HOUSEHOLD SAVING AND BEQUEST BEHAVIOUR : AN INTERTEMPORAL-STRATEGIC APPROACH WITH SPECIAL REFERENCE TO JAPAN

BY

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ABSTRACT

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This thesis explores the mechanisms of household saving and bequest behaviour in Japan. It is well known that the Japanese household saving rate has been high by international standards. However, the mechanisms of household saving behaviour have been poorly understood. Alternative hypotheses suggested by previous studies on this subject have not received full empirical support and have not had rigorous theoretical foundations.

By way of providing an alternative model, this thesis first identifies the most important motivations for savings in Japan and, then, establishes theoretical foundations. The theoretical model is applied to empirical investigations including the measurement of bequest wealth ratio to total wealth holdings, the estimation of the econometric model of aggregate savings and the forecast of future saving rates. In addition, fiscal policy effects on saving and bequest behaviour are examined. Analyses are restricted to macroeconomic levels.

The major findings are that the bequest motive and bequest transfers play an important role in Japanese saving behaviour, that bequest wealth accounts for 40-50 percent of total wealth and the bequest ratio to total wealth is increasing over time and that fiscal policy has no influence on saving and bequest behaviour. This thesis provides a new method of estimating bequest wealth and uses encompassing tests to show that the bequest model can explain Japanese savings at least as well as the life-cycle model. Fiscal policy effects are evaluated by Granger-causality and co-integration tests as well as by encompassing tests. The game-theoretic approach used here provides new ways of analysing altruistic household behaviour and the Ricardian equivalence proposition.

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Above all, my deepest gratitude goes to my parents, Ranko and Tetsuro Kitamura, who have allowed me to pursue the intellectual luxury of writing a D.Phil thesis. Without their affection and financial support, this thesis could not have completed. This thesis is dedicated to them.

Y.K.

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GENERAL INTRODUCTION

The purpose of this thesis is to explore the mechanisms of household saving and bequest behaviour in Japan.

It is well known that the Japanese household saving rate has been high by international standards. However, household saving behaviour have not been fully investigated. As long as savings were used for domestic investment, other countries were not concerned with Japanese savings. In the 1980s, the situation has changed. Japanese household savings have been at high levels (the saving rate has been above 16 percent) while net savings in many other OECD countries have declined rather sharply (in particular in the USA and UK). Together with sluggish private investment and decreases in the budget deficit of the Japanese government, Japan has emerged as the world's leading capital exporter since 1983. The world economy, particularly the US, Latin American and ASEAN countries, in recent years has been financed substantially by Japanese household savings.

In short, Japanese household savings now have wide repercussions and policy implications not only for the Japanese economy but also for the world economy. Savings are the source of financing for investment, and in turn, current investment is the source of future economic growth. Japanese savings may, therefore, be contributing to the future prosperity of the world economy. The picture is, however, not always rosy, as the third world external debt problem and capital losses in foreign assets resulting from rapid appreciation of the yen have emerged.

Many economists and policy makers are now keen to understand Japanese household saving behaviour. Earlier empirical studies on this subject provided several alternative hypotheses but none of these hypotheses have received full empirical support. Many of them are based on institutional factors alone and lack rigorous theoretical foundations. In addition many of them focus only on motivations for savings in individual households which may vary over a vast range. The study of such individual motivations, however, does not always help in understanding aggregate household savings and it therefore remains important to identify the major underlying factors which explain aggregate savings. It is undoubtedly the case that institutional and cultural factors influence Japanese economic behaviour, but this does not necessarily imply that Japanese behaviour cannot be explained in terms of economic concept of rationality. Furthermore, policy makers in other countries may want to know whether policies of the Japanese government contribute to the high saving rate and existing empirical studies have not clearly addressed such questions.

In an attempt to fill part of the gap in our understanding of Japanese saving behaviour, this thesis raises the following questions and tries to resolve them:

(1) What are the most important motivations for savings in Japan ?

(2) What theoretical foundations can we give to Japanese saving and bequest behaviour ?

(3) Does bequest wealth account for a high proportion of total wealth holdings ?

(4) What sort of aggregate saving model is appropriate for explaining actual savings ?

(5) How will the saving rate change in the future ?

(6) Does government policy influence household savings and bequests ?

In answering these questions, we concentrate our analysis on the macroeconomic level and search for a robust empirical model which can be used for policy analysis and forecasting.

The contents of each chapter are summarised as follows.

Chapter 1 briefly surveys the relevant issues in the general economics literature on savings. It shows that the

Marshallian tradition emphasising bequest transfers has seen a revival in the saving literature.

Chapter 2 sets out to investigate the basic facts of Japanese saving behaviour in recent years. This is done by examining savings from different perspectives. First, from an international perspective, the importance of Japanese savings in the world economy is documented. Secondly, the domestic macroeconomic perspective stresses that household sector savings have remained at a high level regardless of sluggish private investment and government deficits. Thirdly, the microeconomic perspective is mainly concerned with the age-profile of saving behaviour. A critical fact is that older households continue to save significant amounts. This fact contradicts a pure life-cycle hypothesis of savings. Lastly, earlier empirical studies on Japanese saving behaviour are critically examined by a simple statistical analysis. The most significant finding is that Japanese saving behaviour has undergone structural change in the post growth period (i.e., 1970-1985). The main characteristic of household savings in this period is a decrease in the saving rate alongside an increase in bequest transfers.

Chapter 3 establishes the theoretical foundations of saving and bequest behaviour. An overlapping generations model is used to analyse intergenerational interactions. The model provides some theoretical as well as empirical insights. First, by introducing the concept of social accounting for a heterogeneous (two generations) economy, aggregate consumption and savings are shown to be different from a homogeneous (representative household) economy. Secondly, the model is able to distinguish strictly between life-cycle motivated savings and bequest motivated savings. Thirdly, an intergenerational game determines endogenously an intergenerational weight which decides the quantity of bequest transfers to the next generation. The optimal strategy for each generation is to follow a "tit-for-tat" policy ; when one generation receive the maximum bequest from its parents, it must leave the maximum bequest to the next generation.

Chapter 4 investigates the question of whether bequests account for a high proportion of total wealth holdings in Japan. The estimated ratio for bequest of financial assets is 36.58 percent and that for real estate bequests is 44.99 percent on average during the period 1965-1985. We further find that the values of the bequest ratio increase rapidly in the 1980s. This is especially so in the case of the real estate bequests ratio which reaches 63.84 percent in 1985. These results indicate that bequest wealth occupies a significant portion of total wealth and the ratio has been increasing over time.

Chapter 5 builds a macroeconomic time series model with bequest variables. The bequest model of savings provides new evidence to show that bequest transfers are important explanatory variables. Along with one-period lagged bequest variables and the one-period lagged saving rate, the change in the inflation rate and two oil shock dummies are important factors in Japanese household savings over the past twenty years. A pure life-cycle model is encompassed by the bequest model as an explanation of changes in the aggregate saving rate although neither model provides a straightforward explanation of the continuing high level of savings. In addition, we calculate a projection of the saving rate up to the twenty first century. Despite the increase in bequest transfers the projection forecasts that the saving rate will rise slightly by about 1 to 3 percentage points up to 1995. After 1996, the saving rate will start declining steadily but slowly. The rate will remain at around 16 percent in 2010.

Chapter 6 examines the Ricardian equivalence proposition by means of rigorous econometric tests. The major finding is that there is no active fiscal policy effect on household savings and bequests. Empirical results reject both Ricardian equivalence and Keynesian multiplier stories. Saving and bequest decision making are likely to be carried out without consideration of fiscal policy variables.

Chapter 7 extends the intergenerational game discussed in chapter 3 to incorporate the response to the government's fiscal policies and in particular the earlier empirical result refuting the Ricardian equivalence proposition for the bequest transfer mechanism. The model shows that a non-Ricardian equivalence outcome would be rationally chosen as a result of strategic interactions between the household sector and the government. It is also shown that the household sector forces the government to choose a debt-finance policy and avoids a tax-increase policy.

PART I REVIEW

CHAPTER 1

A BRIEF SURVEY OF THE LITERATURE

I. Introduction

This chapter surveys the issues of interest to us in the literature on saving models. No attempt is made to undertake a comprehensive survey of the literature itself. Danziger, Haveman and Plotnick (1981), Kotlikoff (1984), King (1985), Hall (1987) and Blundell (1988) have all compiled good recent surveys of the literature on consumption and saving behaviour.

Our main interests concern the intertemporal and intergenerational aspects of saving behaviour and its macroeconomic fiscal policy implications. This survey relates to these aspects of saving models. Empirical work on Japanese saving behaviour will be examined in chapter 2.

In section II, traditional approaches to the saving model are reviewed. In spite of recent technical advances, the basic ideas are derived from the works of Marshall, Fisher and Keynes. It is worthwhile investigating the original ideas of the saving models. In section III, recent developments in the study of saving behaviour are discussed. The topics we choose are highly selective. A summary of research frontiers in both theoretical and empirical spheres is given in the concluding section of the chapter.

II. Three Traditions in The Saving Models

II.1. Marshall

Marshall (1920) considered altruistic bequest transfers as the main motive for saving. He wrote that " what has had a far greater effect on the growth of wealth, it has rendered it far easier for a man to provide a secure income for his wife and children after his death : for, after all, *family affection is the main motive of saving.*" (*op.cit.*,p.227)(italics added) and also that " a man can have no stronger stimulus to energy and enterprise than the hope of rising in life, and *leaving his family to start from a higher round of the social ladder than that on which he began.*" (*ibid.*,p.228)(italics added).

Marshall rejected the precautionary motive of saving for uncertainty in one's lifetime. He remarked, " were it not for the family affections, many who now work hard and save carefully would not exert themselves to do more than secure a comfortable annuity for their own lives ; either by purchase from an insurance company, or by arranging to spend every year, after they had retired from work, part of their capital as well as all their income." (*ibid.*,p.228). This is exactly the point raised in recent times by economists criticising the life-cycle hypothesis [e.g., B. Friedman and Warshawsky (1985a,b)]. Marshall also recognised that " men labour and save chiefly for the sake of their families and not for themselves, (this) is shown by the fact that they seldom spend, after they have retired from work, more than the income that comes in from their savings, preferring to leave their stored-up wealth intact for their families." (*ibid.*,p.228). This point seems to correspond with observed behaviour in the Japanese case (as will be discussed in chapter 2).

Marshall's view of the intergenerational transfer motive of saving certainly reflected the view of the English middle classes in the 19th century (footnote 1). He wrote " the greatest savings are made by those who have been brought

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1. From medieval times to the present, the importance of inheritance and gifts has been recognised as one of the main motives in savings as well as family formation (i.e. marriage and child-bearing). For historical evidences, see, for example, Houlbrooke, R.A. (1984) The English Family 1450-1700 (Longman), Macfarlane, A. (1986) Marriage and Love in England 1300-1840 (Blakwell) and Sutherland, D. (1988) The Landowners (Muller).

up on narrow means to stern hard work, who have retained their simple habits, in spite of success in business, and who nourish a contempt for showy expenditure and a desire to be found at their death richer than they had been thought to be. This type of character is frequent in the quieter parts of old but vigorous countries, and it was very common among the middle classes in the rural districts of England." (*op.cit.*,p.229).

II.2. Fisher

Irving Fisher was, of course, the foremost monetary economist in the United States in this century. He was also the founder of microeconomic analysis of intertemporal resource allocation problems. Fisher's view of saving was expressed in The Theory of Interest as Determined by Impatience to Spend Income and Opportunity to Invest It (1930)(It is often quoted simply as The Theory of Interest). As this title explicitly shows, the interest rate is determined by the equilibrium between savings and investment and savings comes from the patience in not spending income. He wrote, " the uncertainty of life itself casts a shadow on every business transaction into which time enters. Uncertainty of human life increases the rate of preference for present over future income for many people, although for those with loved dependents it may decrease impatience. Consequently, the rate of interest, even on the safest loans, will, in general, be raised by the existence of such life risks. The sailor or soldier who looks forward to a short or precarious existence will be less likely to make permanent investments, or, if he should make them, is less likely to pay a high price for them. Only a low price, that is, a high rate of interest, will induce him to invest for long ahead." (*op.cit.,* pp.216-217).

Fisher's view of life is sharply contrasted with Marshall's view deriving from the life of the English middle classes. For Fisher, life was tough and uncertain which might reflect the reality of 19th century United States (footnote 2). According to his theory, if the time of death becomes uncertain, a risk averse individual should prefer less risk and will therefore consume more in the present.

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2. American consumption and saving behaviour in the 19th and early 20th century is well documented in Pitkin (1932). This neglected book covers nearly all aspects of consumption and saving behaviour that are currently discussed by economists such as bequest motive, life-cycle aspect, uncertainty of length of lifetime, habit formation, occupational, age, race and sex differences in consumption behaviour. On average, American households in that period were self-made and left very small bequests (i.e., 82 percent left nothing, 15 percent left between 2000 and 10000 dollars, 2 percent left modest estates over 10000 dollars, and 1 percent left big estates. Pitkin(1932) p.194.).

Savings are weakly motivated either by an increase in certainty of length of lifetime or by an increase in the interest rate (i.e., capital gain motive).

Fisher did not consider the bequest motive of saving and even criticised the idea of inheritance. He argued, " Americans still admire this sort of individual (i.e., "self-made man") compared to the man whose wealth came to him through no merit of his own, but merely by accident of birth." (1916, p.694).

In the post war consumption function controversy, both Friedman's permanent income hypothesis (1957) and Ando-Modigliani-Brumberg's life-cycle hypothesis (1954,1957 and 1963) were theoretically based on the Fisherian tradition of lifetime utility maxmisation subject to lifetime wealth. Naturally such theories ignored the Marshallian bequest motive of saving. Friedman (1957), in particular, followed the Fisherian tradition. Friedman gave three reasons for holding wealth: (1) straightening out the consumption stream, (2) earning interest and (3) availability of a reserve for emergencies (uncertainty).

Marshall was concerned with an intergenerational time horizon. This can be described as the long term view of saving. Fisher restricted his view to a lifetime horizon. It can be termed the medium term view of saving. Keynes took a much shorter time horizon. It can be called the short term view of saving.

II.3. Keynes

Keynes (1930, 1936) did not discuss an independent saving model. For him, saving was the source of financing investment, and in turn, investment determined income. Employment was causally determined by income. This process was assumed to take place in a short period of time. He wrote, " the amounts of aggregate income and of aggregate saving are the results of the free choices of individuals whether or not to consume and whether or not to invest ; but they are neither of them capable of assuming an independent value resulting from a separate set of decisions taken irrespective of the decisions concerning consumption and investment. In accordance with this principle, the conception of the propensity to consume will, in what follows, take the place of the propensity or disposition to save." (1936, p.65). In this respect, Keynes' concept of saving can be called the residual view of saving (i.e., $S = Y - C$). Dividing consumption into several items such as food, clothing, housing, *etc*, and taking one item out of the list of items to avoid the singularity problem, we can estimate consumer demands and saving simultaneously. This approach which is close to the linear expenditure system stems from Keynes' residual view of saving [see, for example, Lluch, Powell and Williams (1977) and Owen (1986)].

Keynes had more to say about saving-consumption behaviour. " The fundamental psychological law,..., is that men are disposed, as a rule and on the average, to increase their consumption as their income increases, but not by as much as the increase in their income..... This is especially the case where we have short-periods in view, as in the case of the so-called cyclical fluctuations of employment during which habits, as distinct from more permanent psychological propensities, are not given time enough to adapt themselves to changed objective circumstances. For a man's habitual standard of life usually has the first claim on his income, and he is apt to save the difference which discovers itself between his actual income and the expense of his habitual standard ; or, if he does adjust his expenditure to changes in his income, he will over short periods do so imperfectly. Thus a rising income will often be accompanied by increased saving, and a falling income by decreased saving, on a greater scale at first than subsequently." (*op.cit.*,pp.96-97). This point was later taken up by Duesenberry (1949) in his relative income hypothesis. Recent developments in time series analysis acknowledge the importance of habit formation in determining consumption-saving behaviour [see Muellbauer (1986)].

The Keynesian model is best applied in policy analyses. Most policies are aimed at remedying short term problems in which the economic agents' behavioural functions are temporarily fixed. Hicks (1983) pointed out the problem with the IS-LM model by saying, " one can hardly get a plausible rule while confining attention to what happens within a single period. So it would seem that the proper place for such a proceeding is in sequential models, composed of a succession of periods, in each of which the relevant parameters have to be determined ; there is then room for linkages between the periods, and so for lags." (*op.cit.*,pp.56-57).

