
110
100
90
1990
1995
2000
2005
Year

FIGURE 6.6

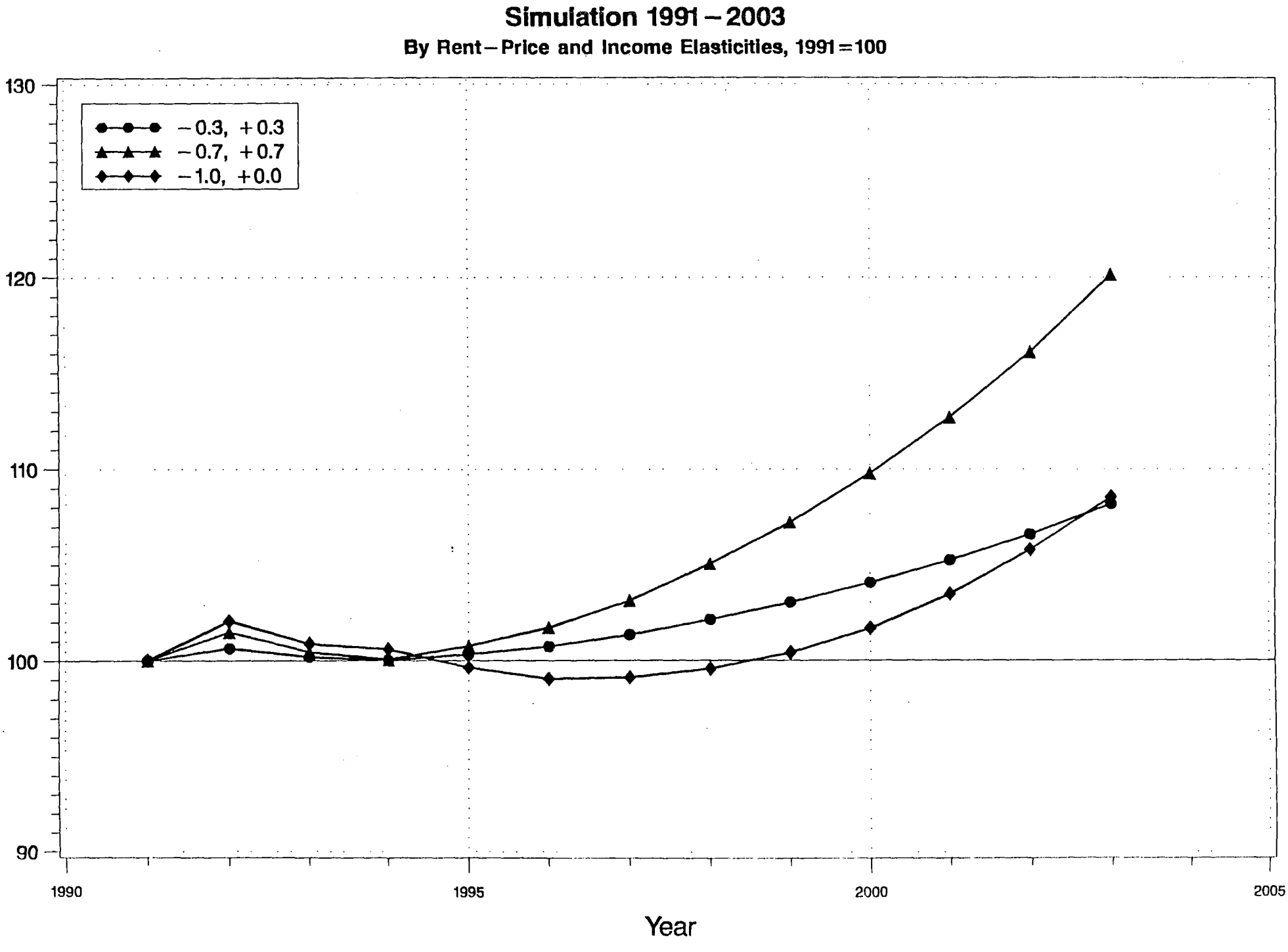

Simulation 1991 – 2003
By Rent – Price and Income Elasticities, 1991 = 100
– 0.3, + 0.3
– 0.7, + 0.7
– 1.0, + 0.0
130
120
110
100
90
1990
1995
2000
2005
Year

FIGURE 6.7

consistently at about 2% per year after 1994, so that by 2003, the headship rate is 20% higher than the 1991 value.

Changes on the order of 20-30% must be judged substantial. On the other hand, the family elasticities presented in the upper halves of Tables 4.1 and 4.2 suggest that the corresponding headship rates for most age groups will grow much more slowly and will not likely be even 5% higher by 2003. When examining these simulation results, it is important to remember that the projected changes in headship rates, whether 5% or 30%, are relative to any projections made on the basis of non-economic factors. To see this, note that the basic headship rate function, $hh = AR^{\beta 1}Y^{\beta 2}$, implies that

$$\Delta hh/hh = \Delta A/A + \beta 1 \Delta R/R + \beta 2 \Delta Y/Y .$$

This equation tells us that the rate of growth of the headship rate equals the rate of growth of A (non-economic factors) plus $\beta 1$ times the rates of growth of real rents plus $\beta 2$ times the rate of growth of real income (the 5% to 30% changes described above represent the combined effects of the second and third terms). For example, if, holding incomes and rents fixed, we expect family household headship rates to grow by X% by 2003 (due to an X% growth in A), our analysis is to be interpreted as identifying the differential economic impact, thus indicating that total growth may range from (X+5)% to (X+30)% when incomes and rents are expected to change as well.

7. Estimated Ownership Rate Functions

The empirical research on tenure choice reviewed in Appendix B does not exploit the aggregate data which is available to our study. As a result, there is no Canadian paper that can be used as a point of departure and, in this sense, the results reported here are novel and not directly comparable to earlier work.

This section describes our results from estimating ownership rate functions using aggregate Canadian data. The ownership rate in period t, denoted op_t, equals the proportion of households in a particular population of households that owns its accommodation; $1\text{-}op_t$ represents the corresponding proportion that rents accommodation. The census data on

ownership rates provided to us by CMHC appear in Table 7.1. These numbers were interpolated using the constant growth technique described earlier to generate annual ownership rate time series by age group and family status.

As before, we focus attention on two explanatory variables, income and price. Income is again measured by real per capita PDI and denoted by Y_t. On the price side, we consider two different measures, the rental price of housing services and the sale price of housing stock. The rental component of the CPI, divided by the CPI, is again used as the real rental price and is again denoted by R_t. Most measures of the sale prices of houses impose a compromise of some sort. In this study we use the average sales price represented by the MLS Canada-wide price measure; dividing the MLS price by the CPI gives a real house price, which we denote by A_t. A_t is plotted in Figure 7.1.

The ownership propensity should be a function of income and the relative price of owned versus rented housing services. We begin by restricting attention to the real income and rent variables. Table 7.2 records the estimated coefficients from the following three equations:

$$\log(op_t) = \alpha + \beta*\log(R_{t-1}/Y_t) , \tag{3}$$

$$\log(op_t) = \alpha + \beta1*\log(R_{t-1}) + \beta2*\log(Y_t) , \tag{4}$$

$$\log(op_t) = \alpha + \beta1*\log(R_{t-1}) + \beta2*\log(Y_t) + \gamma*UN_t . \tag{5}$$

The coefficients in Column A of Table 7.2 are from model (3), those in Columns {B1,B2} are from model (4), and those in Columns {C1,C2,C3} are from model (6).