The Keynesian model is concerned with short term economic phenomena but leaves room for dynamics.

III. Recent Developments in The Consumption-Saving Models

While the behavioural and motivational understanding of consumption and savings analysis has remained fundamentally unchanged in recent years, there have nevertheless been new empirical and theoretical advances in the field over the last decade.

Three new developments in the consumption and saving models are of interest to us. As is often the case, these new approaches have been subjects of controversy. We will survey them in turn.

III.1. Rational Expectations versus Structural Consumption Functions

The Lucas critique [Lucas (1976)] of econometric policy models introduced the application of rational expectations to consumption behaviour. According to Lucas, the optimal inference that a consumer should make about permanent income from observed income can be altered by changes elsewhere in the economy, for example, by a change in tax policy. For this reason, he argues that a model for policy analysis based on a consumption function is self-defeating. Hall (1978) formulated a simple empirical test of the idea that consumers maximised the expected value of lifetime utility subject to an unchanging real interest rate. He used the Euler equation describing intertemporal optimality and argued that no better information to forecast the present consumption level was available than that of the previous year's consumption level. In fact, in Hall's result consumption was a random walk, and the structural model of consumption was rejected.

This result, which required rather strong assumptions, gave rise to various criticisms. Flavin (1981) found the income variable to have sufficient predictive power in the consumption function, and she rejected the random walk hypothesis. Muellbauer (1983) criticised Hall's method on several counts. Liquidity constraints, changes in real interest rates, changes in consumer preferences over time and institutional structural changes (such as changes in social security and tax systems) all serve to negate Hall's model, since they can alter consumption patterns. Muellbauer also criticised the extreme form of the rational expectations hypothesis as being unrealistic. Each of these factors has been investigated in order to explain why strong forms of the Hall model fail. [On liquidity constraints, see, for example, Hayashi (1987) and Muellbauer and Bover (1986). On the durable goods effect, see Mankiw (1982,1985), Bernanke (1984) and Hayashi (1985). On preference changes, see Garber and King (1984) and MaCurdy (1987). On the interest rate change or intertemporal substitution effects, see Hall (1985,1988), Mankiw, Rotemberg and Summers (1985) and Wickens and Molana (1984)].

After these empirical investigations, Hall (1987) reached the following conclusions: (1) " the rate of change of consumption can be predicted by past values of real income and past values of a number of financial variables "; (2) " durable goods and the durability of consumption seem to explain the finding reasonably well "; (3) " liquidity constraints can also explain the finding in a reasonably convincing way "; and (4) " intertemporal substitution does not seem to be an important part of the explanation of the predictive power of lagged income and other variables." (*op.cit.*,pp.29-30).

Quite independently, Davidson, Hendry, Srba and Yeo (1978, DHSY for short) developed a structural consumption function with new statistical diagnoses. They showed that lagged consumptions, growth of disposable income and effects of inflation were important explanatory variables. While the rational expectations model assumes that the economy is in equilibrium, the DHSY model presents the disequilibrium approach (i.e., the error correction mechanism) of consumption. This model is essentially in the spirit of Keynes. Recent work by Hendry (1988) and Hendry and Neale (1988) showed that the rational expectations model could be encompassed by the feedback structural model although their arguments were not specifically directed to works on the consumption function.

III.2. Life-cycle Hypothesis versus Intergenerational Transfer Hypothesis of Saving Behaviour

Recent empirical work on inheritance [e.g., Atkinson and Harrison (1978) and Harbury and Hitchens (1979) for British inheritance, Brittain (1977,1978) for American inheritance and Blomquist (1979) for Swedish inheritance] and theoretical simulations of bequest behaviour [e.g., Blinder (1973,1974,1976), Bevan (1979), Darby (1979) and papers in Kessler and Masson (1988)] cast a strong doubt on the validity of the pure life-cycle hypothesis without bequest motive. Many economists also realise that intergenerational transfer (i.e., bequests = inheritance + gifts) is a major cause of inequality in general.

Apart from the distributional, welfare, and social mobility aspects of bequests, there are important implications of intergenerational transfers for macroeconomic consumption and saving behaviour.

The aim of theoretical investigations is to discover how the representative household decides on its bequest transfers to the next generation. The following three theoretical formulations of bequest behaviour are commonly used.

First, the strategic bequest motive is incorporated with the basis of bequest behaviour. For example, Bernheim, Shleifer and Summers (1985) considered a model in which the benefactor of bequests influenced the decision of his beneficiaries by holding wealth in bequeathable forms and by conditioning the division of bequests on the beneficiaries' actions. Kotlikoff and Spivak (1981) took a family as a substitute for the incomplete annuities market to reflect the idea of intergenerational risk sharing.

Secondly, accidental bequests are considered by Davies (1981) and Abel (1985). If the span of a lifetime is uncertain, then even without a bequest motive, there could be accidental bequests to the next generation. The problems with this model are : (1) the model can only deal with cases of unexpectedly shorter lives. There is another type of accident where people survive longer than expected and deplete their stock of savings, and (2) if the first problem is valid, then old households must buy annuities as Marshall (1920) argued. This has been empirically refuted by Friedman and Warshawsky (1985a,b). The motivation for leaving bequests must be found elsewhere.

Thirdly, there is the altruistic bequest motive that is the most popular explanation of bequest behaviour. For example, in Becker (1974,1981) and Barro (1974), parents are supposed to gain utilities by leaving bequests to their children. There are two ways of formulating this approach:

(1) the dynastic model in which parents obtain utility from their children' utility. By chain substitutions, the current generation of parents is connected with infinite future generations. This mechanism makes the Barro version of Ricardian equivalence transfers operationally possible. This model is criticised by Bernheim (1987a) who says that the dynastic equilibria are never welfare optima.
(2) the joy-of-giving model in which parents leave bequests and obtain utility directly from their bequests. This model cuts the infinite intergenerational linkage and makes the bequest transfer problem more tractable [see Abel (1986), Abel and Warshawsky (1987) and Blinder (1974)]. This formulation can be interpreted as a reduced form of a dynastic model which is used to derive a relation between *a priori* given values of the altruism parameter and the values of the joy-of-giving parameter. It is, therefore, necessary to introduce the children's utility function at some stage in order to endogenously determine the value of the altruism parameter [on this, see Abel (1987a), Kimball (1987) and Weil (1987)].

The alternative investigation is based on microeconomic panel data of age profile saving and consumption behaviour. The major goal of these studies is to examine whether or not old households dissave as assumed by the pure life-cycle hypothesis. King and Dicks-Mireaux (1982), Diamond and Hausman (1982), Kurz (1981,1984), Ando *et al.* (1986), Bernheim (1987d), among others, found that the wealth of a given cohort tended to decline very moderately after reaching its peak in the 60-65 age range, if not increasing [Mirer (1979) found it increasing]. The general consensus on the inadequacy of the pure life-cycle hypothesis as an explanation has led to the introduction of the bequest motive. However, Hurd (1987) presented some results that show, at least for retired people, a systematic decline in marketable wealth at an appreciable rate. Menchick and David (1983), using probate records in Wisconsin, showed the occurrence of relatively modest bequest transfers.

The problems with panel data analysis lie in (1) the sample biases such as regional differences, year-specific patterns, and other factors affecting each cohort differently, (2) the fact that variables are not properly controllable, and (3) the lack of clarity in the overall implications of characteristic variables.

In sum, the majority of panel data studies indicate inconsistency with the pure life-cycle model.

A natural extension to the above mentioned models is to interpret microeconomic findings in a macroeconomic perspective. Kotlikoff and Summers (1981,1988) and Kotlikoff (1988) tried to estimate the magnitude of intergenerational transfers in aggregate capital accumulation. With some arbitrary assumptions and inevitable reliance on different sources, they came up with the result that approximately 80 percent of wealth was bequest related wealth and only 20 percent was accounted for by pure life-cycle savings. Modigliani (1986, 1988a,b) used an alternative method and calculated the share of bequest related wealth to be 20 percent with the remaining 80 percent being life-cycle wealth. This controversy has not yet been settled and further discussion is presented in chapter 4. The major problem seems to lie in the estimation method and in differences in definitions of variables. Without a consensus on these aspects, each side can create their own figures. If, however, Kotlikoff and Summers' estimate is closer to reality, the macroeconomic life-cycle saving model would be crucially misleading. That is to say, if the majority of wealth is bequest wealth, then the implications of the estimate would be very different from the case in which all wealth was considered as life-cycle wealth.

III.3. Ricardian Equivalence Proposition versus Keynesian Fiscal Policy Effectiveness

David Ricardo (1951) wrote, " it is only by saving from income, and retrenching in expenditure, that the national capital can be increased; and neither the income would be increased, nor the expenditure diminished by the annihilation of the national debt. " (*op.cit.,*p.246). This is now known as the Ricardian equivalence proposition.

Barro (1974) revived this proposition within the context of an overlapping generations model where individuals were finitely lived. The presence of operative intergenerational transfers was shown to eliminate the apparent net wealth effect of shifts between taxes and government deficits. The most important implication of the Barro model is that the argument against a significant wealth effect of public debt issue also becomes an argument against the efficacy of fiscal policy.

On the theoretical level, according to Bernheim (1987c), Ricardian equivalence depends on, at least, the following assumptions ; (1) altruistic linkages of generations, (2) perfect financial markets, (3) non-redistributional and non-distortional effects of current and future taxation and (4) rational expectations or perfect foresight.

Bernheim and Bagwell (1988) have argued that the linkage hypothesis cannot be even approximately valid and all policy prescriptions based upon the dynastic framework were thus suspect [see also Tobin (1980)]. Poterba and Summers (1987) also questioned the importance of intergenerational issues in connection with Ricardian equivalence. They found from historical data that a substantial fraction of the deferred tax burden was not shifted to future generations.

Buiter and Tobin (1981) argued that when households faced liquidity constraints, government borrowing might have real effects. In their empirical works, Hubbard and Judd (1986) showed the short-run importance of liquidity constraints.

If the deficit policy, income, and other relevant factors are all determined stochastically (theoretically in general equilibrium) and the representative household has rational expectations, then household consumption or saving must be martingale (i.e., a random walk) [for this result, see Sargent (1987, chapter XII & XIII) and Leiderman and Razin (1988)]. If, on the other hand, uncertainty of future income [Feldstein (1988)] or distortional taxation [Abel(1986)] is introduced, the Ricardian proposition is shown to be invalid.

The issue of Ricardian equivalence is, fundamentally, an empirical matter. Most empirical studies are based on the use of the consumption function approach to measure the magnitude of Ricardian equivalence and to examine its statistical validity. Supporters of the Ricardian equivalence proposition include, among others, Kormendi (1983), Seater (1982), Seater and Mariano (1985), Tanner (1978,1979), Kochin (1974), Ihori (1986), Honma *et al.* (1987), Leiderman and Razin (1988). Modigliani and Sterling (1986), Blinder and Deaton (1986), Feldstein (1982), Bernheim (1987c), Boskin and Kotlikoff (1985) provide evidence on the net wealth effect of public debt.

Although these studies differ in their empirical implications and model specifications, all of them rely on traditional hypothesis testing and use the t-test and F-test. As consumption may be influenced by various other factors, the Ricardian equivalence effect cannot easily be isolated in a simple consumption function approach. It is necessary to use either direct tests such as causality and co-integration tests or more rigorous diagnostic tests.

IV. A Summary of Research Frontiers as Conclusion

As Marshall, Fisher and Keynes reflected historical and economic environments of their time in the formation of economic ideas, our research interests are also bounded by current socio-economic conditions.

Over 40 years of relative peace and high economic growth in the OECD countries have permitted the accumulation of significant wealth. By improvements in diet, hygienic conditions and medical care, people tend to live longer than before and consequently, the proportion of aged people has increased steadily. After the first oil shock depression, the OECD countries started running huge government budget deficits. The exchange rate system was also converted into the floating regime. Current account imbalances turned out not to be easily adjusted by floating exchange rates. There are much deeper structural differences between countries which cannot be adjusted in the short term.

Research frontiers seem to have gradually changed in accordance with such economic environments.

First of all, the Marshallian tradition of bequest transfers has seen a revival in the saving literature. Many empirical studies show that a large part of accumulated household wealth is not consumed in one's lifetime but is transferred to the next generation.

To provide a basic framework of analysis, a theoretical model of life-cycle saving with bequest motive is presented in chapter 3. Such a framework is especially important in the Japanese case because the existing literature on Japanese saving behaviour lacks rigorous (neoclassical) microfoundations. This lack of foundation is established by a survey of basic facts and of the existing literature in chapter 2. It is worthwhile investigating whether or not the bequest model of saving explains Japanese household behaviour and if so, how much of the total wealth holdings in Japan are bequest-related. These questions are addressed in chapter 4. After the 1980s, what sort of dynamic saving behaviour will be relevant ? How will the saving rate change in the future ? Chapter 5 will build a dynamic saving model with bequest motive and provide a future projection of the Japanese saving rate.

The second research frontier exists in the Ricardian tradition. Currently, due to the occurrence of huge budget deficits, many economists have made an effort to identify a causal relationship between public debt and household consumption and saving behaviour. However, this controversy is not yet solved. In chapter 6, econometric tests of the

Ricardian equivalence proposition will be undertaken. Chapter 7 succeeds in incorporating earlier empirical findings into a theoretical framework. In particular, it explains why the Ricardian equivalence transfers have not taken place.

The third research frontier is concerned with understanding the theoretical foundations of econometric practice. Whether the rational expectations-equilibrium approach encompasses the Keynesian structural-disequilibrium approach depends, after all, on objective empirical reality. Our approach throughout this thesis is based on the structural (theory-based) approach and is shown to be justifiable on empirical grounds.

CHAPTER 2

THE ROLE OF JAPANESE HOUSEHOLD SAVINGS IN COMPARATIVE PERSPECTIVES

I. Introduction

The interdependence of the world economy seems an inevitable process of ever expanding human economic activities. From a national economy's point of view, this process can be accelerated by some economic advantages of a country. Japan is no exception.

Ever since the yen began its steep rise in 1985, Japan has been going through a dramatic change in all dimensions of economic life. The Japanese have been buying not only land and shares, but also foreign holidays and foreign goods with remarkable magnitude. Japanese firms are investing directly abroad where demand exists. Foreign businessmen and workers have flooded into Japan to seek business opportunities and jobs.

It is certainly true that the rapid appreciation of the yen makes the Japanese feel rich and behave differently. However the biggest advantage comes from a traditional Japanese habit of thrift. This habit, together with the yen's appreciation, has transformed Japan into the world's leading creditor. In 1987, 133 billion dollars flowed out of Japan as long-term capital investment resulting in accumulated foreign assets of 241 billion dollars. This amount is the biggest credit any country has ever had.

This chapter conducts a fact finding investigation of Japanese saving behaviour in recent years. This is done by focusing on different perspectives. In section II, we look from an international perspective on Japanese savings. It is argued that Japan started running a large current account surplus in the 1980s when savings of other OECD countries declined rather sharply. As a result, Japan became the world's leading creditor. Section III gives a macroeconomic perspective on savings. The important facts are (1) a large private savings-investment (S-I) gap (largely due to sluggish domestic investment) and (2) a reduction of government's S-I deficits in the 1980s. These facts brought a current account surplus in the 1980s. The main point is that household savings remained at a high level regardless of private investment and government deficits. The microeconomic perspective (section IV) is mainly concerned with the age-profile of saving behaviour. Critical facts are (1) that old age households (age over 65) are net savers with a significantly high saving rate, (2) that they are the highest assets holders in society and (3) that their assets do not seem to be dissaved until the very end of their life. Section V examines earlier empirical studies on Japanese saving behaviour. None of them seems to have received full empirical support. The most significant finding in this section is that Japanese saving behaviour has structurally changed in the post growth period (i.e., 1970-1983). A brief summary is given in section VI.

II. International Perspective

II.1. The National Income Accounting in The G7 Countries

The nature of macroeconomic management has been substantially altered since the beginning of the floating exchange rate regime (1973) and the liberalisation of world financial markets in the early 1980s.

In an open economy, domestic resource and financial constraints do not matter much because agents (private or public) can fulfill their requirements in the world markets. Policy implications in the open economy are, therefore, different from those in the closed economy. For example, if the equilibrium real interest rate is determined in world capital markets, monetary and fiscal policies cannot influence domestic real interest rates. The government deficits do not necessarily crowd out private investment. An increase in saving does not always accompany an increase in domestic investment.

Although international capital mobility may still be imperfect (footnote 1), the general trend moves, undoubtedly, towards a full integration of world financial markets. In this section, we first look at the balance sheet of national income accounting in the G7 countries.

Following Dornbusch (1980, chapter 2), the national income accounting identity in the open economy can be written as follows,

$$(S - I) + (T - G) \equiv X + R - M \tag{1}$$

where S = net private saving, I = net private investment, T = net tax, G = government expenditure, X = total exports, M = total imports, X - M = net exports, R = net international transfer receipts.

The current account surplus is equivalent to the change in net foreign asset holdings (dNFA). (1) can be rewritten as,

$$(S - I) + (T - G) \equiv dNFA \tag{2}$$

1. See Feldstein and Horioka (1980) and Feldstein (1983) for empirical investigations of international capital mobility. They came up with the conclusion that capital mobility was not perfect. Obstfeld (1986), however, argued that with the Feldstein-Horioka approach, the international capital mobility was substantial at least among OECD countries.

The private sector net saving plus public sector net saving (i.e., budget surplus) equals the acquisition of claims on the rest of the world.

The national income accounting of the G7 countries in 1985 is given in Table 2-1.

TABLE 2-1 : THE NATIONAL INCOME ACCOUNTING IN THE G7 COUNTRIES IN 1985

	USA	UK	CANADA	GERMANY	ITALY	FRANCE	JAPAN
net savings	146.72	32.83	26.41	60.09	27.46	31.48	238.03
net capital formation	256.38	24.13	30.46	46.21	31.75	35.47	195.28
S-I+T-G	-109.66	8.70	-4.05	13.88	-4.29	-3.99	42.75
statistical adjustment	-5.54	-4.20	2.58	0.00	0.00	0.00	6.13
current account surplus = dNFA	-115.20	4.50	-1.46	13.88	-4.29	-3.99	48.88

Source : OECD Historical Statistics 1960-1985, OECD (1987), p.14.
Notes : (1) the unit of value is billions of US dollars at current prices and exchange rates.
(2) the net savings include the government saving (i.e., T = net tax) and the net capital formation includes the government expenditure (G).

Striking facts in Table 2-1 are (1) the huge current account deficit of the USA, (2) the huge current account surplus in Japan and (3) an overwhelming amount of net saving in Japan. Canada and European G7 countries show a balance in the domestic saving-investment gap.

Next, look at Table 2-2. It shows that Japanese net saving has been higher than that of any other G7 country over the period 1960-1985. While net saving ratios in the other G7 countries in the 1980s remained in single-digit figures, Japan recorded an average of 17.4 percent points which was outstanding.

TABLE 2-2 : THE GROSS AND NET SAVING OF THE G7 COUNTRIES AS A PERCENTAGE OF GDP

Gross saving (%)			Average values		
	1960-67	1968-73	1974-79	1980-85	1960-85
USA	19.9	19.6	19.8	17.6	19.2
UK	18.5	20.5	17.8	18.1	18.7
CANADA	21.4	22.2	22.6	20.3	21.6
GERMANY	27.3	27.1	22.6	21.2	24.7
ITALY	24.4	23.2	22.0	19.0	22.3
FRANCE	24.9	25.6	23.1	19.2	23.3
JAPAN	33.0	38.0	32.8	30.8	33.6
Net saving (%)			**Average values**		
	1960-67	1968-73	1974-79	1980-85	1960-85
USA	9.8	9.2	7.7	4.3	7.9
UK	10.0	11.3	6.6	5.9	8.6
CANADA	12.0	12.9	10.9	7.7	11.0
GERMANY	18.2	16.9	11.5	8.8	14.2
ITALY	16.2	15.2	12.1	8.8	13.3
FRANCE	15.1	16.0	12.0	7.2	12.7
JAPAN	20.6	24.6	20.2	17.4	20.7

Source : OECD Historical Statistics 1960-1985, OECD (1987). pp.69-70.

A well known problem with any international comparison lies in the statistical adjustments made for purposes of comparison. Saving rates also need to be compared with care (footnote 2). However, a significant gap between the Japanese saving rate and that of other G7 countries is known to remain even after making such statistical adjustments [see Hayashi(1986)]. Judging from Tables 2-1 and 2-2, Japan is undoubtedly the leading saver among the G7 countries and in the 1980s, it became the leading creditor to the world economy, especially to the United States.

II.2. The United States - Japan Economic Relationship

Let us now move our focus to the US-Japan economic relationship. The two countries have, after all, the most important and powerful vehicle economies in the world. Furthermore, the interdependence of the two countries is ever growing. Although this thesis is not directly concerned with the US - Japan relationship, it is worthwhile providing a brief background information on the bilateral

2. Hayashi (1986) pointed out several definitional as well as statistical discrepancies between the saving data of US and Japan ; (1) the boundary of the relevant sector, (2) the definition of income, (3) the scope of assets (inclusion of consumer durables) and (4) the valuation method of depreciation. In addition, the capital valuation under the inflationary period is quite an important aspect in saving measurement. For this, see Pesaran and Evans (1984).

relationship. Note that the Japanese saving "problem" has been criticised mainly by Americans (footnote 3) because Japan's huge trade surplus comes from the US and net savings are mostly reinvested in the US (footnote 4).

According to Bergsten and Cline (1987), " the US-Japan economic relationship is critical to both countries. Their integration through trade considerably exceeds that between either country and its other trading partners. In trade among industrial countries, the United States supplied 53.4 % of Japan's imports in 1984 and Japan provided 30.9 % of US imports. In contrast, the United States supplied only 20.1 % of the imports of all other industrial countries, and Japan only 5.9 % " (*op.cit.*,pp.2-3).

However, the recent bilateral trade accounts show an imbalance in Japan's surplus which is documented in Table 2-3 below. These imbalances are expected to continue in the future. According to a recent estimate by OECD [OECD Economic Outlook 43 (1988)], even after sizable appreciation of the yen, Japan will continue to run current account

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3. George Shultz, for example, put it as follows: " Japan must deal with its savings-investment balance if its chronic imbalance in trade is to be corrected." (Address before the Woodrow Wilson School of Public and International Affairs, Princeton University, on 11 April 1985).

4. For policy recommendations on US-Japan economic problems, see, for example, Marris (1987), Bergsten and Cline (1987) and Yoshitomi (1985).

surpluses averaging about 80-85 billion dollars annually throughout the 1980s and will become a net creditor country of 500 billion dollars by the early 1990s.

Japan's current account surplus against the US is mostly reinvested in US assets markets ; buying long-term US Treasury bonds and investing in US stocks, other securities and real estates.

TABLE 2-3 : JAPAN'S TRADE AND CURRENT ACCOUNT BALANCES 1977-1984 (billion dollars)

	1977	1978	1979	1980	1981	1982	1983	1984
TOTAL EXPORTS								
	81.08	98.35	102.30	130.44	151.50	138.40	146.96	169.70
to US	20.08	25.36	26.45	31.91	38.88	36.55	43.34	60.43
TOTAL IMPORTS								
	64.42	71.74	100.12	129.34	130.89	120.30	115.94	124.90
from US	11.28	13.47	18.38	22.53	23.18	22.18	22.74	24.67
TRADE BALANCE								
	16.66	26.61	2.18	1.10	20.61	18.10	31.02	44.80
with US	8.80	11.89	8.07	9.38	15.70	14.37	20.60	35.76
CURRENT ACCOUNT BALANCE								
	10.88	17.53	-8.71	-10.74	5.12	6.98	20.94	36.40
BALANCE ON SERVICES AND TRANSFERS								
	-5.78	-9.08	-10.89	-11.84	-15.49	-11.12	-10.08	-8.40

Source : Bergsten and Cline (1987) The United States - Japan Economic Problem, Washington, D.C. Institute for International Economics. pp.34-35.

This significant imbalance with the US started around 1983. There are several dimensions to this problem.

First, there are differences in trade practice. These include (1) market accessibility, (2) fairness of national practices (including non-trade barriers), (3) standard protectionism, and (4) barriers in the distribution system. Bergsten and Cline (1987) add that " Japan's *keiretsu* system of industry conglomerates tends to discriminate against nongroup (including foreign) suppliers, and for their part, many American companies simply have not made the effort necessary to penetrate the Japanese market " (*op.cit.*,p.3.).

Secondly, monetary and fiscal policy stances have been growing in contrast in the past several years. The sharp growth in the US budget deficits has contrasted with Japan's substantial efforts in reducing its budget deficits which must have contributed to the US trade deficits. Japan's liberalisation of its financial markets increased capital outflow from Japan to the US during 1983-84 which weakened the yen further. America's elimination of its withholding tax on interest payments to foreign investors in US Treasury securities has attracted foreigners' dollar holdings.

Thirdly, the exchange rate was extremely misaligned (the dollar was overvalued by 30-40 percent in relation to an estimated "equilibrium" level in a Williamson-Marris sense) until the Plaza meeting in September 1985. A strong dollar would encourage imports and discourage exports (footnote 5).

Fourthly, the gap in economic growth rates between the US and Japan in 1983-85 contributed to the US deficits because of high US demand and low domestic demand in Japan.

Fifthly, and most importantly, there exist significant structural differences between the two countries. The US has an extremely low rate of national savings while Japan has a very high rate and a large S-I surplus as shown in Table 2-1.

This section described Japan as the world's leading saver and creditor. This fact contributed to the US-Japan current account imbalances in recent years. In the following section, we investigate the macroeconomic sectoral saving-investment balances in Japan.

5. Whether the exchange rate adjustment can recover the US current account balance is an open question. There seem to exist two-way causalities between exchange rate adjustment and the trade (current account) imbalance. At the same time, the trade imbalance is influenced by domestic private saving-investment balance and the government budget deficits.

III. Macroeconomic Perspective

III.1. The Sectoral Saving-Investment Balance

According to the classification in National Accounts of Japan, five institutional sectors are defined as follows; (1) non-financial incorporated enterprises, (2) financial institutions, (3) general government, (4) private non-profit institutions, and (5) household (including private unincorporated non-financial enterprises). Table 2-4 reproduces the sectoral saving-investment balances in Annual Report on National Accounts 1987. The figures of sectoral classification correspond to the above numbers (1)-(5).

TABLE 2-4 : THE SECTORAL SAVING-INVESTMENT BALANCE IN CALENDAR YEAR NOMINAL VALUE (thousand million yen)

YEAR SECTOR	1974	1975	1976	1977	1978	1979
(1)	-18575.9	-14980.6	-12503.6	-10826.1	-5590.2	-10697.2
(2)	1335.6	910.5	781.3	348.2	527.5	1107.9
(3)	487.1	-4104.5	-6144.7	-7076.4	-11226.6	-10507.0
(4)	277.0	392.5	258.4	224.8	591.0	608.0
(5)	15108.2	16992.1	18782.8	19471.1	18477.3	17304.2
YEAR	1980	1981	1982	1983	1984	1985
(1)	-14973.4	-16148.9	-14173.8	-12305.5	-13659.8	-17149.0
(2)	1250.0	-7.5	858.3	471.2	131.2	-87.6
(3)	-10598.8	-9874.8	-9719.0	-10257.2	-6237.7	-2679.0
(4)	444.4	483.0	494.3	313.3	253.5	95.6
(5)	21075.4	25182.2	23369.8	25651.1	26584.5	29875.6

Source : Annual Report on National Accounts 1987 (Economic Planning Agency, Government of Japan).

The non-financial incorporated enterprises (1) run S-I deficits all through the period. This can be related to tax reduction practices, "animal spirits" in investment behaviour and institutional patterns of the Japanese corporate finance. Needless to say, this sector is the major investor in the economy. The financial institutions (2) maintain, more or less, a S-I balance with a small surplus. This sector is to be considered as the financial intermediary of lending and borrowing capital. The general government sector (3) has run significant S-I deficits since 1975. However, note that this is not the same concept as budget deficits on the basis of general account (*Ippan kaikei*). Budget deficits on the general account are restricted to the central government's budget while the general government S-I deficits include central and local governments as well as social security funds. The private non-profit institutions (4) have always had a S-I surplus but its magnitude is negligibly small. It is the household sector (5) that saves more than the aggregates of other sectors' S-I deficits. The saving surplus in this sector has been huge and it seems to have accelerated in the 1980s. This sector is the major saver and supplier of capital not only to the other macroeconomic sectors in Japan but also to the rest of the world.

It is important to understand Japanese household saving behaviour for various reasons: (1) The world economy depends heavily on Japanese savings, for example, the US budget deficits could not have been financed without Japanese financial investments. (2) The future economic growth of Japan depends on current investment financed mainly by household savings. (3) Public investment financed by debt will be paid off in the future and sufficient household savings and bequests guarantee future repayments and (4) An aging society without sufficient social security funds has to depend on private savings.

III.2. Net Saving, Budget Deficits and Current Accounts

In a macroeconomic perspective, one of the most discussed issues is concerned with the following identity,

$$(S - I) + (T - G) \equiv dNFA \qquad (2)$$

where $S - I$ = net private saving
$T - G$ = government surplus (deficits)
$dNFA$ = current account surplus (deficits)
= net foreign assets acquisition

Drawing on this *ex post* accounting identity, many economists have wondered if there is any causal (behavioural) relationship between the three variables.

The first possible relationship is concerned with international capital mobility [e.g., Feldstein and Horioka (1980), Feldstein (1983), Sachs (1981) and Obstfeld (1986)]. Suppose capital mobility is imperfect, then most investments would have to be financed domestically. Government deficits would crowd out private investments as a consequence. An increase in the budget deficits, therefore, tends to increase net private savings [*via* a swap between I and (T-G)] while the current account balance remains, more or less, constant.

The second relationship is also concerned with net savings and budget deficits. This argument is known as the Ricardian equivalence proposition [e.g., Barro (1974), Bernheim (1987c) and Feldstein (1988)]. If the private sector considers budget deficits as future tax liabilities, then it will respond by saving to compensate for future liability repayments. If this argument is valid, deficit-finance raises saving (S) by the same amount (T-G) and leaves investment (I) unchanged. In this case, again, the current account balance is assumed to be unaffected.

The third possible relationship is discussed by Bernheim (1988). Rejecting the above two possibilities and observing US trade deficits alongside huge budget deficits, he argues that there is a positive correlation between budget deficits and current account balance.

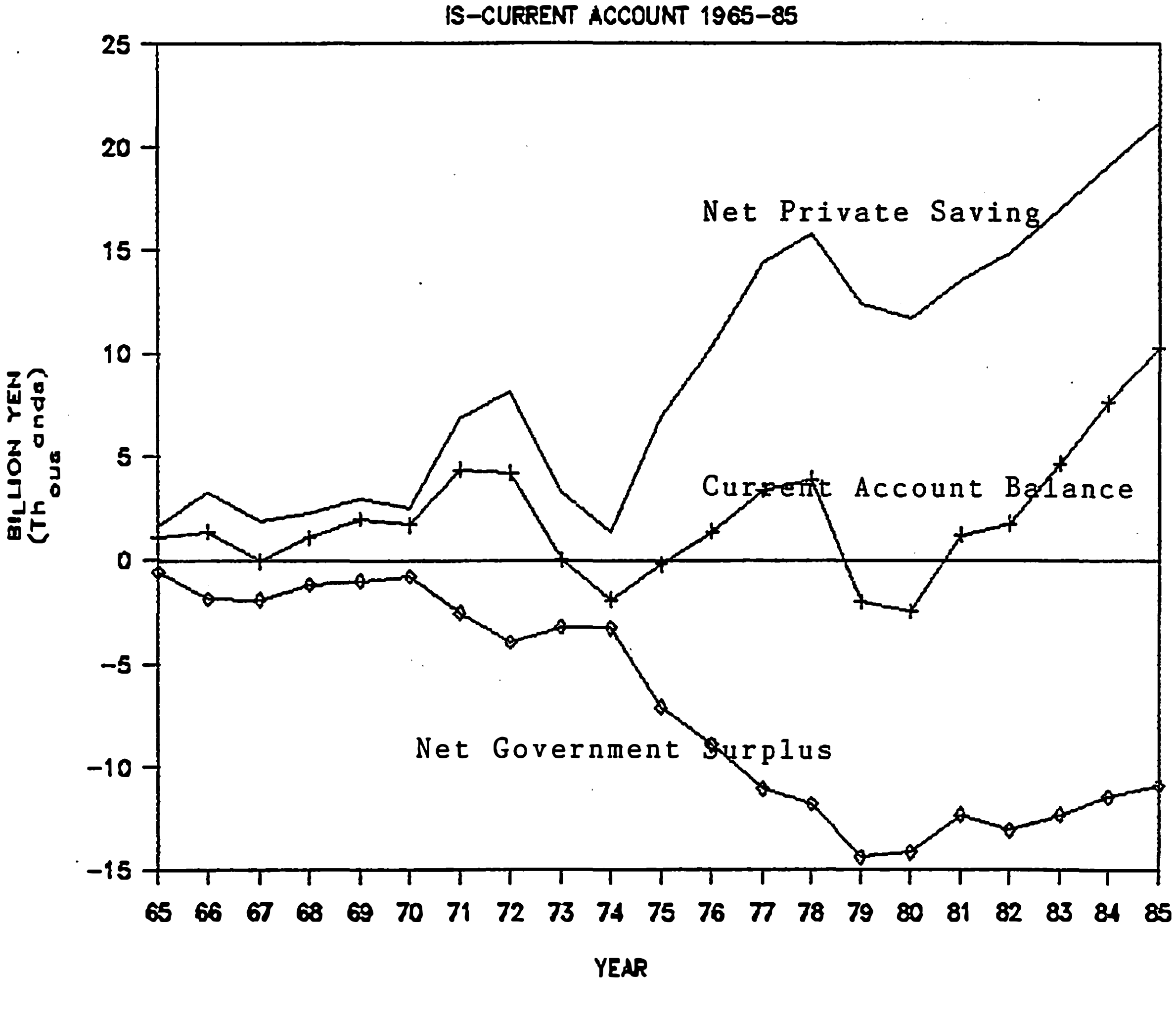
Figure 2-1 presents the sectoral balance in Japan. Let us consider whether any of the above three possible relationships are in effect in Japan. In general, it is clear that the sectoral imbalances of Japan started in 1975 and that the current account surplus grew rapidly only after 1983.