The overall pattern of coefficients in Table 7.2 is not too different from those observed earlier in the case of headship rates; that is, the ownership rates for non-family households are more sensitive to rent and income changes than are ownership rates for family households and, among both groups, these sensitivities tend to decline with age. Interestingly, a comparison of Tables 4.1 and 7.2 reveals that the ownership rate for family households is more responsive to changes in the economic environment than is their rate of household formation whereas, for non-family households, the headship rate is more responsive than the ownership rate. A puzzling feature of these results is the negative impact

TABLE 7.1

OWNERSHIP PROPENSITY DATA

YEAR	AGE GROUP	OWNERSHIP PROPENSITY	
		FAMILY	NONFAMILY
1971	15-24	.18	.05
1976	15-24	.27	.06
1981	15-24	.27	.08
1986	15-24	.24	.09
1991	15-24	.19	.08
1971	25-34	.47	.10
1976	25-34	.59	.15
1981	25-34	.61	.19
1986	25-64	.58	.20
1991	25-64	.57	.21
1971	35-64	.75	.37
1976	35-64	.78	.36
1981	35-64	.80	.38
1986	35-64	.80	.39
1991	35-64	.80	.40
1971	65+	.77	.54
1976	65+	.75	.49
1981	65+	.76	.47
1986	65+	.78	.48
1991	65+	.80	.50

Housing Price 1961–1992 + Forecast 1993–2003

(Total MLS Property, 1986–$)

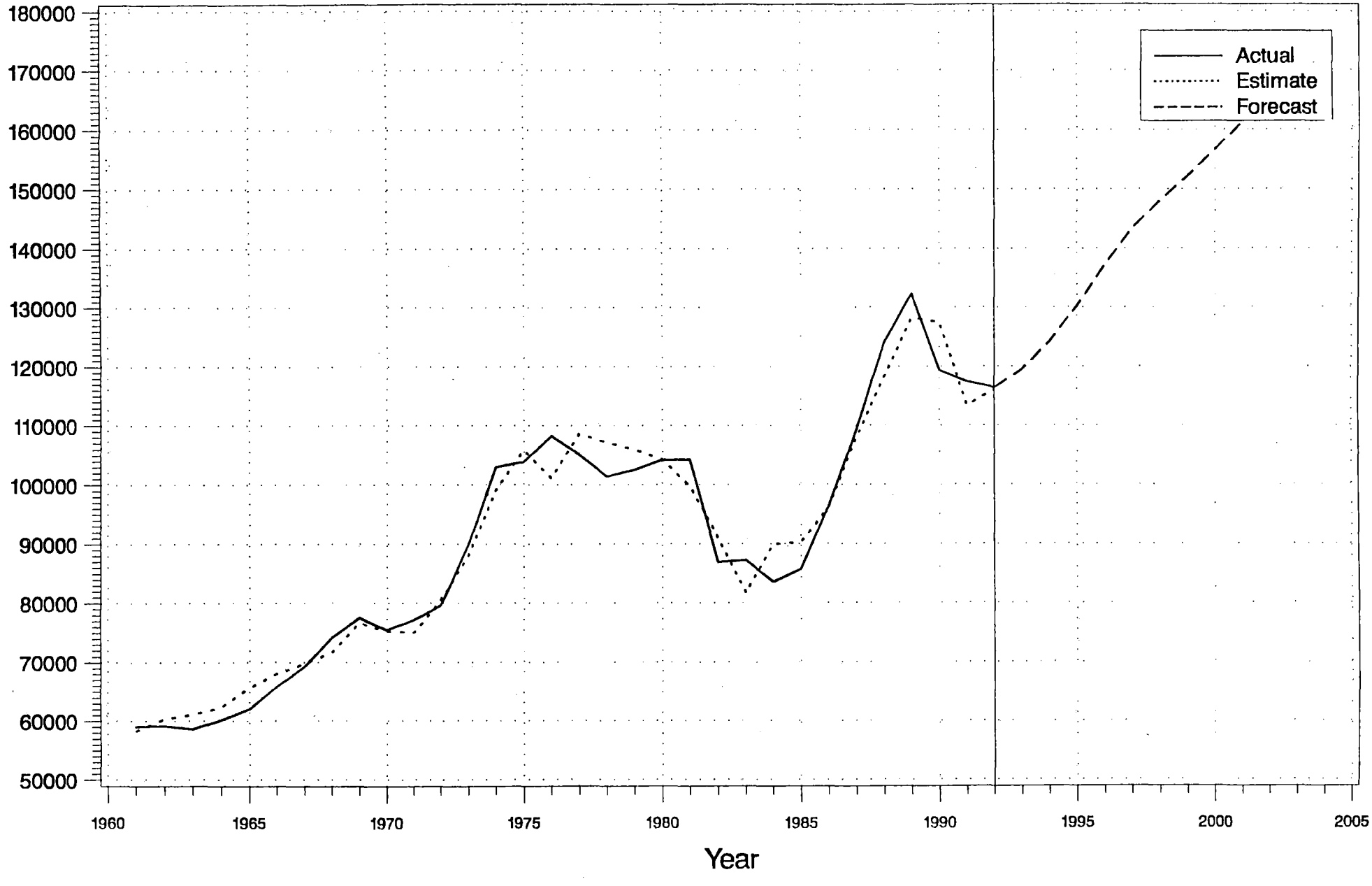


FIGURE 7.1

TABLE 7.2

OWNERSHIP RATE FUNCTIONS (1971-1991)

AGE GROUP	log R_{-1}/Y (A)	log R_{-1} (B1)	log Y (B2)	log R_{-1} (C1)	log Y (C2)	UN (C3)
FAMILY						
15-24	-0.31*	-0.82	-0.49	-1.53*	0.20	-0.13*
25-34	-0.27**	-0.38	0.05	-0.71**	0.33	-0.06**
35-64	-0.08**	-0.10**	0.04	-0.13**	0.07*	-0.01*
65+	-0.01	0.05	0.12*	0.14*	0.04	0.01**
NONFAMILY						
15-24	-0.62**	-0.96**	0.30	-0.99**	0.34	-0.01
25-34	-0.76**	-0.72**	0.71**	-0.88**	0.88**	-0.03**
35-64	-0.06**	-0.02	0.15*	0.07	0.05	0.02**
65+	0.13**	0.29*	0.07	0.44**	-0.06	0.03*

* = significant at the 5% level
** = significant at the 1% level

of real rents on ownership rates as this implies that rental propensities respond positively to real rents.

The earlier simulation results in Figures 6.1-6.7 provide some sense of the implications of the elasticities recorded in Table 7.2. For example, since the rent-to-income elasticities for family households with a head aged 19-24 and 25-34 year in Column A are both approximately equal to -0.3, the plot in Figure 6.7 generated under the hypothesis that $\beta 1 = -.3 = -\beta 2$ indicates that the ownership rate for these groups will be flat to 1994 and rise gradually thereafter so that by 2003 the ownership rate is 8% higher than its 1991 value.

As indicated above, the real market rent for housing services is not the only price variable that will likely affect tenure decisions. Indeed, the correct relative price for housing services as concerns an ownership decision is the ratio of the user-cost of housing to the market rental price. The user-cost is basically the after-tax interest plus operating costs associated with a house net of any anticipated capital gains. Ignoring operating costs and taxes, we examined the following real quasi-user cost, $UC_t = A_t(i_t - {}^A\pi_t^e]/P_t$, where i_t is the conventional 5-year mortgage rate, ${}^A\pi_t^e$ is the expected rate of growth of the price of a housing unit between periods t and t+1, and P_t is the CPI in period t. UC_t is plotted in Figure 7.2.

Recall that the variable to be explained here, op_t, is an interpolated variable, and so its time series will be relatively smooth. On the other hand, observe that the real user-cost in Figure 7.2 has been considerably more volatile than the real average MLS price in Figure 7.1 which, in turn, has been more volatile than the real rent in Figure 5.2. Since a highly volatile variable generally cannot explain much of the variation in a non-volatile variable, we did not expect our user-cost variable to be an important determinant of the ownership rate. This was confirmed when estimating several different models that employed UC_t as a right-hand-side variable. In fact, the MLS price A_t itself also provided no explanatory power. Once again we attributed this negative result to a question of relative volatility.

(While our user-cost variable is not an important determinant of the smoothed ownership rate derived from census data, one could argue that it may well have a substantial impact on the actual but unobservable ownership rate at a point in time; we remain unsympathetic to the latter view, however, as we have found no evidence suggesting that

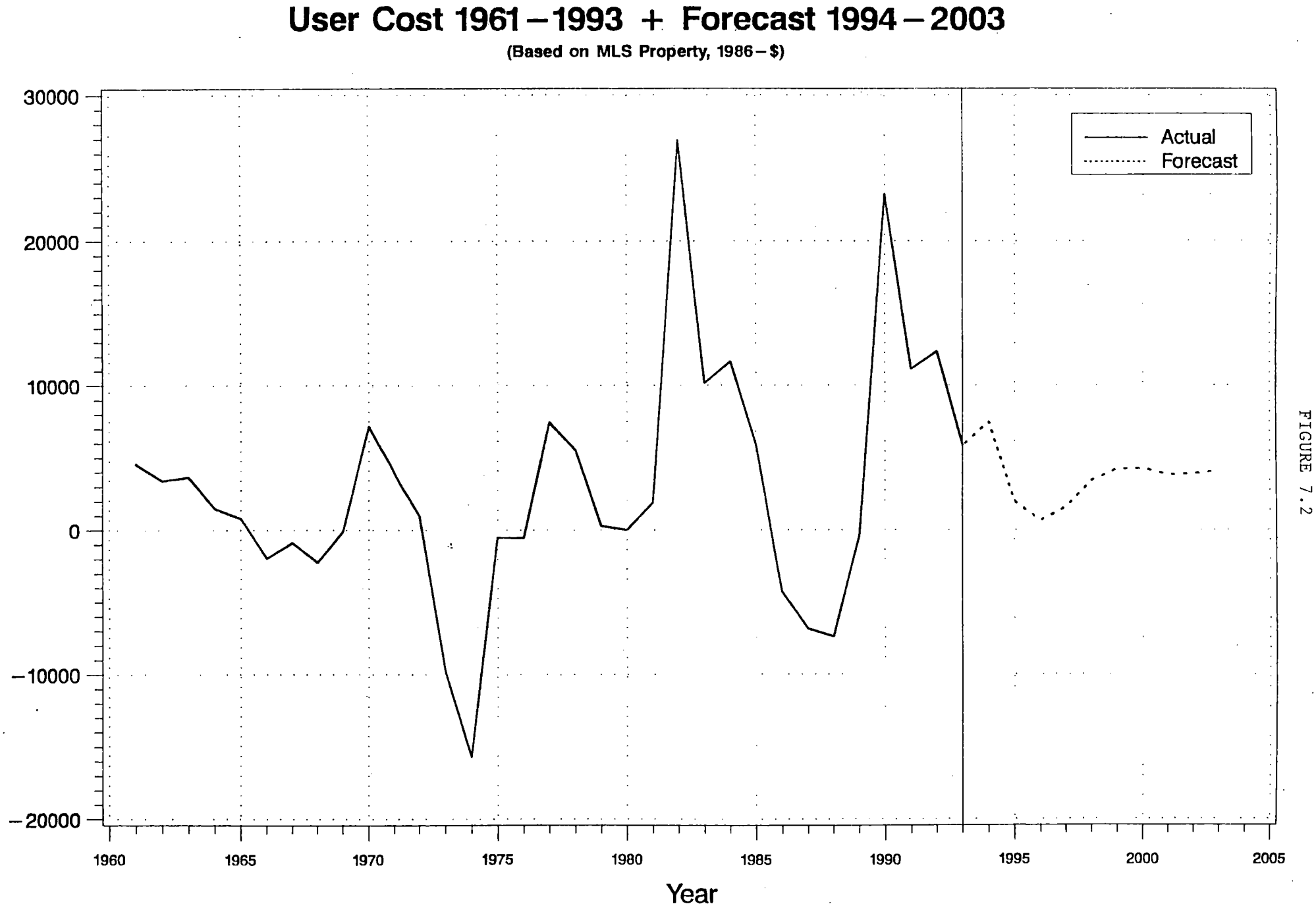

User Cost 1961 – 1993 + Forecast 1994 – 2003
(Based on MLS Property, 1986 – $)
30000
20000
10000
0
–10000
–20000
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
Actual
Forecast
SAS/GRAPH

FIGURE 7.2

TABLE 7.3

OWNERSHIP RATE FUNCTIONS (1971-1991)

AGE GROUP	log AP_{-1}/Y (A)	log AP_{-1} (B1)	log Y (B2)	log $AP_{-1}/\overline{R}_{-1}$ (C1)	log Y (C2)
FAMILY					
15-24	0.02	0.06	0.26	0.14	0.05
25-34	0.0004	0.05	0.36**	0.09	0.24
35-64	-0.02	-0.002	0.13*	0.01	0.12**
65+	-0.01	-0.01	0.07*	-0.01	0.09*
NONFAMILY					
15-24	-0.22	-0.10	1.13**	0.001	1.03**
25-34	-0.15	-0.01	1.29**	0.09	1.15**
35-64	-0.04	-0.03	0.20**	-0.03	0.24**
65+	0.03	0.004	-0.20**	-0.02	-0.16

* = significant at the 5% level
** = significant at the 1% level

ownership rates are especially variable even in the short run.)

Finally, instead of using A_t, we constructed a 4-year moving average of A_t, denoted AP_t, and estimated the following models:

$$\log(op_t) = \alpha + \beta*\log(AP_{t-1}/Y_t) ,$$
$$\log(op_t) = \alpha + \beta1*\log(AP_{t-1}) + \beta2*\log(Y_t) ,$$
$$\log(op_t) = \alpha + \beta1*\log(AP_{t-1}/R_{t-1}) + \beta2*\log(Y_t) .$$

The estimated coefficients appear in Table 7.3 and confirm that the MLS price has had no impact on tenure decisions. Indeed, it remains unclear to us why the real rent seems to have a positive impact while neither UC_t, A_t nor AP_t has any significant effect at all. Still, the income effects are present: once again, non-family households are more responsive to per capita PDI than family households, and younger age groups are more responsive than older ones. The simulations in Figure 6.2, which depict only income effects, nicely capture the range of possible forecasts corresponding to the numbers in Table 7.3. They indicate that family household ownership rates should not grow by more than 4% by 2003, whereas non-family ownership rates for younger age groups may grow by as much as 20%.

8. Concluding Remarks

This project describes how demographic change affects the housing market. Section 1 provides a brief summary of Canada's post-1945 demographic experience. The outstanding development here and elsewhere during that period was the rise and subsequent decline of fertility rates and live births, and the consequent changes in the age distribution of the population that are known as the "baby boom" and "baby bust".

Of course, many other researchers have been interested in the impact of the baby boom on housing demand and the housing market. In one form or another, most studies have converted the underlying population changes into changes in housing demand using historical household formation and ownership rates. Here, we argue that these rates were themselves determined by their contemporaneous economic environments. It then follows that any attempt to project household formation and ownership rates requires (i) an

understanding of the impact of the economic environment on household formation and the decision to own (versus rent), and (ii) projections of changes in that environment over time. The focus of this study is (i); in the case of (ii) we adopt a well-respected and publicly available set of macroeconomic forecasts for the Canadian economy generated by other researchers here at the University of Toronto.