The first and second relationships are roughly satisfied during 1974-1978 but not during 1978-1985. The third relationship is invalid for most of the period except 1983-1985. Indeed, Bernheim (1988) himself found that no fiscal effects on the current account were evident in Japan.

The strongest correlation seems to exist between the net private savings and the current account balance. The key variable influencing the current account balance is, judging from Figure 2-1, the net private savings.

The issues raised in this section will be discussed in some detail in Part III of this thesis.

FIGURE 2-1 : THE SECTORAL BALANCE



Source : Annual Report on National Accounts 1987 .

Note : Constant Price in the 1980-value.

IV. Microeconomic Perspective

IV.1. The Household Consumption Pattern over The Life-cycle

Given the fact that the Japanese household sector is the major saver and creditor in the world economy, who exactly does save within the household sector? The household sector can be decomposed into several microeconomic levels. There are at least four traditional levels classified by (1) income scale, (2) occupational differences, (3) regional classifications and (4) age profile.

As far as saving behaviour is concerned, income scale and age profile factors are important. In this thesis, we are interested in the life-cycle aspects of household behaviour and income distributional aspects are ignored altogether this is partly because of lack of data which includes information on bequests, assets holdings and income distribution and partly because our analysis intends to concentrate on macroeconomic levels.

It is quite misleading to assume that the representative household behaviour remains the same over time. The evolution of a family (footnote 6) changes household economic behaviour.

6. The evolution of a family implies a process of creating a new generation of the family through (1) marriage, (2) child-birth, (3) child rearing, (4) children's independence, (5) retirement and (6) death or merging into a child's

Figure 2-2 shows the life-cycle pattern for major consumer expenditure. Clothing and health-medical expenditures remain, more or less, constant over the life-cycle. The housing expenditure ratio decreases over the lifetime as home-ownership increases. Education and food expenditures are directly related to the growing-up of children over a family life-cycle. When children are young (i.e., a head of household is between 25 and 35 years old), school fees and meals are the major expenditure on them, but as they grow, tutorial fees in the case of university entrance, university fees after university entrance, and remittances to children who live in other towns and attend university increase significantly. When children have completed their education, the family's education expenditure drops sharply. Food expenditure reflects a similar pattern. That is to say, food expenditure increases until children reach the high school age, then it starts decreasing as children begin to leave home. Towards the end of the life-cycle, the food expenditure ratio increases slightly, the latter is not because actual consumption increases but because household income decreases after the head of household is 50-55 years of age.

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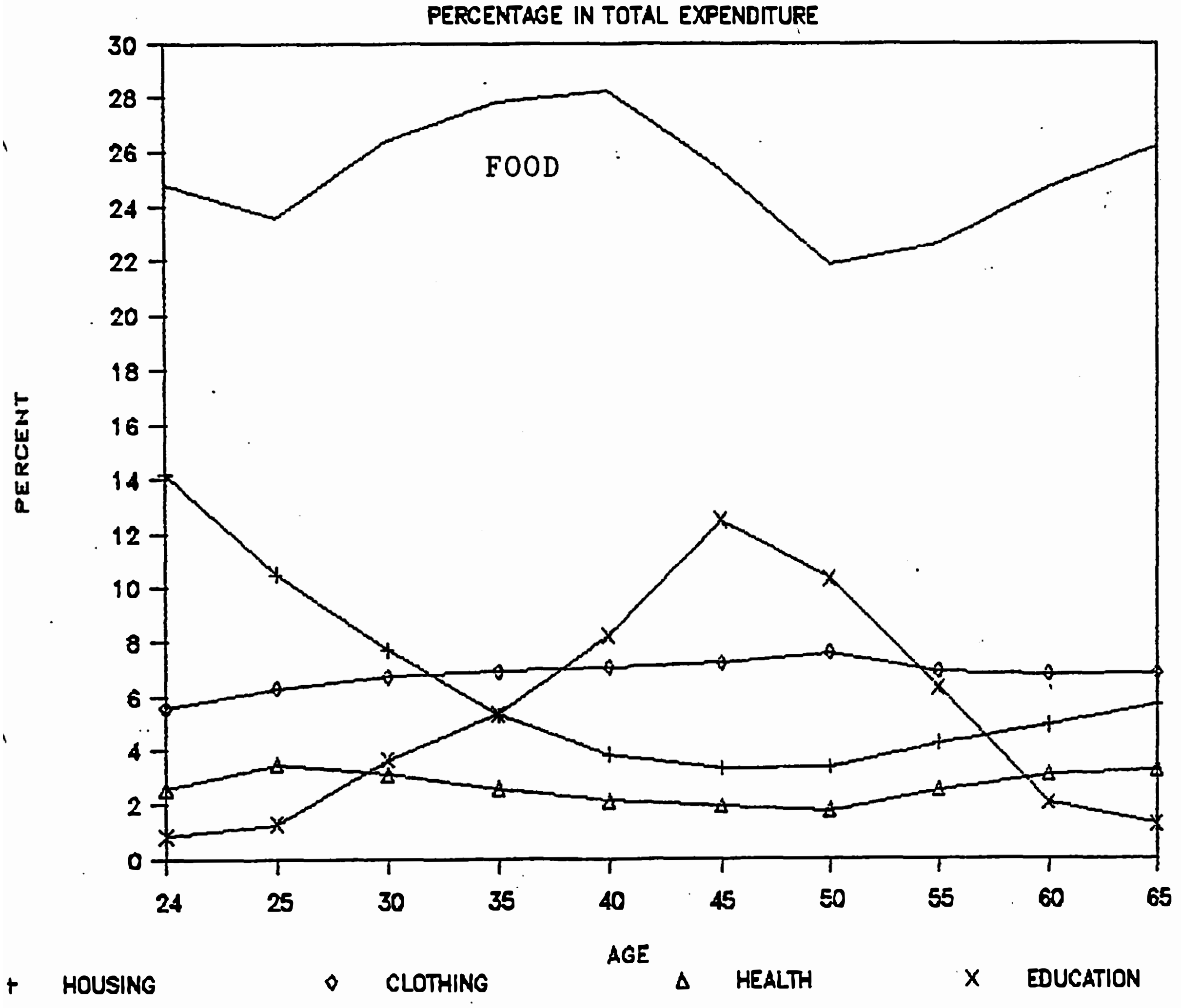
family. At each stage, not only the number of family members but also consumption patterns change.

FIGURE 2–2 : HOUSEHOLD EXPENDITURE



Source : Annual Report on The Family Income and Expenditure Survey 1986.

Note : The samples are the workers' households in all Japan.

These patterns of consumer behaviour form a convincing reason for us to divide the household sector into two groups [i.e., the young (working) household living with children and the old(retired) household]. The overlapping generations model can be an approximation to such cases. In fact, we will use this model as the theoretical base in chapter 3.

IV.2. Life-cycle Saving and Asset Accumulation

The Ando-Brumberg-Modigliani life-cycle hypothesis assumes that the household builds up assets during the working period and dissaves after retirement in such a way as to make the lifetime consumption path a smooth one.

Let us first see whether this picture of life-cycle pattern is valid for the case of the Japanese household. Figure 2-3 shows the saving rate by age profile during 1965-86, a proxy for the life-cycle behaviour. A significant difference from the pure life-cycle hypothesis is noted, namely, that the old age household (age over 65) does not dissave but saves at a level of around 15 percent. Even taking account of the prolonged life expectancy, on average, no household seems to dissave in Japan (footnote 7).

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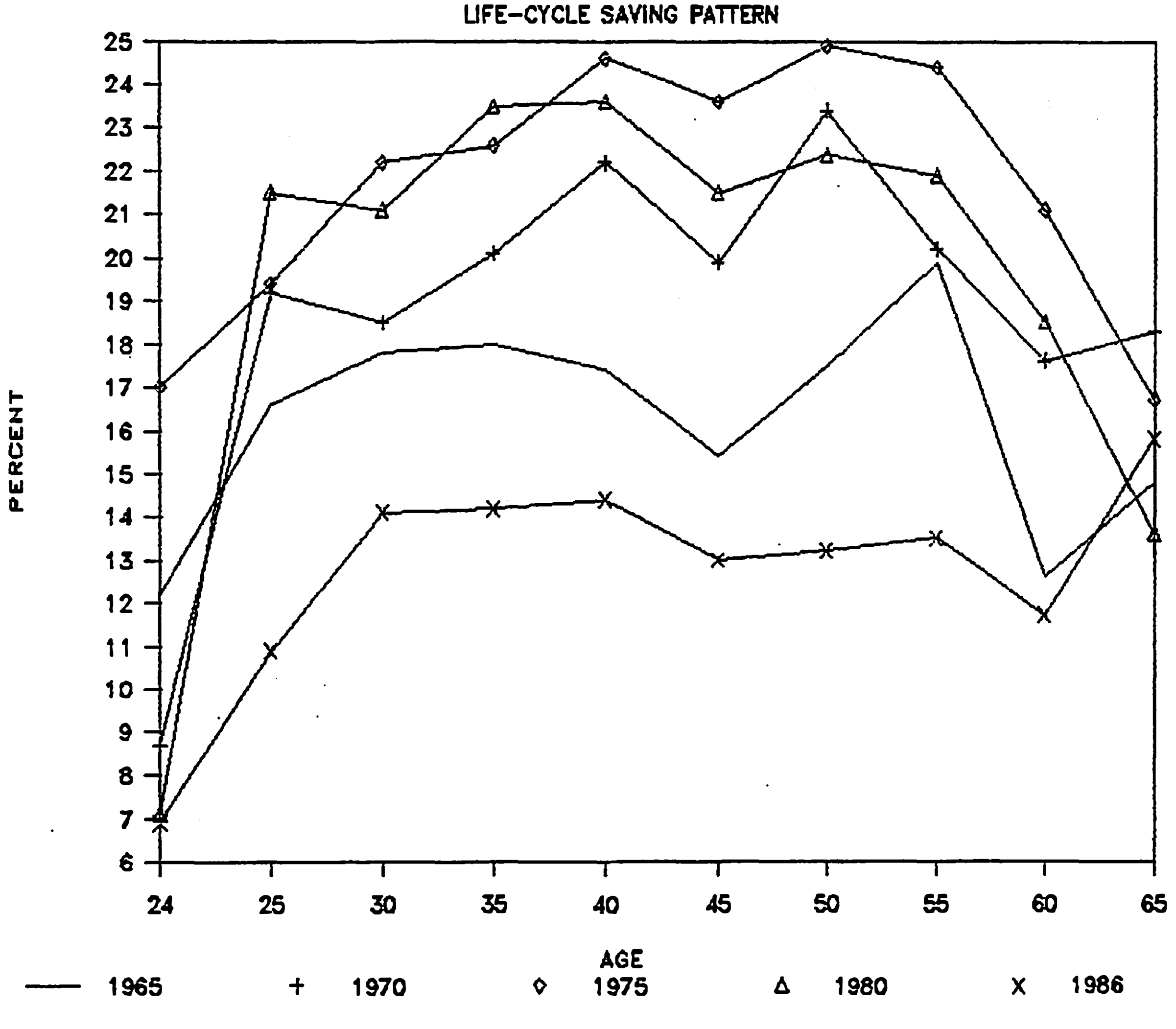
7. However it is sometimes pointed out that both the Family Saving Survey and the Family Income and Expenditure Survey have sample biases in the old age household data. That is, the survey uses the major earner as the head of household. If the old worker who lives with his/her child's family (i.e., two generations extended family which is common in

FIGURE 2-3 : SAVING BY AGE GROUP



Source : Annual Report on The Family Income and Expenditure Survey, annual issue.
Note : The samples are the workers' households in all Japan.

The life-cycle hypothesis shows further contradictions when the age profile assets accumulation is examined in Table 2-5.

TABLE 2-5 : AVERAGE ASSETS AND LIABILITIES BY AGE PROFILE (thousand yen)

AGE	20-29	30-39	40-49	50-59	OVER 60
YEAR		(1) GROSS ASSETS			
1984	2642	4580	6481	9520	10727
1985	2741	4643	6933	9565	13111
1986	3066	4955	7197	10209	13436
YEAR		(2) LIABILITIES			
1984	935	2421	3055	1956	942
1985	1193	2697	3050	2312	859
1986	1153	2812	3282	2451	892
YEAR		NET ASSETS = (1) - (2)			
1984	1707	2158	3426	7564	9785
1985	1547	1946	3883	7254	12252
1986	1913	2143	3915	7757	12544

Note : The samples are taken from workers' households in nominal values.
Source : Family Saving Survey 1986 (Statistics Bureau), pp.16-17.

Net assets increase significantly after 50-59 years of age and those over 60 years of age hold the biggest net assets in the age profile distribution. The working generation, i.e., those between 30-49 years of age, have

Japan) earns less than his/her child, then the old worker is not reported as the head in the survey. Indeed many poor old families are integrated into young households in Japan. The average figures in such surveys, thus, have upward biases for the old age household. This fact does not come to the aid of the life-cycle hypothesis because such extended family behaviour is usually related to the bequest motive which is analysed further below.

high liabilities mostly due to housing loans (i.e.,mortgages). Although in this table, real estate holdings are not included, it is also known that home ownership is highest among the households over 60 years of age.

Starting from the international perspective, we can now trace the origin of financial sources of domestic and international investment in *the old age Japanese household savings*. This generation had been the major working force in the high economic growth period in Japan and created the present prosperity of Japan. We must note that life-cycle aspects are highly correlated with historical changes. It is misleading to assume that this saving pattern can last forever in Japan. As Ishikawa (1987) pointed out, the high labour force participation rate among the elderly enabled old age households to save at a significant level. But this pattern of labour participation may not continue in the future. From recent social observations, we can imagine that many elderly citizens will enjoy their retirement life by dissaving behaviour.

Next, some economists try to explain saving behaviour in terms of uncertainty of future income. Risk averse consumers are assumed to save for "rainy days". In addition, if the precautionary saving motive is strong, then households would prefer riskless assets in their portfolio selection.

These aspects are examined in Table 2-6 which shows the portfolio composition by age profile.