The basic theoretical arguments are made in Sections 2 and 3; estimation and simulation results for Canada are presented in Sections 4-7; Appendices A and B summarize recent empirical research on household formation and tenure choice, respectively, in Canada and elsewhere.

Section 2 develops a technique for projecting headship rates and tenure propensities that are responsive to economic variables. Section 3 argues that forecasts of headship and ownership rates should be based on economic analyses by age group, of the type identified in Section 2. In particular, we argue that extrapolation of either age-group or cohort histories can be justified only to the extent that the headship and ownership rates are driven by trend movements in factors which are unobservable; i.e., cohort analysis is meaningful only where cohort effects proxy for unobservables.

The empirical results presented in the text confirm with more recent data for Canada the material presented in the appendices; specifically, economic variables are important determinants of household formation and tenure choice, especially for non-family households. Certainly, the results for family households were disappointing, if not intriguing. In the latter case, the clear deterioration in the performance of the rent and income variables in the 1971-91 period, versus the earlier 1961-81 period, suggests that some important changes have occurred that merit further investigation.

Appendix A

Household Formation

A selection of recent research on household formation and headship rates is summarized below. A consistent pattern emerges from these different studies. The parameter estimates reported therein will later form the basis for our specification of the headship rate correction factors detailed in Section 2.

The first set of papers by Hickman (1974), Smith (1984), Smith et al (1984) and Hendershott and Smith (1985) use aggregate time-series data; Hickman and Hendershott-Smith use U.S. data, Smith uses Canadian data, and Smith et al use data from Canada, Britain, France and the U.S.. The second set of papers by Borsch-Supan (1986), Miron (1988), Pitkin (1990), Haurin, Hendershott and Kim (1993), Bourassa et al (1993), Borsch-Supan et al (1993) use cross-sectional (mostly individual) data; for the most part, these studies restrict attention to certain age groups, specifically, young individuals and the elderly. Miron is the only cross-sectional piece described here that uses Canadian data.

A.1 Time-Series Studies

In an early piece, **Hickman (1974)** constructed a model of U.S. household formation for the period 1922-1970. His estimated model includes economic and demographic variables and is given by

$$\ln HH = -.781 + .0606\ln YPD + .2744\ln HHS - .005\ln PYHR - .0556\ln PCE$$

$$+ .665\ln HH_{-1} + .9655U_{-1}$$

where HH is the number of nonfarm households, YPD is disposable income (billions), HHS is the number of standardized households (population weighted by 1940 headship rates), PYHR is the price deflator for nonfarm dwellings, PCE is the implicit price deflator for personal consumption, and U_{-1} is the estimated residual from previous period.

This equation identifies changes in standardized households (the demographic effect) and real disposable income as the key determinants of changes in the number of households. Neglecting the rent and price terms, PYHR and PCE, we get, as an approximation,

$$\ln HH \backslash HH_{-1} \approx .2744\ln HHS/HHS_{-1} + .0606\ln YPD/YPD_{-1} + .665\ln HH_{-1}/HH_{-2}.$$

That is, the short-term elasticity of the relative rate of household formation with respect to a relative increase in standardized households is 0.27, while the corresponding elasticity for a relative increase of real disposable income is 0.06. By contrast, the long-term income elasticity is much larger at .18. To see this, note that in a steady-state equilibrium, the rate of growth of households is constant, so that $\ln HH/HH_{-1} = \ln HH_{-1}/HH_{-2}$, and hence

$$\ln HH\backslash HH_{-1} \approx .819 \ln HHS/HHS_{-1} + .181 \ln YPD/YPD_{-1},$$

$$\approx \ln HHS/HHS_{-1} + .181 \ln(YPD/HHS)/(YPD_{-1}/HHS_{-1}).$$

Thus, according to Hickman's estimates, long-term fluctuations in household formation relative to standardized household changes are largely attributable to changes in real income per standardized household.

Smith (1984) argues that identifying the determinants of age-specific headship rates is critical for an understanding of demographic impacts on the housing market. This is because household formation, and thus housing demand, depend not only on the size and age composition of the population but upon its propensity to form itself into housing demand units. And this propensity may depend on such economic variables as the affordability and availability of housing.

To begin, Smith observes that, during the 1960-1980 period, Canadian housing starts far outstripped net family household formation (net family formation accounted for 58.7% of total starts). The vast majority of excess starts provided dwelling accomodations for nonfamily households. Between 1961 and 1981, nonfamily households increased by 333% while family households increased by 46%. This growth in the relative importance of nonfamily households was due to (i) an increase in the proportion of the population in the age categories typically associated with nonfamily households and (ii) an increase in the nonfamily headship rate relative to the family headship rate; and most of the growth in the relative importance of nonfamily households is attributable to (ii).

Smith hypothesizes that the headship rate for a given household type i having a head in age group j, hh_{ij}, can be written as follows:

$$hh_{ij} = f_{ij}(R_{-1}/Y_{ij}, APH, SOC),$$

where Y_{ij} denotes real personal dispoable income for household i and age group j, R_{-1} is the real user cost of housing services lagged one period (to avoid simultaneity problems), APH represents the availability of public housing, and SOC denotes socioeconomic variables reflecting such influences as the divorce rate and the female participation rate.

A different equation was estimated for each household type and each of the following age groups, 15-24, 25-34, 35-64, 65+. The dependent variable was $\log(hh_{ij})$ and the RHS was linearly additive in the explanatory variables. As age-specific income was unavailable, he used total real disposable income per capita for Y in all equations. The real user cost, R, was measured by the rental component of the CPI in all equations; this rental index measures variations in the cost of rental housing as well as the cost of homeownership services under the assumption the real user cost of equivalent housing services through renting and ownership are equated. SHS measures the availability of new subsidized housing for the elderly (proxied by publicly financed new housing starts for the elderly, lagged two periods to allow for completions); SHS was entered only in the 65+ equations. DIV denotes the number of current divorces.

The main coefficient estimates are as follows (* denotes statistically insignificant values):

	Non-Family Headship Rate			Family Headship Rate		
Age	R_{-1}/Y	DIV	SHS_{-2}	R_{-1}/Y	DIV	SHS_{-2}
15-24	-.92	.10		-.18	*	
25-34	-.77	.09		-.051	*	
35-64	-.27	.04		*	*	
65+	-.24	.02	.02	*	*	*

Observe that the rent/income and divorce coefficients have the expected signs, that their magnitudes decrease as the age group increases, and that non-family household formation is more responsive to economic variables than family household formation. These estimates also imply that demand elasticities in the rental housing market are likely much higher than in the homeownership market since the largest elasticities are in the youngest non-family household age categories, and these categories are predominently renters.

Smith, Rosen, Markandyya and Ullmo (1984) investigates the influence of the availability and affordability of housing on demographic changes through an international analysis of the relationship between age-specific headship rates and housing availablity and affordability in Canada, France, Great Britain and the United States. During the 1960-1980 period, all four of these countries exhibited a strong upward trend in nonfamily headship rates but experienced little or no change in family headship rates. Further, the growth of nonfamily headship rates was inversely related to age of household head.

The basic finding reported in this paper is that the considerable increase in the headship rate during the postwar period has been facilitated in the four countries under study by the increase in the real affordability of housing. Also, as in Smith's (1984) study of Canada, there is a clear relationship between household age and responsiveness of the headship rate to economic variables.

They estimate a log-linear version of $hh_{ij} = h(Y_{ij}, R_{-1}, APH, SOC)$; all variables are as defined earlier, except that APH represents the availability of public housing (entered with lag only in the 65+ regressions) and SOC is set of socio-economic variables including the divorce rate and female participatation rate. Instead of Y_{ij}, they use real per capita disposible income, Y in all equations (not age specific). Finally, R_{-1}, the index of the real user cost of housing services, is measured by the rental component of CPI. Notice that unlike Smith (1984), who uses R_{-1}/Y as an explanatory variable, Y and R_{-1} are introduced as additively separable terms here.

The results for Canada and the U.S. are as follows:

Non-family Headship Rate

	Canada			United States		
Age	R_{-1}	Y	APH	R_{-1}	Y	APH
15-24	-.80	2.12		-3.36	1.44	
25-34	-.93	1.62		-4.06	0.92	
35-64	-.21	0.70		-0.64	0.52	
65+	-.25	0.50	0.02	-0.61	0.22	0.03

All coefficients above are statistically significant except the coefficient of APH in the Canada

equation which is marginally insignificant.

To determine the aggregate impact of the decline in housing costs over the 1962-1980 period, simulations were done holding housing costs constant. They indicated that for Canada and the U.S. approximately 39% of the increase in headship was due to a decline in housing costs.

Hendershott and Smith (1985) begin by observing that household heads were 29.5% of the U.S. population in 1960 and 36.3 percent in 1980. With the baby-boom population moving into prime household-forming age groups, and assuming that the rate at which the population in different age groups formed households remained constant between 1960 and 1980, only 3% of the 7% increase in the headship rate would be explained. The remaining 4% is thus attributed to an increased demand for privacy due to rising real incomes, declining real costs of privacy (especially for low-income families with dependents), improved health of the elderly and shifting tastes toward privacy (including decreased aversion to divorce).

Given the number of households and population in age category i, HH_i and POP_i, the headship rate for i is $hh_i=HH_i/POP_i$. The change in households between periods o and t is $\Delta HH = HH^t - HH^o$

$$\Delta HH = \Sigma hh_i^t POP_i^t - \Sigma hh_i^o POP_i^o$$

$$= \Sigma hh_i^o \Delta POP_i + \Sigma POP_i^t \Delta hh_i,$$

where ΔX is defined as X^t-X^o. The first term above describes the change in households due to population change given last period's headship rate; this is the exogenous component of household change and is denoted by ΔHX. The second term describes the influence of changes in the headship rates; this is the endogenous component.

It is assumed that $hh_i=f_i(y,r,o,m)$, where y denotes real per capita disposable income, r denotes real price of rental housing (the CPI rent component divided by CPI net of shelter), o is the real price of owner housing (user cost), and m is the real mortgage payment burden (payment to income ratio).

The estimation equation is the result of replacing the first sum, in the expression for

ΔHH, by $a_1\Delta HX$, and the second sum by a linear function of total population times the changes in the variables underlying the headship rates. That is,

$$\Delta HH = a_0 + a_1\Delta HX + a_2POP\Delta y + a_3POP\Delta r + a_4POP\Delta m + a_5POP\Delta o + a_6\Delta DIV$$

$$+ a_7\Delta AFDC$$

where AFDC denotes the number of families on AFDC, and DIV is one of four possible divorce variables. The significant coefficients are those corresponding to the changes in real income (a positive coefficient), the real price of owner housing (a negative coefficient) and the AFDC variable (a positive coefficient).

Their analysis indicates that the increase in households between 1961 and 1978 was due 1/3 to population growth, 1/3 to the changing age structure of the population, and 1/3 to the increase in age-specific headship rates (due, in turn, to higher real incomes and lower real user costs). Additionally, the headship rate increases were greatest for those under 35 and over 75; in the case of the young, this was due in large part to (1) increasing real benefits/lower elegibility of AFDC programs and (2) greater propensity for headship for the population born after 1937; in the case of the old, higher rates reflect better health, higher income (increased real social security payments) and less uncertainty (indexed social security). Finally, in the 1980's, headship rates were lower for those under 35 but continued to rise for those over 44; in the case of the young, this observation is attributed to higher real ownership and mortgage costs and less generous AFDC payments.

Hendershott and Smith decompose the increase in households between 1961 and 1982 into increases for subperiods 1961-78 and 1979-82 (recall that the latter period covered a major recession), and then use their estimated model to identify the determinants of these changes:

	1961-78	1979-82
Total increase (10^6's)	25.5	5.25
Due to Δ population & age structure	17.5	6.25
Due to economic factors	8.	-1.

real income	3.	.25
real cost of housing	.75	-1.5
real mortgage burden	-.25	.25
AFDC	1.5 to 2.5	--
trend	2 to 3	1/4 to 1/2

The difference between these two periods in terms of the effects of the economic variables is quite dramatic.

Finally, the following elasticities of headship rates are reported: evaluated at the same mean, the real income elasticity is .075, the real rent elasticity is -.03, the real owner price elasticity is -.015, and the mortgage payment burden elasticity is -.01.

A.2 Cross-Sectional Studies

Comparing 1976 and 1971, population growth in Canada (including immigration) accounted for about 60% of the total net household formation. An increased propensity for nonfamily persons to head a household accounted for about 25% of this net household formation; other important effects included the decline in families sharing accomodation and the rise in husband-wife families living alone. **Miron (1988)** uses 1971 Canadian Census data from cities with populations exceeding 30,000 to quantify the effects of income on these various propensities.

A unit is defined to be a family or a nonfamily individual. A primary unit is defined to be a unit that maintains a dwelling. Let q_1 denote the propensity to be a primary unit; in the case of families (nonfamily individuals), $1-q_1$ is the probability of being a lodging family (individual). In effect, q_1 is a household formation rate. Let q_2 denote the propensity for a primary unit to have no lodgers; in the case of families (nonfamily individuals), $1-q_2$ is the probability that the family (individual) lives with someone else, say, with a grandparent (room-mate).

A pair of logistic models are estimated: $q_1 = z_1/(1+z_1)$, where $z_1 = \exp(a_0+a_1Y)$, Y denotes income and $\{a_0,a_1\}$ are parameters to be estimated; $q_2 = z_2/(1+z_2)$, where $z_2 = \exp(b_0+b_1Y)$. Separate pairs of logistic models are estimated for each of three distinct subsamples; husband and wife families, lone parent families, and nonfamily individuals.

Husband-wife families: The mean q_1 value was about 92-93 for 2 to 3 person

households with a husband aged 15-24, rises to 98-99 for a husband aged 45-55, and falls off to 95-96 for a husband over 65. The estimated a_1's are significant for 2-person households: a_1 is equal to .215 for the 15-24 age group, .144 for the 25-34 age group, and rises thereafter until it reaches .204 for the over 65 group. The income elasticty of q_1 (evaluated at Y equals \$5K) is largest for the 15-24 group, at .13, and then falls to .07 and eventaully to .05. q_2 is largest for the 15-24 group, at about 93-94, and then declines as age rises. However, most coefficients are not significant; and most elasticities are about 0.2 or less, indicating a weak income effect.

Lone Parent families: Miron restricts attention to two-person families (the rest are not significant): the mean q_1 value equals 61 for the 15-24 age group, and then rises continuously to 94 for the over 55 group. The income elasticity of q_1 is .32 for the 15-24 age group, .18 for the next 25-34 group, and is thereafter less than .07. The q_2 results are not significant and exhibit very small income effects.