TABLE 2-6 : PORTFOLIO AND LIABILITY COMPOSITIONS BY AGE PROFILE (percentage)

AGE	-24	25 -29	30 -34	35 -39	40 -44	45 -49	50 -54	55 -59	60 -64	65 -
					PORTFOLIO					
(1)	29.7	10.3	7.6	8.3	7.9	6.5	7.6	5.5	6.5	8.4
(2)	21.3	49.5	53.8	49.1	43.7	44.3	49.2	47.4	42.1	43.9
(3)	49.0	23.1	27.3	28.2	30.7	26.1	28.6	23.1	20.5	19.0
(4)	0.0	17.0	11.4	14.4	17.7	23.0	14.6	24.1	30.9	28.7
a	0.0	10.8	4.8	6.6	9.3	12.8	6.6	8.2	16.2	12.7
b	0.0	1.9	1.8	1.8	2.0	2.8	2.8	6.1	4.8	5.8
c	0.0	0.7	0.6	0.7	1.0	0.9	0.8	1.7	2.5	1.4
d	0.0	1.9	0.4	1.4	1.2	1.3	1.0	1.6	1.7	2.3
e	0.0	1.7	3.8	3.9	4.2	5.3	3.5	6.5	5.8	6.4
					LIABILITY					
(5)	44.6	78.8	84.9	80.5	72.7	66.4	69.8	76.7	88.7	88.4
f	6.0	49.5	29.2	21.1	24.9	24.4	22.1	27.2	44.1	27.5
g	0.0	12.7	10.5	17.6	10.4	10.3	11.7	19.7	18.4	9.4
h	0.0	13.5	36.8	33.5	30.2	25.5	29.2	23.3	22.6	28.1
i	0.0	2.8	7.4	7.5	4.8	5.2	4.0	0.2	2.4	0.0
j	39.1	0.3	1.1	0.8	2.4	1.0	2.8	6.4	1.2	23.6
(6)	55.4	21.3	15.1	19.5	27.3	33.6	30.2	23.3	11.4	11.6
k	9.2	13.6	11.6	16.0	24.7	28.8	24.9	20.5	5.3	0.0
l	0.0	0.0	1.1	1.7	1.2	3.5	2.3	0.8	1.2	0.0
m	46.2	7.7	2.4	1.8	1.5	1.3	3.0	2.0	4.6	11.6

Notes :(A) (1)= demand deposits, (2)= time deposits, (3)= life insurance, (4)= securities, of which a= stocks and shares, b= bonds, c= unit trust, d= bond trust, and e=loan trust, (5)= liabilities in financial institutions, of which f= banks, g= mutual loan and saving banks, h= housing loan corporations, i= other government financial institutions, j= post office, postal life insurance and life-insurance companies, (6)= liabilities in non-financial institutions, of which k= liabilities to one's own companies, l= debts to

individuals, and m= monthly and yearly installments and others.
(B) (1)+(2)+(3)+(4)= 100 % and (5)+(6)= 100 % .
(C) (1)(2) and (3) are safe assets and (4) is risky assets.
(D) The samples are taken from workers' households in 1986. Sample size = 3765.
Source : Family Saving Survey 1986 (Statistical Bureau).

In general, the portfolio balances of the Japanese household seem very sound. At least 70 percent of total portfolios are saved in safe assets, of which over 40 percent are held in time deposits. It may be possible to conclude that the degree of risk aversion in Japanese household saving behaviour is rather high.

A recent study by King and Leape (1987) cast light on the relationship between portfolio composition and age profile in the life-cycle framework. They showed that even after controlling for wealth and other household characteristics, the age factor was positively correlated with the probability of ownership of "information-intensive" (risky) assets. This tendency can also be traced in Table 2-6. Households aged over 60 shift their portfolio composition towards risky assets such as shares-stocks and loan trusts.

There are at least two explanations for this:
First, as The Family Saving Survey does not control the wealth holdings factor, this may simply reflect the fact that the household's degree of risk aversion is decreasing

in wealth holdings (i.e., the relative risk aversion). Old age households are usually wealthier, so they choose a portfolio with higher risks. Supporting evidence for this can be found in The Annual Public Opinion Survey on Savings 1987 (Source: The Central Council for Savings Promotion, The Bank of Japan). The opinion survey shows that, in general, the attitude towards risk bearing is positively higher in younger households and in wealthier households. The results of the Family Saving Survey, therefore, may be influenced by the wealth factor rather than the age factor.

Secondly, a jump in stock-share holdings in households aged above 60 reflects the institutional fact that when workers retire from companies, they often receive companies' shares as a part of their retirement allowance and bonus. This *locked-in-the-company* tradition (footnote 8) can be observed on the liability side as well. In Table 2-6, households of 40-59 years of age borrow 25 percent of their liabilities from their own companies which is nearly equivalent in value to bank borrowing and to housing loan liabilities. Company loans have interest rates that are lower than market rates.

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8. By locked-in-the-company, we mean that even after retirement, ex-workers are still tightly influenced by their companies' activities [e.g., share prices or part-time jobs in related (i.e., *keiretsu*) companies].

Such aspects of the locked-in-the-company tradition may not be found outside Japan.

We consider this second explanation to be more plausible for workers' households in Japan than that of accumulation of knowledge and information of portfolio investment as an increasing function of age (King and Leape's view).

V. Empirical Work on Japanese Saving Behaviour

V.1. Alternative Explanations

Why is the Japanese household saving rate so high by international standards ? This is one of puzzles which has attracted the interest of many economists over a long time.

Several good surveys of the literature are available. Komiya (1975) surveyed the early literature (in the 1960s). Mizoguchi (1973) also provided a very comprehensive survey. More recently, Kurosaka and Hamada (1984) had a chapter on Japanese savings. Hayashi (1986) had a brief section cataloguing explanations for the high Japanese saving rate. Horioka (1985) was the most exhaustive survey of the literature. From these surveys we can isolate six major explanations that seem to deserve further consideration.

(1) High Income Growth. The high economic (income) growth rate can explain the high saving rate because a temporary rise in the growth rate raises the saving rate, according to the life-cycle or permanent income hypothesis. The high economic growth of Japan in the 1950s and 1960s may have contributed to the high saving rate. We will examine this explanation in the next section V.2.

(2) Demographic Structure. The life-cycle hypothesis assumes that an increase in the proportion of the aged (over 65 years) decreases the household saving rate. Japan has been a relatively "young" country, compared with the USA and European countries, thus she has had a higher saving rate.

(3) Social Security System. Mizoguchi (1973) argued that lack of social security benefits might have forced households to prepare for uncertainty. However the social security effect on household saving in Japan is not at all clear. Following the Feldstein approach, Noguchi (1984) and Yoshikawa (1982) conducted some econometric tests and showed that social security effects were inconclusive. We take the view that the social security system is still immature and exposes households to some uncertainties (e.g., fear of future bankruptcy of a pension fund). These factors make households more or less self-reliant.

(4) Bonus System. Shinohara (1982,1983) argued that bonus as a transitory component of income could explain the high saving rate in Japan. According to the permanent income hypothesis, transitory income raises the saving rate. Komiya (1975) criticised Shinohara, arguing that since the bonus system had already been taken for granted, it could not be regarded as transitory but as permanent and therefore it could not have increased the average propensity to save over time. A recent econometric work by Ishikawa and Ueda (1984) showed that the bonus system had exerted a statistically significant effect on Japanese personal savings, however, the quantitative magnitude of its contribution was very small; at most 3 percent points out of 20 percent (the average saving rate in 1958-78). Weitzman (1986) and Freeman and Weitzman (1986) gave a positive evaluation of the Japanese bonus system. A criticism of their explanation is made in the next section.

(5) High Land Prices. High land prices, together with the high down-payment requirements and the non-tax-deductibility of interest expenses on mortgage borrowing may contribute to high savings by younger generations [see Hayashi, Ito and Slemrod (1988), Horioka (1988) and also Mizoguchi (1973)]. The implications of this factor may change completely if

households expect to receive real-estate bequests in the future.

(6) Bequests. Recent contributions to the literature recognise the importance of bequests and their connection to the prevalence of the extended family in Japan. Hayashi (1986), Ando *et al.*(1986) and Ishikawa (1987) have discussed this aspect. All three studies were based on microeconomic panel data and found a high saving rate among old working households. Even the retired households dissaved very slowly (2.1 percent annually). On the whole, old households have significantly high saving rates as was shown in Figure 2-3. These factors may explain the high saving rate in Japan. Note that the last factor conflicts with the life-cycle demographic explanation in which the increase in old households would decrease the total saving rate because of dissaving.

In addition to the above major explanations, there are some minor but possibly important influences on saving behaviour.

(7) Inflation Effect. It is said that the high inflation rate of the 1970s may have increased the saving rate in the period. Niida (1981) and Kurosaka and Hamada (1984) took the view that Japanese households were more concerned with the

net wealth effect than with the substitution effect and, in a period of inflation, Japanese households tended to behave on the basis of a long term perspective.

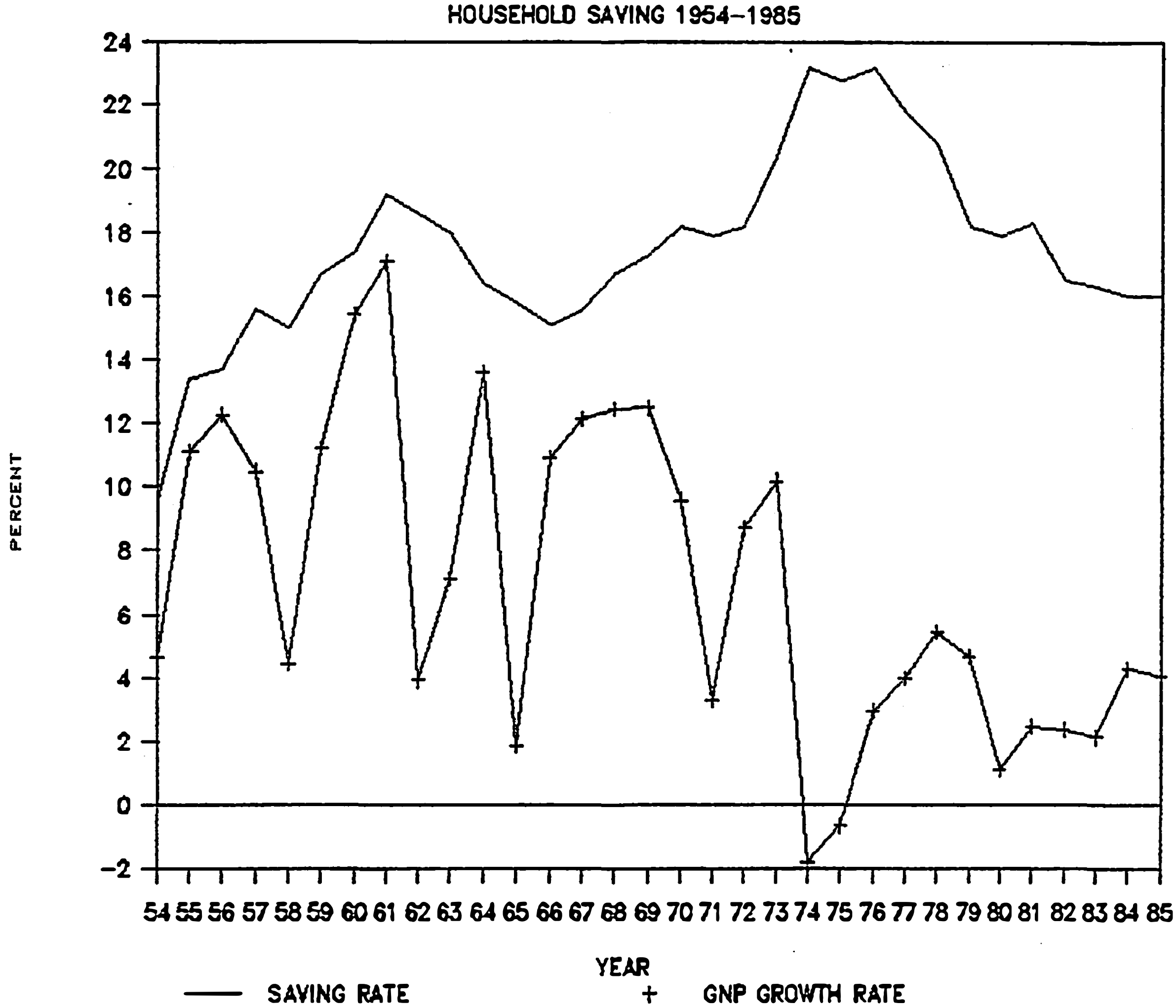
(8) Tax and Interest Rate Incentives. If Japanese households behave in accordance with a Fisherian (neoclassical) model, they must be sensitive to tax and interest rate incentives. The Japanese tax system (especially the Maruyu system) encourages savings because capital income is nearly tax-free. But Yoshino (1984) and Ishikawa (1987) found that the Maruyu system had no significant effect on household savings. In fact, the system was abolished in the spring of 1988. Akabane (1981) argued that the low tax rate explained the high saving rate. This is supplementary to the explanation of insufficient social security. Yoshino (1984), Hayashi (1986), among others, showed that Japanese saving was insensitive to interest (real and nominal) rates. Capital gain did not seem an important motivation for household saving in Japan.

V.2. Heuristic Illustrations

An old Japanese saying is that to watch a thing once makes you understand more than to hear about it a hundred times (roughly equivalent to "seeing is believing"). In this section, the historical evidence on Japanese household savings is examined to see whether the hypothetical explanations we considered above are justifiable. The illustrations are purely for heuristic purpose. Rigorous statistical discussion is presented later.

First, the correlation matrix among alternative explanatory variables of savings is considered in Table 2-7. The choice of variables approximately corresponds to the hypothetical explanations of saving behaviour. The high income growth hypothesis is represented by the disposable income growth rate (i.e., dY/Y). The life-cycle hypothesis, especially the demographic factor, is approximated by the percentage of population above the age of 65 years in the total population (i.e., POP65). The bonus hypothesis is represented by bonus payments in terms of months of base wage rate (i.e., Bonus). The land price inflation rate (i.e., Land) represents the high land price hypothesis. The inflation hypothesis is approximated by the consumer price inflation rate (i.e., CPI). The bequest hypothesis can be expressed in terms of the inheritance tax payments per unit of disposable income (i.e., Inherit). The social security hypothesis is ignored because the social security system started only after 1965. The system is definitely not a mature one.

FIGURE 2-4 : ANNUAL SAVING RATE



Source : Annual Report on National Accounts, annual issue.

TABLE 2-7 : THE CORRELATION MATRIX AMONG CURRENT YEAR VARIABLES

	S/Y	dY/Y	POP65	CPI	Land	Inherit	Bonus
S/Y	1.000						
dY/Y	-0.308	1.000					
POP65	0.315	-0.766	1.000				
CPI	0.667	-0.183	-0.073	1.000			
Land	-0.153	0.566	-0.577	0.077	1.000		
Inherit	0.259	-0.267	0.647	0.248	-0.271	1.000	
Bonus	0.655	-0.449	0.740	0.585	-0.327	0.806	1.000

Notes: (1) The data are taken from The Annual Report on National Accounts (annual issues)(Economic Planning Agency), Economic Statistics Annual 1987 (The Bank of Japan), and Japan Statistical Yearbook 1987 (Statistical Bureau). The bonus data are taken from Weitzman (1986) p.324. The raw data are available in data appendix at the end of the thesis.
(2) The data are based on annual, calendar year, nominal values in billions of yen between 1958 and 1983.

Several interesting facts are observed in Table 2-7.

As opposed to the high income growth hypothesis, the saving rate has a negative correlation with the income growth rate. While the saving rate had an upward trend during the period of the 1950s and early 1970s, the growth rate gradually decreased over the same period. When the saving rate started declining after 1975, economic growth recovered slowly. Figure 2-4 shows this picture clearly. It is misleading to consider the high *average* growth rate in the 1950s and 1960s as leading to a high saving rate in the same period. The second important point to note in Figure 2-4 is that the business cycle (economic fluctuations) had a small effect on the saving rate. The saving behaviour may have some kind of habit formation or ratchet effect.