Nonfamily individuals: All coefficients are significant. For men (women), the mean q_1 is 26 (30) in the 15-24 age group, rises to 50 (50) for the 25-34 group, and peaks at 56 (61) for the 45-64 group. The estimated a_1 equals .169 for men 15-24, declines to .045 for those 55-65, and rises to .094 for those over 65. The estimated a_1's for women, across the same age groups, are .308, .249, .2, .207, .163 and .254. Men's elasticities equal .58, .27, .23, .2, .1, .21; women's equal .81, .58, .46, .36, .27, .32. The q_2 values are smaller than their counterparts for husband-wife and lone-parent groups, and also unresponsive to income.

The substantial change in the number of households over and beyond that explained by changes in total population, and the distribution of age and marital status, focused attention on the rise in real income in the sixties. In 1975-80 period, however, household formation accelerated while the rise in real income slowed and real rents fell. And in the early 1980's, household formation leveled off while real rents started to rise again.

Given these observations, **Borsch-Supan (1986)** estimates a model of household formation and shows that the headship rate is responsive both to income and housing prices. Two populations are examined: (i) young singles, specifically, unmarried white men and women without children, and (ii) single (single,widowed,divorced) elderly (>60) white

women without children. The data are drawn from three SMSA's in the U.S. during 1976-77.

The basic idea is to split up households into true decision units (nuclei). A nucleus consists of a married couple or single individual and includes their children under 18; children over 18 are considered to be a different nucleus even if they live with their parents. Also, houses with several adults are viewed as having several nuclei.

Let $u_{in}=v_{in}+\epsilon_{in}$ denote the utility from choice i for nucleus n where $v_{in}=v(x_{in})$ and x_{in} is a vector of attributes specific to choice i and decision unit n, and ϵ_{in} is the unobservable component of the payoff function. It is assumed that $v_{in}=\Sigma_k \beta^k x_{in}^k$. Seven choices are considered: (1) nonhead; (2) head, rent family house; (3) head, rent small apartment; (4) head, rent large apartment; (5) head, own small single family house; (6) head, own medium SFH; (7) head, own large SFH. The probability of choosing i is the probability that $u_{in} > u_{jn}$ for al j not equal to i. Basically, they are estimating a logistic model with parameter vector β.

The key explanatory variables are: income (gross income of nucleus); for renters, user cost is gross rent; for owners, user cost equals out-of-pocket expenses minus the return, with the latter introduced as separate explanatory variables. (That is, user cost equals expenses + equity cost - appreciation, which equals expenses - (appreciation - equity), which equals expenses - return.)

The paper's main results are as follows: First, the model for elderly women performs better than the model for young singles. Second, out-of-pocket expenses has a highly significant, negative coefficient. Third, the return to ownership has a weaker but still important positive effect. Fourth, the income effect is less clear because it affects relative price of housing (privacy). Fifth, the fraction of nuclei <u>not</u> living indepedently responds negatively (positively) to an increase in the out-of-pocket expenses of living as non-head (head, in each category). Sixth, the nonhead decision of the elderly is much more (negatively) responsive to income than is the same decision of the young.

An important conclusion of the paper is that there is a strong response of headship rates to relative housing prices; for the elderly, the own-price elasticities are in the -.2 to -.4 range, and for the young the same elasticity ranges from -.4 to -.7 .

Youths used to leave their parents' homes primarily upon marriage but now tend to set up independent households when still single. **Haurin, Hendershott and Kim (1993)** aim to explain the proportion of youths that live independently, to explain the decision of whether or not to live with unrelated individuals and the marriage decision. Unlike standard demographic studies of household formation, they account for truncation bias (in generating different samples) and consider marriage and having children to be endogenous decisions.

Household formation should depend on both the cost of independent living and an individual's ability to pay this cost. With respect to the latter income effect, note that real income is the product of the real wage rate and the quantity of labor supplied, and that the latter decision is made jointly with household formation. This means that real income is endogenous and its use in regressions may lead to biased estimates. Similarly, current real wages may not represent earning capacity if the current job is part time (which is likely if an individual resides with parents or in a group). The correct concept is the real wage that could be earned should the respondent take on the responsibility of independent living. They estimate a full-time wage equation and use its predicted value as an explanatory variable in their analysis of household formation. In terms of welfare programs, they examine the effect of AFDC on the decisions of young women regarding any of the four choices modeled.

They model four decisions being made simultaneously: (i) whether to live with parents or not, (ii) whether or not to live with a group of adults (aside from spouse), (iii) whether to marry or not, and (iv) whether to have children or not. The main focus is on (i) and (ii).

Let j1 and j2 denote tendencies to reside outside parental household and to live separately, and let i1 and i2 denote the observed dichotomous variables:

$$
\begin{aligned}
i1 &= 1 \text{ if } j1 > 0 \\
&= 0 \text{ otherwise}
\end{aligned}
$$

$$
\begin{aligned}
i2 &= 1 \text{ if } j2 > 0 \text{ and } j1 > 0 \\
&= 0 \quad j2 \leq 0 \quad j1 > 0 \\
&= \text{unobserved otherwise}
\end{aligned}
$$

It is assumed that j1 and j2 are generated as follows:

$$j1 = a_1X + a_2M + a_3C + a_4W + \epsilon_1$$
$$j2 = b_1Z + b_2M + b_3C + b_4W + \epsilon_2$$

where X and Z represent exogenous variables (including the housing rental cost and the AFDC variable), M is the probability of marriage (endogenous), C is the probability of having children (endogenous), and W is the potential wage.

Ability (income) to form a household can determine marital status, while marriage (capability of maintaining an independent household) leads to new housholds; they treat M as endogenous, and use its predicted value from a reduced-form probit estimation. Similarly, the choice of living arrangement may influence, and be influenced by, the choice of whether to have children or not; C is likewise replaced by its predicted value from reduced-form probit. The M and C equations contain as explanatory variables all of the exogenous variables in the model. In estimating the potential wage, they correct for sample selection bias to account for the possibility that unobserved attributes (and market opportunities) of youths who live outside parents' homes are different from those who stay. Empirically, this selection correction was not significant.

The models are estimated using cross-sectional U.S. data from the 1987 NLSY on individuals aged 22-29. The M, C, and W equations are not presented. The remaining results of interest are (t-values in brackets):

	Living outside parental home	Living separately
wage	0.4 (2.2)	.01 (.06)
rental cost	-.22 (2.2)	-.26 (1.8)
female(0/1)xAFDC	-.36 (.8)	.88 (1.8)
married	.55 (1.9)	1.14 (3.4)
children	.74 (3.2)	.45 (1.8)

The estimated real wage thus has a significant positive effect on the decision to live outside of the parental household. Note, however, it does not affect the decision to live in a group or alone.

The earnings capacity effect is difficult to disentangle from the probability of marriage variable. In particular, since the wage measure is for the respondant, and so

excludes the spouse's wage, the probability of marriage variable in part reflects a change in earning capacity as well as desire for privacy. It is clear that earnings capacity influences household formation and that the most significant change occurs when earnings increase as a result of marriage.

Finally, the impact of the rental cost equals its direct effect plus its indirect effect through M and C (i.e., the net effects exceed -.22 and .-26).

Bourassa, Haurin, Haurin and Hendershott (1993) extend the analyses of Haurin, Hendershott & Kim (1993) by testing the household formation and tenure choice models using Australian data. Of special interest is the fact that the tax and subsidy structure for owner-occupied houses differs. Interest paid on mortgages is not tax-deductible in Australia, and Australia experimented with a special subsidy to promote first-time ownership during the study period while the US did not.

Their estimates are based on a sample of 4000 individuals aged 16-25. Several results are noteworthy: First, the coefficient of the owner cost variable is negative and significant, and the availability of subsidized government housing has a significant positive effect (on the probability of owning given the decision not to live with parents). Second, respondents' potential wage and employment opportunities have positive but insignificant effects. Third, in the tenure choice equation, the cost of owning relative to renting has a significant negative effect and the predicted wage has a significant positive effect on the propensity to own. Fourth, among 25 year olds, the cost elasticity for tendency to live alone and for tendency to own are both negative and greater (in magnitude) than the US elasticities. Lastly, the first-time homeowners subsidy has a negligble effect on independent living but a significant positive effect on ownership.

Pitkin (1990) begins by observing that, for the foreseeable future, the growth in the population of elderly is projected to be greater than in any other group in the U.S. Focusing on the elderly, Pitkin examines a joint household headship-tenure choice. The three mutually exclusive alternatives contemplated are: (i) live as a nonhead in a household headed by someone else; (ii) head a household and own the house/apartment; or (iii) head a household

and rent one's house/apartment. The data are from a sample of individuals in 57 different U.S. metropolitan areas in the mid-1970's. Separate relationships are estimated for those aged 60-79 for (i) married couples, (ii) widows and (iii) never-married and divorced individuals.

Let O_i, R_i and N_i denote the proportion of head-own, head-rent and nonhead in the relevant population in location i. The equations estimated are:

$$\log(O_i/R_i) = a_1 Y_i + a_2 P_i + a_3 \log[(O_i/R_i)^{-1}]$$

where Y_i is the average income in i, P_i is a vector of rents/prices in i and $(O_i/R_i)^{-1}$ is the lagged (5 years earlier) ratio of owners to renters, and

$$\log(N_i/R_i) = a_1 Y_i + a_2 P_i + a_3 \log[(N_i/R_i)^{-1}].$$

The papers main results are as follows: Higher current income and lower housing prices both lead to more ownership and formation of more households; and higher current ownership expenses and mortgage interest rates and lower expected capital gains discourage ownership. But the 'force of inertia' exerts a far stronger and dominant influence on choices; i.e., whether an elderly individual owned, rented or was nonhead 5 years ago has a much more decisive impact than economic variables.

Two caveats: (i) The lagged effect is picking up unobserved attributes of the local community and not individual behavior. (ii) Y_i and P_i can have strong effects of the same sign on O_i and R_i and yet appear to have very small effects on O_i/R_i; in fact, the claim that these variables have the expected sign effects on the ratios only suggests that O_i and N_i are more income-rent responsive than R_i.

Borsch-Supan, McFadden and Schnabel (1993) study the choice of living arrangements among elderly Americans and, in particular, investigate the effect of latent health status and the impacts of housing and financial wealth on the choice of living arrangement.

The choice of living arrangement is as an independent household, with adult children or other related or unrelated persons, or in an institution. Earlier studies find an increasing

proportion of the elderly living alone and attribute this to the positive income-elasticity of privacy. This study corrects for the fact that health is a latet (unmeasured) variable and seeks to distinguish housing wealth versus financial wealth effects; for example, does housing wealth tie the elderly to their homes?

A sample of 2200 individuals aged 76-102 is examined. Two choice equations are studied: (i) live independently versus live with children or others; and (ii) live independently or in an institution.

The authors show that while wealth is an important economic variable in the choice of living arrangements, income proves to be of little relevance once wealth is included. As expected health (captured by 2 measures, one associated with independent activities and related to age, and one a person-specific factor associated with basic activities) is one of the main predictors of living arrangements. Living with others (mainly children) is positively affected by financial and housing wealth; homeowners are less likely to become institutionalized.

Appendix B

Tenure Choice

This appendix summarizes a selection of recent research on tenure choice. The purpose of the review is to set out a theoretical framework and empirical results that would be useful for projecting ownership propensities. There have been almost no papers analyzing ownership propensities over time. Therefore the literature does not provide estimated parameters that could be used in the model developed in the text of this study. Nevertheless the literature is useful for systematically thinking about future changes in ownership propensities.

Rosen (1979) investigates the impact of tax laws on tenure choice and housing demand. A *probit* model was used to represent the tenure-choice d decision:

$$I_j = \gamma_o + \gamma_1 \log (P_{oj}/P_{xj}) + \gamma_2 \log (P_{rj}/P_{xj}) + \gamma_3 \log (Y_j) + \sum_{t=1}^{m} \gamma_{3+i} Z_{ij}$$

where I_j measures the likelihood of owning over renting, P_{oj} is the net price of housing services generated by owner-occupied housing, P_{xj} is the price of all other goods, P_{rj} is the price of renting, Y_j is permanent net real income, and Z_{ij} is a set of m demographic variables (such as: age of household head, number of children under the age of seventeen in the family unit, race of the household head, and the gender of the household head) that influence the tenure choice decision.

Households may obtain their housing services through renting or through owning. Ignoring the question of whether there is "pride of ownership", an important determinant of tenure choice is the relative price of obtaining housing services as a renter versus as an owner. A comprehensive measure of the price of housing services to owners is the user cost, which includes the foregone interest on home equity and the capital gains (losses) from owning the home. This comprehensive measure emphasizes that home ownership is, in part, an investment decision: savings are invested in home equity rather than in alternative investments. The income tax treatment of this investment, relative to alternative investments, will be an important determinant of tenure choice and of the relative price of obtaining housing through rental versus ownership.

In Canada, the net imputed return from home equity is not taxed and the capital gains

on a principal residence are not taxed. Much of the literature on tenure choice has focussed on the effect of income taxes; for example Laidler (1969) and Aaron (1972). Rosen (1979) calculates P_{oj}, the net price of housing services to owners, incorporating the U.S. income tax treatment of owner-occupied housing.

Rosen found, using cross section data from the United States for 1970, that: (i) a higher relative price of owner occupied housing discourages home ownership; (ii) the probability of owning increases with the age of the head of the household; (iii) the probability of owning increases with the number of children; and (iv) females and blacks are less likely to own (ceteris paribus) than males and whites. Rosen also found that income has a positive effect on home ownership. This might be because the types of housing available through renting and owning are different and "owned" housing characteristics are normal goods. Or it might be that there are imperfections in the mortgage market which make financing the purchase of a home difficult for low-income people.

Rosen and Rosen (1980) is the major study of ownership propensity using time series data. They used U.S. data for the period 1949-74. During that period the proportion of U.S. housing stock that was owner occupied rose from 48 to 64 percent. The model they estimated was a semi-logarithmic equation:

$$\ln\Theta_t^* = \beta_o + \beta_1 P_t + \beta_2 Y_t + \beta Xt$$

where Θ_t^* is the percentage of households that desire to own in year t, P_t is the relative price of owning to renting in year t, Y_t is real per capita permanent disposable income, the β are parameters and X_t is a vector of socio-demographic variables that influence Θ_t^*. It is assumed that the actual percentage of homeowners Θ_t will not equal the desired percentage because the adjustments required to change housing tenure occur slowly, due in part to search costs and other transactions costs. They assume a simple partial adjustment model

$$\ln\Theta_t - \ln\Theta_{t-1} = \Pi(\ln\Theta_t^* - \ln\Theta_{t-1})$$

and therefore

$$\ln\Theta_t = (1-\Pi)\ln\Theta_{t-1} + \Pi\beta_o + \Pi\beta_1 P_t + \Pi\beta_2 Y_t + \Pi\beta X_t$$

They found that the coefficient on price was negative, i.e., as the relative price of owning rose, the percentage of households owning fell; and that as income rose the

percentage owning also rose. There is no strong theoretical presumption that increases in per capita income should increase home ownership (unless there are market imperfections as noted above or downpayment constraints); but this result is consistent with the cross-section result. However, they did not find that demographic and social changes over the sample period influenced the proportion of homeowners. Neither the proportion of the population between the ages of 35 and 64, the percentage of families without children or the female labour force participation rate proved to be significant.