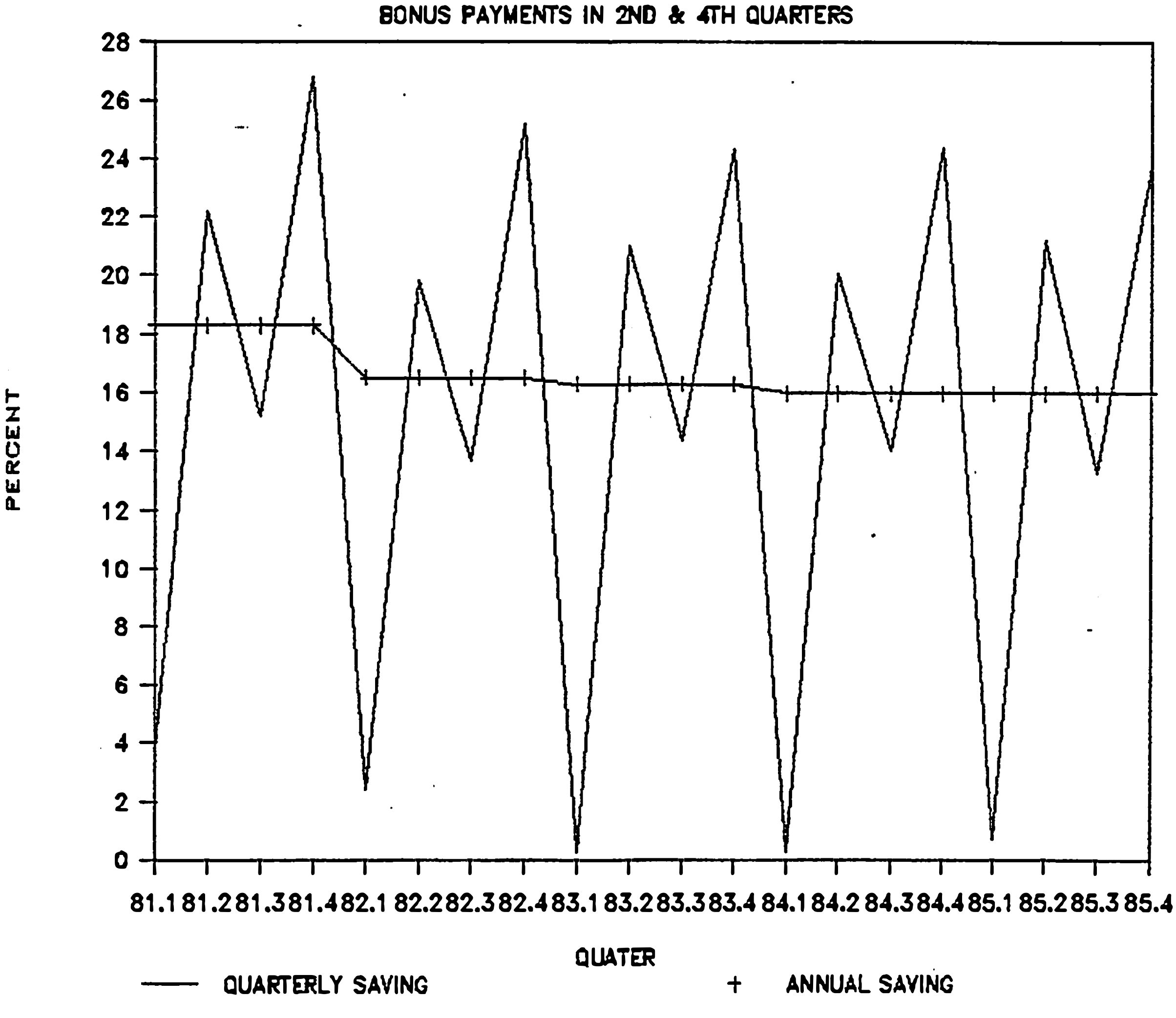
The life-cycle hypothesis based on the age or demographic factor is also contradicted by the positive correlation in Table 2-7. The historical data shows that the aged population saved more than the average saving rate. This fact corresponds with the bequest hypothesis rather than with the life-cycle hypothesis.

The high land price hypothesis argues that high land prices encourage savings. It faces another contradiction from a negative correlation between land price inflation and the saving rate. The life-cycle hypothesis and the high land price hypothesis need to be examined in separate periods. The implications of these hypotheses may be very different in the high growth period and in the post growth period. Land price inflation was, in fact, much higher in the 1950s and 1960s than in the 1970s.

The bequest hypothesis does not provide an *a priori* sign condition for the correlation matrix. It depends on whether the major savers are benefactors of bequests or beneficiaries. In case of benefactors, a positive correlation is expected and in the case of beneficiaries, a negative correlation is expected. The historical data implies, on average, that the major savers have been benefactors of bequests. This hypothesis again has different implications when the sample period is divided into sub-periods. We will come back to this point shortly.

As far as the correlation matrix is concerned, both the high inflation hypothesis and the bonus hypothesis satisfy the observed sign conditions, namely highly positive correlations. However the naive bonus hypothesis (considering bonus as a transitory income) is refuted. Look at Figure 2-5 which shows the quarterly saving pattern. The bonuses are usually paid in June/July (i.e., the second quarter summer bonus) and in December (i.e., the fourth quarter winter bonus). It is clear from Figure 2-5 that the bonuses raise saving rates and that the first quarter's saving rate is critically lower (1-2 percent) than the average saving rate. The latter implies that the winter bonus is temporarily saved but is subsequently used which makes up the annual saving rate. The regular saving pattern in Figure 2-5 confirms the view that the bonus system is institutionalised in household saving decisions. The naive bonus hypothesis must be rejected.

FIGURE 2-5 : QUARTERLY SAVING RATE



Source : Annual Report on National Accounts 1987.

Let us turn to the second illustration. The above explanatory variables are regressed against the saving rate with separate sample periods (i.e., 1958-73 and 1970-83). This method aims to capture the structural change in Japanese saving behaviour between the high growth period (i.e., in the 1950s and 1960s) and the post growth period (i.e., in the 1970s and 1980s). The results are given in Table 2-8 below.

TABLE 2-8 : REGRESSIONS ON THE SAVING RATE

Method : OLS Dependent variable : S/Y

variable (t-value)	EQ I 1958-83	EQ II 1958-73	EQ III 1958-73	EQ IV 1970-83	EQ V 1970-83
constant	-3.978	5.545	4.399	2.486	
	(-1.207)	(0.593)	(2.731)	(0.304)	
$(S/Y)_{t-1}$	0.840	0.435	0.452	0.607	0.669
	(6.387)	(2.233)	(4.485)	(1.807)	(5.728)
dY/Y	0.195	0.200	0.201	0.236	0.246
	(1.504)	(2.044)	(3.847)	(1.411)	(2.051)
POP65	0.480	-0.233		0.346	0.475
	(0.797)	(-0.108)		(0.426)	(1.694)
CPI	0.169	0.115	0.113	0.306	0.304
	(1.510)	(1.414)	(2.604)	(1.585)	(4.196)
Land	0.050	0.099	0.101	-0.038	-0.027
	(1.988)	(4.034)	(6.403)	(-0.526)	(-0.693)
Inherit	-2.426	3.743	3.287	-2.622	-1.825
	(-0.626)	(1.267)	(3.234)	(-0.413)	(-0.516)
Bonus	0.268	0.174		0.061	
	(0.156)	(0.062)		(0.014)	
R^2	0.906	0.954	0.954	0.949	0.999
% σ	4.75%	2.56%	2.30%	4.12%	3.60%
DW	1.504	2.292	2.324	2.733	2.745
D-h	1.705	-0.933	0.707	n.a.	-1.549

Note : The data are the same as those used in Table 2-7. The raw data are shown in the data appendix.

As is expected, there is significant structural change in the post growth period. The major changes and their implications are as follows.

First, the sign of POP65 changes from a negative one in 1958-73 to a positive one in 1970-83. In the high growth period, the major savers probably were working generations and the aged population were dissavers or "lower than average" savers. The life-cycle hypothesis seems a plausible explanation for the high growth period. In the post growth period, in contrast, the aged population has a higher saving rate. It corresponds with the fact that old households saved at a significant level (say 15 percent) in the 1970s and 1980s (as was shown in Figure 2-3). This change may indicate that aged households save for bequest transfers.

Secondly, the high land price hypothesis is valid in the high growth period but not in the post growth period. In the high growth period, rapid industrialisation was taking place and gave rise to large labour migration as a consequence. Housing demands during that period were so high that land price inflation continued at a rapid rate. Households had to save to pay high down-payments to obtain their homes. The saving rate naturally went up. After the 1970s, over 60 percent of households became homeowners. Together with those who expect real estate bequests in the future, the majority of households show a wealth effect from appreciation of the value of their own homes. At the same time, those who neither own houses nor expect to receive bequests may be discouraged from savings because of "impossibly" high land prices in certain areas.

Thirdly, the sign of Inherit also shifts in 1970-83 (note, however, that coefficients are not significant in the post growth period). The implication of this change is that the major savers in society become the beneficiaries of bequests in the post growth period. It may also be inferred that bequest transfers were taking place in significant magnitude during this period. Society in general may have been changing from a wealth accumulation process to a wealth transfer process.

In addition to the above three major changes, it is necessary to talk about three other variables.

The bonus hypothesis does not seem to have any significance in the regressions. EQ.III and EQ.V improve their standard errors when the bonus variable is omitted. This result leads us to ignore the bonus factor in the main discussion of the thesis.

The high income growth variable shows a consistent sign throughout the sample periods. However, taking account of the growth rate differences, the high growth factor was more significant in the 1950s and 1960s than in the post growth period. In the 1980s, for example, it explains only 0.5% of the saving rate (calculated from EQ.IV).

The inflation effect is significant throughout and especially in the 1970s.

The above heuristic illustrations demonstrate many important aspects of Japanese household savings. The most significant finding is that Japanese saving behaviour has structurally changed in the post growth period. The implications of possible explanatory variables are, in general, different in the different periods. The inflation effect is probably the only consistent factor in saving behaviour.

As we are mainly interested in the post growth period, it is useful to summarise the characteristics of household savings in this period.

(1) Bequest transfers start increasing. However the overall effect on reduction of the saving rate is of a very small magnitude.

(2) Old households (benefactors of bequests) still save at a significant level.

(3) Young households (beneficiaries of bequests) are discouraged to save by prospects of bequests in the future.

(4) The high land price is positively correlated with the increase in bequests. The inflation effect is still important while the growth factor plays a negligible role in this period.

VI. Conclusion

This chapter has provided first-hand evidence on the role of Japanese household savings from different perspectives.

Starting from an international perspective, it is shown that Japan has been the leading saver among the major industrialised countries of the world. In the 1980s, Japan's saving-investment surplus has been outstanding. After 1983, Japan consequently became the world's leading creditor while the US became the world's leading debtor nation.

In a macroeconomic perspective, it is pointed out that the household sector is the major saver in society. Household savings are so huge that, since 1975, the private sector's overall S-I balance has been continually in surplus (i.e., positive net private savings).

One noteworthy microeconomic perspective is that old age households (over 65 years of age) are still saving at a significant level (say, 15 percent). These households are inevitably the highest assets holders in society. After all, it is largely *the old age Japanese household savings* that have financed, for example, the US budget deficits, investment projects in Latin America and in ASEAN countries, as well as domestic investment in Japan. Japanese household savings have wide repercussions and policy implications not only for the Japanese economy but also for the world economy in general.

Section V surveyed empirical work on Japanese saving behaviour. Heuristic illustrations show that earlier studies contradict the historical data if we examine them over the entire sample period (i.e.,1958~1983) and that Japanese saving behaviour has structurally changed in the post growth period. The characteristic of household saving behaviour in the post growth period can be focused on bequest transfers.

PART II ANALYSIS

CHAPTER 3

A THEORETICAL MODEL OF SAVING AND BEQUESTS WITH OVERLAPPING GENERATIONS

I. Introduction

The purpose of this chapter is to establish the theoretical foundations of saving and bequest behaviour. The analytical framework used to explain Japanese household behaviour is orthodox neoclassical intertemporal optimisation.

The model is designed to provide both an aggregate saving function (section II) and an intergenerational bequest transfer mechanism (section III). In doing so, the overlapping generations model is selected for analysing intergenerational interactions. Aggregate saving is derived from optimisations by two (young and old) generations. This approach reflects the fact that society has heterogeneous consumers with different optimisation problems. An intergenerational bequest transfer mechanism is explained by use of a game-theoretic approach. We introduce the concept of reciprocal altruism which gives a stable optimal solution for bequest transfers.

II. A Basic Model of Saving with Bequest Motive

The model we discuss in this section is made as simple as possible. The simplifications include the following: (1) The government and the firm sectors are ignored. Income is measured net of taxation. The analysis of fiscal policy effects is put aside until Part III. The production side is not discussed explicitly. (2) There is no money illusion and all transactions are taken in real values. (3) The financial market is perfect and the real interest rate is exogenously given and (4) the economy is closed.

In general, time-period is expressed by t (in a subscript) and a generation is identified by i (in a superscript). Capital letter indicates aggregate value and small letter implies per-household value.

II.1. Assumptions

(1) A generation lives for two periods and two (working and retired) generations coexist in each period.

(2) Children start working when their parents retire. The parents die at the end of the retirement period (no one dies in midstream)(the assumption of certainty).

(3) During the retirement period, there is no source of income but for savings and interest income from the earlier working period.

(4) A planned bequest is announced at the beginning of the retirement period so that the next generation can take bequests as a part of their budget constraint. Furthermore, it is assumed that at the beginning of the working period, the working generation has perfect information about all relevant variables in both the working and retired periods (the assumption of perfect foresight).

II.2. Social Accounting

Before discussing the process of utility optimisation, it is useful to clarify the social accounting used in this model that ignores the firm and the government sectors.

Aggregate Production :

Aggregate gross domestic production (GDP) is equal to aggregate income of the working generation such that,

$$Y_t = h_t^{i+1} y_t^{i+1} \qquad (1)$$

where h_t^{i+1} = number of households in i+1-th generation at time t.
y_t^{i+1} = household wage income.

Aggregate Wealth :

Aggregate real estate (L) is equal to non-bequests real estate (NBL) held by the working generation plus real estate bequests (BQL) held by the retired generation such that,

$$L_t = NBL_t^{i+1} + BQL_t^{i} = h_t^{i+1} nbl_t^{i+1} + h_t^{i}\ bql_t^{i} \qquad (2)$$

where nbl_t and bql_t are per household values of NBL and BQL respectively.

Aggregate financial assets (F) are equal to the working generation's non-bequests financial saving (NBF) plus financial bequests (BQF) such that,

$$F_t = NBF_t^{i+1} + BQF_t^{i} = h_t^{i+1} nbf_t^{i+1} + h_t^{i} bqf_t^{i} \qquad (3)$$

where nbf_t and bqf_t are per household values of NBF and BQF respectively.

Aggregate wealth is then given by,

$$W_t = L_t + F_t = BQ_t^{i} + NBW_t^{i+1} \qquad (4)$$

where $BQ_t = BQL_t + BQF_t$ and $NBW_t = NBL_t + NBF_t$.

This is the stock accounting of national wealth. In this thesis, a stock concept of savings is mainly used. Aggregate wealth (W_t) is equal to total savings at t. There is another way of looking savings by means of aggregate budget. We must note that stock and flow of savings in this model are identical because each generation saves only in their working period (one period), given bequest transfers from the previous generation and because the retired generation does not hold wealth (*ex post*).

<u>Aggregate Budget :</u>

At time t, two (i.e.,i-th and i+1-th) generations coexist in society. The aggregate budgets of the two generations are as follows.

The i-th generation's aggregate budget in the t-th period :

$$(1+r_{t-1})S_{t-1}^{i} = Y_{t-1}^{i} + BQ_{t-1}^{i-1} - C_{t-1}^{i} = C_t^{i} + BQ_t^{i}$$

which is equal to the total saving of i-th generation in t-1-th period with interest gains.

The i+1-th generation's aggregate budget in the t-th period :

$$Y_t^{i+1} + BQ_t^{i} = C_t^{i+1} + S_t^{i+1}$$

which is equal to the wage income plus received (or announced) bequests.

Putting the two budgets together and rearranging them, we get the aggregate budget (Z_t) at t.

$$\begin{aligned} Z_t &= (1+r_{t-1})S_{t-1}^{i} + Y_t^{i+1} \\ &= C_t^{i} + C_t^{i+1} + S_t^{i+1} \\ &= C_t + S_t = C_t + W_t \end{aligned} \quad (5)$$

where Z_t is either consumed (C_t = aggregate consumption) or saved (S_t = aggregate saving) in society at t.
W_t = aggregate wealth = $S_t = L_t + F_t$.

Note that the i+1-th generation's aggregate budget is allocated into their lifetime consumption and bequests such that,

$$\begin{aligned} Y_t^{i+1} + BQ_t^{i} &= C_t^{i+1} + C_{t+1}^{i+1} + BQ_{t+1}^{i+1} \\ &= LCW^{i+1} + BQ^{i+1} \end{aligned} \quad (6)$$

where LCW^{i+1} = the life-cycle saving of i+1-th generation which needs to be strictly distinguished from total savings S_t^{i+1} including the bequest motivated saving.

This identity is quite important when the life-cycle model and the bequest model of saving are compared (as will be discussed in chapter 4).

II.3. Utility Optimisation

To derive specific parametric values, a log-linear utility function of the representative (average) household is used. We take the "joy-of-giving" view of intergenerational transfers which means that a household gains utility from bequests *per se* rather than from the utility therein children (footnote 1).

Utility function :

The i+1-th generation's utility function is given as,

$$U^{i+1} = \alpha_t^{i+1}\ln(c_t^{i+1}) + \alpha_{t+1}^{i+1}\ln(c_{t+1}^{i+1}) + \beta^{i+1}\ln(b_{t+1}^{i+1}) \qquad (7)$$

where c_t^{i+1} = household consumption of the i+1-th generation at t.
b_{t+1}^{i+1} = household bequests of the i+1-th generation. $b = bqf + bql$.
α^{i+1} = preference parameters.
β^{i+1} = an intergenerational weight of the i+1-th generation for the i+2-th generation. $\beta > 0$ (footnote 2).

1. The most popular alternative model is the dynastic view of intergenerational transfers in which the household gains utility from its descendant's utility. By repeating the same procedure, a generation will be connected with an infinite number of future generations. See, for example, Barro (1974). As Abel and Warshawsky (1987) argue, the joy of giving formulation has the practical advantage that it is more easily tractable. However, in our model an intergenerational weight (a degree of reciprocal altruism) is ultimately determined by an intergenerational interaction. In this sense, each generation is linked infinitely with future generations.

2. Non-negativity of β is the conventional assumption. See, e.g., Kimball (1987) and Modigliani (1987, p.18.). But the reasons for bequest transfer to be positive have not been fully explored. It is necessary to have a theory of positive bequests. In reality, there are parents who leave negative bequests (i.e.,liabilities) but in aggregate, bequest

Budget Constraint :

The budget constraint of the i+1-th generation in the t-th period's is,

$$y_t^{i+1} + \tau^i b_t^i = c_t^{i+1} + s_t^{i+1} \tag{8}$$

where s_t^{i+1} = household saving including real estate holdings at t .

τ^i = h^i/h^{i+1}. Adjustment for per household bequest receipt of i+1-th generation.

Saving is made for purposes of consumption in the retired (t+1-th) period and for subsequent bequests to the i+2-th generation. The budget constraint of the i+1-th generation in the t+1-th period is,

$$(1+r_t)s_t^{i+1} = c_{t+1}^{i+1} + b_{t+1}^{i+1} \tag{9}$$

where r_t = real interest rate at t.

As planned, the retired generation lives on dissaving. But a substantial portion of savings are left as bequests to the next generation.

From (8) and (9), the i+1-th generation's lifetime budget constraint is obtained,

$$y_t^{i+1}+\tau^i b_t^i = c_t^{i+1} + (c_{t+1}^{i+1} + b_{t+1}^{i+1})/(1+r_t) \ . \tag{10}$$

Saving is used as an instrument to smooth lifetime consumption and bequest transfers.

---

transfers have always been positive. Although we do not intend to develop the theory here, one idea is that bequest transfers may improve the young (working) generation's credit position by increasing its collateral.

<u>Optimisation :</u>

The i+1-th generation optimises their lifetime utility subject to their lifetime budget constraint. The optimisation problem is simply given by { Max U^{i+1} subject to (10) }. Optimal consumption and bequests are given below (left-hand side superscript asterisk implies optimal).

$$ {}^{*}c_t^{i+1} = [\alpha_t^{i+1}/(\alpha_t^{i+1} + \alpha_{t+1}^{i+1} + \beta^{i+1})] [y_t^{i+1} + \tau^i b_t^i] $$

$$ {}^{*}c_{t+1}^{i+1} = [\{\alpha_{t+1}^{i+1}(1+r_t)\}/(\alpha_t^{i+1} + \alpha_{t+1}^{i+1} + \beta^{i+1})] [y_t^{i+1} + \tau^i b_t^i] $$

$$ {}^{*}b_{t+1}^{i+1} = [\{\beta^{i+1}(1+r_t)\}/(\alpha_t^{i+1} + \alpha_{t+1}^{i+1} + \beta^{i+1})] [y_t^{i+1} + \tau^i b_t^i] . \quad (11) $$

By the same procedure, the i-th generation's optimal consumption and bequests are given below.

$$ {}^{*}c_{t-1}^{i} = [\alpha_{t-1}^{i}/(\alpha_{t-1}^{i} + \alpha_t^{i} + \beta^{i})][y_{t-1}^{i}+\tau^{i-1}b_{t-1}^{i-1}] $$

$$ {}^{*}c_t^{i} = [\{\alpha_t^{i}(1+r_{t-1})\}/(\alpha_{t-1}^{i}+\alpha_t^{i}+\beta^{i})][y_{t-1}^{i}+\tau^{i-1}b_{t-1}^{i-1}] $$

$$ {}^{*}b_t^{i} = [\{\beta^{i}(1+r_{t-1})\}/(\alpha_{t-1}^{i}+\alpha_t^{i}++\beta^{i})][y_{t-1}^{i}+\tau^{i-1}b_{t-1}^{i-1}] \quad (12) $$

II.4. Aggregate Saving Function

From (11) and (12), aggregate consumption at t can be derived as the cross section aggregate of the consumption of the i-th and i+1-th generations. This aggregation reflects the idea that society consists of heterogeneous consumers with different optimisation problems at different periods.

Aggregation of the i-th and the i+1-th generations' optimal consumption at t is made by,

$$*C_t = h_t{}^i * c_t{}^i + h_t{}^{i+1} * c_t{}^{i+1}. \quad (13)$$

This optimal value includes a stochastic error term such that $C_t = *C_t - \varepsilon_t$ where ε_t is a white noise (footnote 3). Substituting (13) into (5) and replacing C_t by $*C_t$, the aggregate saving function is obtained by,

$$S_t = Z_t - *C_t + \varepsilon_t = (1+r_{t-1})S_{t-1}{}^i + Y_t{}^{i+1} - *C_t + \varepsilon_t. \quad (14)$$

Since,

$$(1+r_{t-1})S_{t-1}{}^i = *C_t{}^i + BQ_t{}^i - u_t$$

(14) is transformed as,

$$S_t = *C_t{}^i + BQ_t{}^i + Y_t{}^{i+1} - *C_t + \varepsilon_t - u_t$$
$$= BQ_t{}^i + Y_t{}^{i+1} - *C_t{}^{i+1} + v_t \quad (14')$$

From (11), aggregate consumption of the i+1-th generation at t is given by,

$$*C_t{}^{i+1} = \{\alpha_t{}^{i+1}/(\alpha_t{}^{i+1} + \alpha_{t+1}{}^{i+1} + \beta^{i+1})\}(Y_t{}^{i+1} + BQ_t{}^i)$$

(14') can be rewritten as,

$$S_t = \{(\alpha_{t+1}{}^{i+1} + \beta^{i+1})/(\alpha_t{}^{i+1} + \alpha_{t+1}{}^{i+1} + \beta^{i+1})\} *(Y_t{}^{i+1} + BQ_t{}^i) + v_t$$
$$= \alpha\ (Y_t{}^{i+1} + BQ_t{}^i) + v_t \quad (14'')$$

As expected, aggregate saving is a function of the i+1-th generation's aggregate budget at t because the i+1-th generation is the only saver at t. With simplified notations, the aggregate (stock) saving function is written as,

$$S_t = \alpha_1 Y_t{}^{i+1} + \alpha_2 BQ_t{}^i + v_t\ . \quad (15)$$

---

3. ε_t can be considered as a sum of two white noises, u_t and v_t. u_t and v_t come from i-th and i+1-th generations' respective optimisations. We assume that u_t and v_t are uncorrelated. Thus $\varepsilon_t = u_t + v_t$ is also a white noise.

It is useful to divide savings into financial savings and real estate investment such that, $S_t = F_t + L_t$ where F_t is aggregate financial assets and L_t is aggregate real estate holdings. Bequests are also divided into two factors; namely real estate bequests (BQL) and financial bequests (BQF). (15) becomes,

$$F_t = a_1 L_t + a_2 Y_t + a_3 BQF_t + a_4 BQL_t + v_t \qquad (15')$$

This is the optimal (stock) aggregate financial saving function with sign conditions : $a_1 = -1$ and $a_2 = a_3 = a_4 > 0$.

For empirical applications of this model to annual time series econometric saving models, the following (annual flow) financial saving function with a lag structure is approximated by error correction mechanism (i.e., $F_t - \alpha F_{t-1}$, $0 < \alpha < 1$).

$$\begin{aligned} F_t - \alpha F_{t-1} = {} & a_1 L_t - \alpha a_1 L_{t-1} + a_2 Y_t - \alpha a_2 Y_{t-1} \\ & + b_1 BQF_t - \alpha b_1 BQF_{t-1} + b_2 BQL_t - \alpha b_2 BQL_{t-1} \\ & + (1-\alpha)\varepsilon_t' \end{aligned}$$

Rearranging the above equation, the baseline model is obtained.

$$\begin{aligned} AS_t = {} & a_1' F_{t-1} + a_2' L_{t-1} + a_3' L_t + a_4' Y_{t-1} + a_5' Y_t \\ & + b_1' BQF_{t-1} + b_2' BQF_t + b_3' BQL_{t-1} + b_4' BQL_t + \varepsilon_t'' \end{aligned} \qquad (16)$$

where AS_t = annual financial savings.
= $F_t - F_{t-1}$.
F_{t-1} = financial assets stock at t-1.
L_t = real estate holdings at t.
Y_t = annual disposable income.
BQF_t = annual financial bequest transfers.
BQL_t = annual real estate bequest transfers.
ε_t'' = a white noise error.

The sign conditions from theoretical overlapping generation models are not useful in the approximated annual model (16) because the theoretical time period is one working period (concerned with stock savings) while the empirical time period is a year (concerned with flow savings). The signs in time series models are determined by short run movements of explanatory variables. However, in principle, we expect the wealth effect (negative on saving, i.e., $a_1' < 0$) from F, the income effect (positive on saving, i.e., $a_5' > 0$) from Y, and the substitution effect (negative on saving, i.e., $a_3' < 0$) from L. Whether bequests have income effect or wealth effect is *a priori* inconclusive (however, theoretical conditions are $b_1'<0$, $b_2'>0$, $b_3'<0$, and $b_4'>0$).

Bequest transfers are endogenously determined as a function of bequests received in the previous period. This theoretical framework enables us to analyse how the optimal bequest level is determined without an *a priori* assumption about the intergenerational weight (i.e., β). This point is taken up in the next section III.

III. The Determination of Intergenerational Weight as A Degree of Reciprocal Altruism

In the above section II, both the preference parameters on consumption (i.e., α_t^i) and the intergenerational weight (i.e., β_t^i) are taken as being *a priori.* While the preference parameters are likely to be independent of other generations' behaviour, the intergenerational weight (β_t) must depend on the next generation's well-being.

In this section, we will focus on the way in which intergenerational weight, or the degree of reciprocal altruism is determined.

III.1. An Intergenerational Game

Kimball (1987) and Abel (1987a) stress the importance of two-sided altruism, namely altruism by two generations between parents and children. In our view, however, extensions in this direction do not increase our knowledge of altruism (footnote 4).

We see "two-sidedness" of bequest behaviour in a different perspective. Each generation plays two roles in

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4. Although this is a new way of seeing altruism, this approach does not seem a promising one, because gifts to the i-th generation and bequests from the i-th generation can be netted out of the intergenerational transfers and one-sided "net" altruism can be restated. Furthermore, the two-sided altruism literature, *a priori*, assumes the same intergenerational parameters for subsequent generations. There is no strategic relation between generations. For another criticism, see Bernheim (1987c. pp. 265-66).

its life ; as a receiver (beneficiary) of bequests from its parents and as a donor (benefactor) of bequests to its children. The bequest behaviour of a generation is decided strategically by its reciprocal situation over a lifetime.

To understand the mechanism of determination of a degree of reciprocal altruism, an intergenerational game with reciprocal altruism is developed (footnote 5).

The basic idea goes as follows. Parents (the i-th generation) care about their children's (the i+1-th generation) well-being as well as their own. In practice, parents optimise the total consumption level of two generations. Children's (the i+1-th generation) consumption depends in part on parent's bequests and in part on their own bequest decision to the next (i+2-th) generation. Parents choose an optimal degree of altruism in accordance with children's degree of altruism. So there appears to be a Nash equilibrium situation. The main interest of this game is to see how a reciprocal altruistic equilibrium is achieved when each generation plays two roles in their life, as beneficiary and benefactor of bequests.

5. Although our game is substantially different, there are several papers on intergenerational transfer games. e.g., Ray (1987), Lane and Mitra (1981) and Streufert (1985). The paper by Bernheim, Shleifer and Summers (1985) discusses the strategic bequest motive which is somewhat similar to our model. A major difference lies in the fact that they are concerned only with a single-period (one-shot) game while we are basically interested in repetition of social interactions.

It is assumed that each generation prefers an efficient use of resources so that it tries to get the highest payoff with the lowest bequest transfers (i.e., the biggest benefits by the smallest sacrifices) (footnote 6). It would be useful to define *altruist efficiency* in contrast to *Pareto efficiency*. According to Arrow and Hahn (1971, p.91.), " a utility allocation u is *Pareto efficient* if it is feasible and not dominated by any other feasible utility allocation." Such a utility function is normally defined for a self-interest maximising agent. Altruism, on the contrary, is defined as a voluntary act of an agent (e.g., a generation) which strictly *benefits* other agents while strictly *harms* itself. For the selfish agent, such an altruistic utility allocation is far from Pareto efficient while for the altruist, this may be Pareto efficient. To avoid this type of confusion, we introduce the concept of *altruist efficiency* as Pareto efficiency for altruistic agents. This is to be distinguished from Pareto efficiency for selfish agents. Adopting Cornwall's(1984) definition of *Pareto efficiency* as " what is not wasted is the happiness of any individual given the happiness of everyone else", we could define *altruist efficiency* as " what is not wasted is

6. Altruism and economic efficiency do not contradict each other. Altruistic transfer is, after all, made to increase utility or payoff and no altruistic agent gains from any waste of resources.

the happy sacrifice of any altruist given the benefits of everyone else ".

Now we present a formal model of an intergenerational transfer game. For the sake of analytical clarity, a one-shot game is presented first and it is, then, extended to a repeated game.

III.2. The Model (I) : A One-shot Game

The Rule :

(1) There are two (i-th and i+1-th) generations as players in this game. Each generation has perfect foresight over a lifetime for non-strategic (i.e., state) variables such as income and population. Such state variables are treated as given. Each player also has full information about the extensive form of the game (the assumption of a complete information game).

(2) The parents are altruists who are concerned not only with their own well-being but also with that of their children's. They follow the altruist efficiency condition. The children play a rather passive role and their payoff function is seemingly selfish (i.e., bequests from the parents)(footnote 7).

7. However note that by the construction of the game, selfish children become altruistic parents in the next period. Therefore as their lifetime strategy, children will behave as if they are altruists even though the children's

(3) The i-th generation (parents) optimises total consumption levels of the i-th and i+1-th generations, which are derived from each generation's lifetime utility optimisation. The i-th generation can manipulate its payoff (i.e., total consumption) by changing its degree of altruism (i.e., an intergenerational weight β^{i}) which is the i-th generation's strategic (i.e., control) variable.

(4) The i+1-th generation (children) receives a payoff of bequests from the i-th generation as an exchange of the i+1-th generation's reaction against the i-th generation's strategy. The i+1-th generation's strategic variable is again its degree of altruism toward the i+2-th generation (i.e., β^{i+1}). By changing β^{i+1} , the i+1-th generation can change its consumption level which in turn changes the i-th generation's payoff value.

(5) Each generation would like to have the maximum payoff value. Each generation's strategy to deviate from the maximum payoff is, therefore, a credible threat to the opposite player (generation)(the assumption of credible threat).

<u>The Payoff Function :</u>

The i-th generation's (parents) aggregate payoff function is defined as follows,

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payoff seems selfish. This is the key aspect of reciprocal altruism.

$$V^i = h^i(c_{t-1}{}^i + c_t{}^i) + h^{i+1}(c_t{}^{i+1} + c_{t+1}{}^{i+1}) \quad (17)$$

where the notation is the same as in section II.