Gillingham and Hagemann (1983), following the approach of much of the research in the late 1970s and early 1980s, develop a model which emphasizes that tenure choice and the choice of how much housing to consume are simultaneous decisions. They are interested primarily in how estimates of the price and income elasticity of demand for housing services are altered when the model incorporates this simultaneity. However, they do present, unlike many other researchers, the results of their tenure choice equations; using cross-section data from the U.S. Consumer Expenditure Survey of 1972-73.

Their index of the probability of being an owner is positively related to both linear and quadratic permanent income and is negatively related to the relative price of owning versus renting. Their relative price term incorporates the effect of the U.S. income tax. Perhaps surprisingly, expected capital gains from homeownership were not significant. Like other cross-section studies, they find significant influence of socio-demographic variables. The probability of owning rises with the age of household head and with the presence and number of children. Single female households are much less likely to own than single male households.

The table below presents the owner-occupant probability I_o and the income and price elasticities of this owner-occupant probability for four household types at the mean income of the sample.

	Single Person	Husband/ Wife	Husband/ Wife/children	Other family
I_o	0.33	0.67	0.84	0.56
η_y	0.20	0.26	0.30	0.62

η_p	-1.12	-0.85	-0.49	-0.79

Goodman (1988) focusses on the simultaneous choices of housing tenure and of the quantity consumed of housing, recognizing that there are both consumption and investment aspects to purchasing a home. The previous literature had recognized that housing choices have both consumption and investment aspects, but it was difficult to devise a measure of a dwelling unit's investment possibilities. Using hedonic price equations to generate a rental value of a house, Goodman constructs a value-rent ratio. He asserts that an increased cost of owner housing services relative to renter housing services should decrease the probability of owning, whereas a high value-to-rent ratio, from an investment standpoint should increase the probability of owning.

Using data from the 1978 Annual Housing Survey National Sample in the United States, he constructs a price index of the relative cost of owner housing services to renter services P, a value-rent ratio, V, and an estimate of permanent income YP and transitory income YT. The probability of owning is a function of these variables and of a vector of socio-demographic variables.

The permanent income elasticity of tenure choice, evaluated at the mean of variables, is 0.589 and the relative price elasticity is -1.436. Increases in the value-rent ratio increase the probability of owning (but the elasticity is not reported). The probability of owning increases with age, but the tenure choice elasticity declines from 0.508 at age 25 to 0.169 at age 65.

Jones (1989) further explores the investment aspects of tenure choice and housing demand, especially for young, first-time homebuyers. He emphasizes, first, that there are tax advantages to home ownership, that 'security of tenure', 'flexibility' of use, and 'pride of ownership' make ownership desirable for many households, but that housing units are not of similar size in the rental and ownership markets of urban areas and therefore a household requires a threshold downpayment and income to enter the ownership market (where units are larger). Second he emphasizes that capital markets are not perfect and young households

cannot borrow fully against their permanent income. It is, therefore, important to decompose permanent income (total wealth) into labour earnings (human capital wealth) and returns from financial assets (nonhuman or financial wealth). Households must acquire a certain level of financial wealth before they can become homeowners.

This framework, when included in a life-cycle model, draws attention to the timing of the transition to ownership of a young, first-time homebuyer. Using data from the Statistics Canada 1977 and 1984 Survey of Consumer Finances (which include detailed household wealth data), Jones found that current nonhuman wealth plays a prominent role in determining transition to first-time homeownership.

This analysis is possibly significant for projecting age-specific tenure choices. Real house prices rose sharply during the 1980s and therefore required real downpayments increased. However, real personal disposable income per capita was relatively stagnant and likely the ability of young households to save was reduced. Together these forces suggest a decline in ownership propensities among young households. Jones did not have time series data to explore these issues.

References

Aaron, H. **Shelter and Subsidies**, The Brookings Institution, Washington, D.C., 1972.

Borsch-Supan, A. "Household Formation, Housing Prices, and Public Policy Impacts," **Journal of Public Economics**, 30:145-164, 1986.

Borsch-Supan, A., McFadden, D. and Schnabel, R. "Living Arrangements: Health and Wealth Effects," **NBER Working Papers Series**, No. 4398, 1993.

Bourassa, S. Haurin, D., Harin, R. and Hendershott, P. "Independent Living and Homeownership: An Analysis of Australian Youth," **NBER Working Papers Series**, No. 4450, 1993.

CMHC (1993a) "Potential Housing Demand Projection Model: Technical Specifications, Version 1.2" (mimeo), Ottawa: Canada Mortgage and Housing Corporation.

Englehardt, G. and Poterba, J. "House Price and Demographic Change: Canadian Evidence," **Regional Science and Urban Economics**, 21:539-546, 1991.

Gillingham, R., and Hagemann, R. "Cross-Sectional Estimation of a Simultaneous Model of Tenure Choice and Housing Services Demand", **Journal of Urban Economics,** 14: 16-39, 1983.

Goodman, A.C. "An Econometric Model of Housing Price, Permanent Income, Tenure Choice, and Housing Demand", **Journal of Urban Economics**, 23: 327-353, 1988.

Harin, D., Hendershott, P. and Kim, D. "The Impact of Real Rents and Wages on Household Formation," **Review of Economics and Statistics** 75:284-293, 1993.

Hamilton, B. "The Baby Boom, the Baby Bust, and the Housing Market," **Regional Science and Urban Economics**, 21:547-552, 1991.

Hendershott, P. "Are Real House Prices Likely to Decline by 47 Percent?" **Regional Science and Urban Economics**, 21:553-563, 1991.

Hendershott, P. and Smith, M. "Household Formation," in P. Hendershott (Ed.) **The Level and Composition of Household Saving**, Harper-Row Publishers, Camb., 1985.

Hickman, B. "What Became of the Building Cycle?" in P. David and M. Reder (Eds.) **Nations and Households in Economic Growth: Essays in Honor of Moses Abramowitz**, Academic Press, New York, 1974.

Jones, L.D. "Current Wealth and Tenure Choice", **American Real Estate and Urban**

Economics Association Journal, 17: 17-40, 1989.

Laidler, D. "Income Tax Incentives for Owner-Occupied Housing", in Arnold C. Harberger and Martin J. Bailey, (Eds.) **The Taxation of Income From Capital**, The Brookings Institution, Washington, D.C., 1969.

Miron, J. **Housing in Postwar Canada: Demographic Change, Household Formation and Housing Demand**, McGill-Queen's University Press, Kingston, 1988.

Pitkin, J. "Housing Consumption of the Elderly: A Cohort Economic Model," in D. Myers (Ed.) **Housing Demography**, University of Wisconsin Press, Madison, 1990.

Pitkin, J. and Myers, D. "The Effect of Demographics on Future Housing Prices," University of Southern California, mimeo, 1993.

Rosen, H.S. "Housing Decisions and the U.S. Income Tax", **Journal of Public Economics**, 11: 1-23, 1979.

Rosen, H.S. and K.T. Rosen "Federal Taxes and Homeownership: Evidence from Time Series", **Journal of Political Economy**, 88: 59-75, 1980.

Russell, L. **The Baby Boom Generation and the Economy**, Washington, D.C.: The Brookings Institution, 1982.

Smith, L. "Household Headship Rates, Household Formation and Housing Demand in Canada," **Land Economics**, 60;180-188, 1984.

Smith, L., Rosen, K., Markandya, A. and Ullmo, P. "The Demand for Housing, Household Headship Rates, and Household Formation: An International Analysis," **Urban Studies**, 21:407-414, 1984.