As each generation decides on its consumption level by solving for lifetime utility optimisation, the optimal consumption values for each generation as in (11) and (12) are used here.

$$\begin{aligned} V_t{}^i &= h^i({}^*c_{t-1}{}^i + {}^*c_t{}^i) + h^{i+1}({}^*c_t{}^{i+1} + {}^*c_{t+1}{}^{i+1}) \\ &= [(rA_t{}^i)/\{(A_t{}^i)+\beta^i\}](X^i) \\ &\quad + [(rA_{t+1}{}^{i+1})/\{(A_{t+1}{}^{i+1})+\beta^{i+1}\}](X^{i+1}) \end{aligned} \quad (18)$$

where for convenience, we define,

$$(A_t{}^i) = \alpha_{t-1}{}^i + \alpha_t{}^i > 0 .$$
$$(rA_t{}^i) = \alpha_{t-1}{}^i + (1+r_{t-1})\,\alpha_t{}^i > 0 .$$
$$(X^i) = Y_{t-1}{}^i + BQ_{t-1}{}^{i-1} > 0 .$$

The i+1-th generation's aggregate payoff function is simply the bequest from the i-th generation. Again the optimal bequest value is used, such that,

$$BQ_t{}^i = h^i{}^*b_t{}^i = [\{(1+r_{t-1})\beta^i\}/\{(A_t{}^i)+\beta^i\}](X^i) \quad (19)$$

Both payoff functions are continuous and differentiable with respect to the strategic variables (β).

<u>The Game :</u>

As defined in the rules, each generation has strategic variables β^i and β^{i+1} respectively. We have a simple one-shot noncooperative smooth game $G = G(\{\beta^i,\beta^{i+1}\},\{V_t{}^i,\ BQ_t{}^i\},$ $n = i$ and $i+1)$ at t.

By substituting the i+1-th generation's payoff value into the i-th generation's payoff function, we obtain the i-th generation's reaction function against the action of i+1-th generation (footnote 8). An optimal reaction implies a Nash equilibrium solution. Substituting (19) into (X^{i+1}) in (18),

$$V_t^i(\beta^i,\beta^{i+1}) = [(rA_t^i)/\{(A_t^i)+\beta^i\}](X^i) + (K^{i+1})Y_t^{i+1} + (K^{i+1})[\{(1+r_{t-1})\beta^i\}/\{(A_t^i)+\beta^i\}](X^i) \quad (20)$$

where for convenience, we define,

$$(K^{i+1}) = (rA_{t+1}^{i+1})/\{(A_{t+1}^{i+1}) + \beta^{i+1}\}.$$

By the definition of payoff functions, the reaction function (20) is differentiable. The optimal reaction can be examined by working out first and second order conditions.

First order condition;

$$\delta V_t^i/\delta\beta^i = (M^i)(X^i)\{(A_t^i)+\beta^i\}^{-2} \quad (21)$$

where for convenience, we further define,

$$(M^i) = -(rA_t^i) + (K^{i+1})(1+r_{t-1})(A_t^i) .$$

Second order condition;

$$\delta^2 V_t^i/\delta\beta^{i2} = (-2)(M^i)(X^i)\{(A_t^i)+\beta^i\}^{-3} \quad (22)$$

The second order condition has a sign opposite to that of the first order condition, such that,

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8. By the assumptions of the game, the i+1-th generation, being allowed one move only, moves first, then it cannot react against the i-th generation's move. There is no reaction function for the i+1-th generation in this one-shot game.

$$\delta V_t^i/\delta\beta^i \gtreqless 0 \iff (M^i) \gtreqless 0 \iff \delta^2 V_t^i/\delta\beta^{i2} \lesseqgtr 0 \quad (23)$$

By the assumption of altruist efficiency, we do not consider the situation in which the payoff value decreases as bequest transfer increases (i.e., $\delta V_t^i/\delta\beta^i < 0$)(footnote 9). Thus the following restriction is given,

$$\delta V_t^i/\delta\beta^i \geq 0 \iff \{(A_{t+1}^{i+1}) + \beta^{i+1}\} \leq \{(rA_{t+1}^{i+1})(1+r_{t-1})(A_t^i)\}/(rA_t^i) \quad (24)$$

This condition is intuitively reasonable for the i+1-th generation as well. β^{i+1} is maximised at the equality in (24) such that,

$$^*\beta^{i+1} = \{(rA_{t+1}^{i+1})(1+r_{t-1})(A_t^i)\}/(rA_t^i) - (A_{t+1}^{i+1}) \quad (25)$$

If the steady-state economy is assumed, then $(A_t^i)=(A)$ and $(rA_t^i)=(rA)$ for all i and t. (25) is simplified as,

$$^*\beta = (A)r \, . \quad (26)$$

The intergenerational weight is equal to the preference parameter weighted real interest rate, i.e.,$(A)r$. This result is different from the operative bequest condition in Weil (1987) and Abel (1987a) [i.e., their condition is, in our term, $(1+r)^*\beta = 1 + n$, where n = population growth rate].

9.However, as we see in Figure 3-1, the optimal equilibrium is achieved at the same point even in case of $\delta V_t^i/\delta\beta^i < 0$ when $(M^i) < 0$.

It appears that the i-th generation's efficiency condition requires the i+1-th generation to follow the condition ; $\beta^{i+1} \leq {}^*\beta^{i+1}$. Inserting ${}^*\beta^{i+1}$ into V^i, we have

$$V^i(\beta^i, {}^*\beta^{i+1}) = \{(rA_t{}^i)/(A_t{}^i)\}\{(X^i)+Y_t{}^{i+1}/(1+r_{t-1})\}. \quad (27)$$

As is clear from (27), the extreme value of $V^i(\beta^i, {}^*\beta^{i+1})$ does not depend on β^i any more. But if we take a close look, β^i and β^{i+1} are positively related (footnote 10).

To be more precise, let us define $\delta V^i/\delta\beta^i = g(\beta^i, \beta^{i+1})$. Using the relation (21) and (24), given the value of β^{i+1}, say, $\underline{\beta}^{i+1}$, the value of g is uniquely determined. This is so because, by the definition of partial derivative, the value of β^i is *a priori* given (say, $\underline{\beta}^i$) (footnote 11). An increase (decrease) in β^{i+1} would decrease (increase) g(..) which, in turn, implies an increase (decrease) in β^i. Therefore there is a positive one-to-one correspondence between β^i and β^{i+1}. When β^i and β^{i+1} have a positive one-to-one correspondence, the maximum value of ${}^*\beta^{i+1}$ must correspond to the maximum value of β^i (i.e. ${}^*\beta^i$). Formally,

$$\lim_{\beta^{i+1} \to {}^*\beta^{i+1}} \beta^i = {}^*\beta^i. \quad (28)$$

From (24), we have the following relation,

---

10. The maximum value of ${}^*\beta^i$ is determined analogously to the ${}^*\beta^{i+1}$ case, i.e. ${}^*\beta^i$ is derived in connection with i-1-th generation. Certainly $\beta^i \leq {}^*\beta^i$.

11. A partial derivative of V^i with respect to β^i measures the instantaneous rate of change of V^i with respect to changes in β^i abound $\underline{\beta}^i$, i.e. $\underline{\beta}^i + \delta\,\beta^i$.

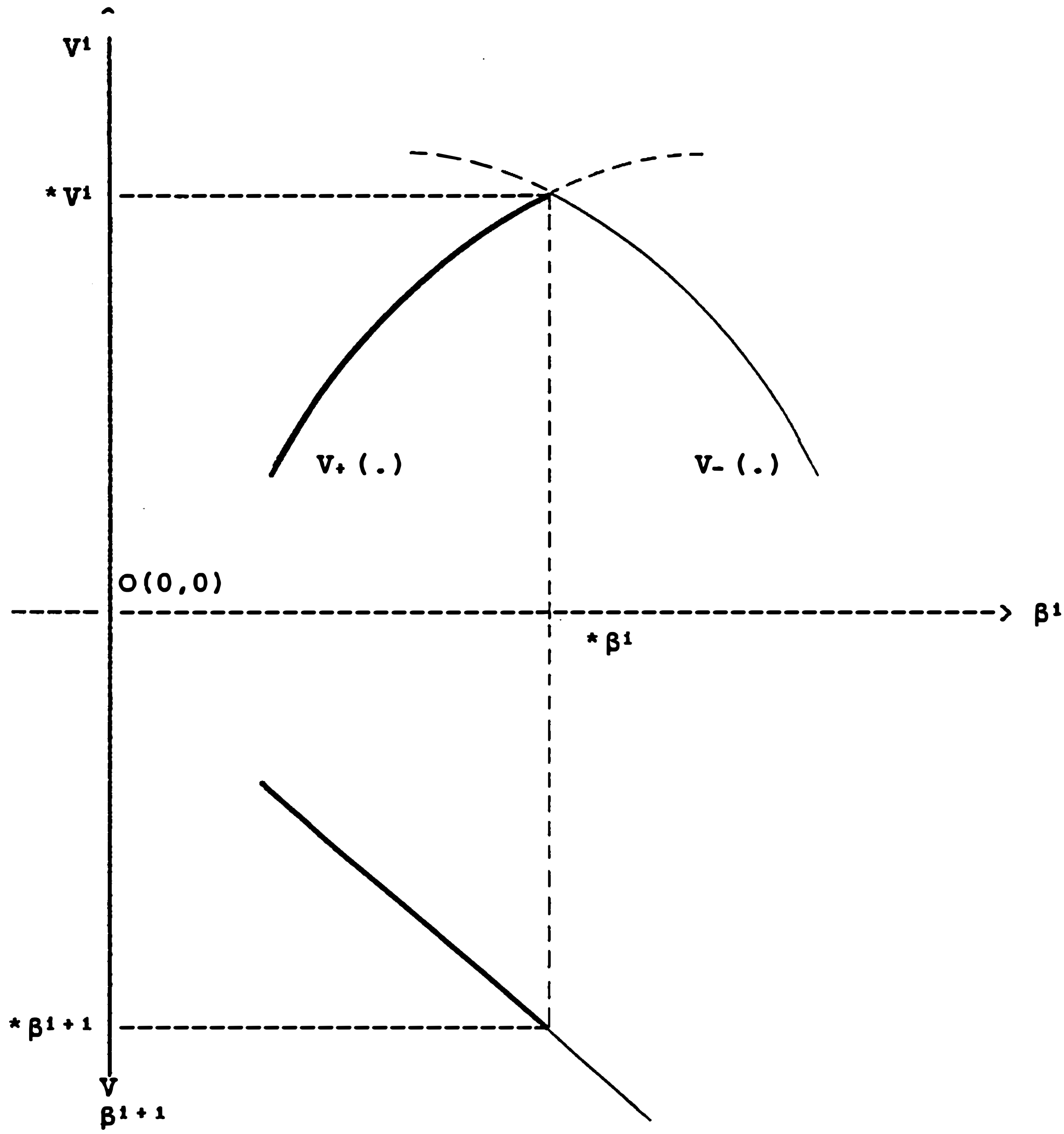
$$\lim_{\beta^{i+1} \to {}^*\beta^{i+1}} \delta V^i / \delta\beta^i = 0. \qquad (29)$$

Put the two limits (28) and (29) together, it is now known that at the limit $\delta V^i/\delta\beta^i = 0$, β^i reaches $^*\beta^i$. The value of V^i would be,

$$\lim_{\beta^{i+1} \to {}^*\beta^{i+1}} V^i(\beta^i, \beta^{i+1}) = {}^*V^i({}^*\beta^i, {}^*\beta^{i+1}). \qquad (30)$$

An implication of (30) is that, given the maximum value of $^*\beta^{i+1}$, the i-th generation's payoff is optimised at $^*V^i$ in which case the value of β^i would also be the maximum (i.e., $^*\beta^i$) (a Nash equilibrium). The graph of V^i is given in Figure 3-1.

FIGURE 3-1 THE PAYOFF SCHEDULE



Note : The heavy lines represent feasible frontiers. The payoff function is defined separately as $V_+(.)$ on $(0, {}^*\beta^i)$ and $V_-(.)$ on $({}^*\beta^i, \infty)$, depending on the i+1-th generation's strategy. The payoff schedule is concave and achieves the maximum $^*V$ at $^*\beta^i$.

In this one-shot game, is it possible for the i+1-th generation to cheat the i-th generation by pretending $^{*}\beta^{i+1}$ to get the maximum bequest $BQ_t^{i}(^{*}\beta^{i})$ while in fact giving lower bequests to the i+2-th generation ? We eliminate this possibility for two reasons. First, the i-th generation can observe the i+1-th generation's consumption level at time t as a signal of their true degree of altruism ($\underline{\beta}^{i+1}$). Since actual bequest transfer has taken place in the i-th generation's retirement period, the i-th generation could punish the i+1-th generation (by the assumption of complete information). Secondly, the i+1-th generation will eventually become altruistic. By reducing bequests to the i+2-th generation, its payoff value for the game with the i+2-th generation would be suboptimal which is undesirable for the i+1-th generation as parents (by the assumption of altruist efficiency). This type of reasoning is highly relevant to a repeated game. So cheating is impossible on informational as well as strategic grounds. A reduction in β^{i+1} would inevitably reduce the i-th generation's payoff value. The i-th generation threatens the i+1-th generation by reducing its bequests. Since this threat is credible, the two generations reach a Nash equilibrium.

Some implications of the above results are discussed below.

First, the two generations' bequest behaviour is reciprocal in a sense that the i+1-th generation's degree of altruism determines the payoff value of the i-th generation, and the i-th generation's degree of altruism determines the value of bequests to the i+1-th generation. Reciprocal altruistic equilibrium is guaranteed when $*\beta^{i+1}$ gives the optimal value $*V^{i}$ to the i-th generation and $*\beta^{i}$ gives the highest bequest to the i+1-th generation.

Secondly, reciprocal altruism can be found more clearly in a repeated game situation. Over a lifetime, each generation plays the game twice ; once as children and once as parents. The critical point to note is that the two games use *the same strategic variable*. Even if the i+1-th generation, participating in the game as children, succeeds in cheating their parents (the i-th generation) in relation to the maximum bequests, it cannot cheat their children (the i+2-th generation) who *actually* receive lower bequests. The i+2-th generation punishes the i+1-th generation by reducing its degree of altruism which, in turn, reduces the payoff of the i+1-th generation. Lessons from this story are: (1) no generation can cheat both its parents and its children and (2) the best strategy is to be honest and to follow the maximum degree of altruism ($*\beta$). In other words, when a generation receives the maximum bequest from its parents, it must leave the maximum bequest to its children. Reciprocal altruism is established (footnote 12).

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12. This result is similar to the view taken by Axelrod (1984). To evolve cooperation or to avoid a repeated Prisoner's Dilemma situation, Axelrod makes four suggestions

Thirdly, we shall not ignore the fact that reciprocal altruistic equilibrium is state-contingent. Both the maximum degree of altruism and the maximum payoff value depend on state variables such as income, real interest rates, and preference parameters [In the steady-state economy, from (26), the optimal intergenerational weight is equal to the preference parameter weighted real interest rate, i.e., $^*\beta$ = (A)r]. Note also that a Nash equilibrium strategy is determined without any concern for the government's interaction. This equilibrium strategy, therefore, should be understood as one without the Ricardian equivalence transfer motive.

III.3 The Model (II) : A Repeated Game

As discussed above, each generation plays two roles in its lifetime as beneficiary and benefactor of bequests. A rational generation would consider its optimal strategy over a lifetime. In doing so, it is necessary to analyse the problem in the framework of a repeated game.

; (1) don't be envious, (2) don't be the first to defect, (3) reciprocate both cooperation and defection and (4) don't be too clever. And as a practical strategy, he insists on a tit-for-tat strategy which satisfies his four requirements. Our result indicates that the best strategy is to conduct reciprocal altruism which is a version of tit-for-tat.

<u>The Rule :</u>

(1) It is sufficient for our purposes to consider a two-shot complete information game without discounting and this two-shot game is repeated infinitely (footnote 13).

(2) The basic game structure is the same as in the one-shot game of the model (I), but the player's position switches in the first and second games.

(3) The player i+1 is not actually committed to β_t^{i+1} until time t occurs. Even if a strategy $\{\beta_t^{i+1}\}$ is decided at the beginning of the game, the player retains the right at any time t to alter it. *A closed loop strategy* is thus allowed.

<u>The Payoff Function :</u>

The payoff function for each iteration is assumed to be the same as before. The i+1-th generation's lifetime payoff function is given as the sum of payoff of bequests from the i-th generation in, say, the t-th game and the payoff of total consumption level of the i+1-th and i+2-th generations in t+1-th game. The two payoff values are summed without discounting.

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13. In a finite economy, as Kurz (1977, proposition 2) proves, no meaningful altruistic equilibrium would exist. It may not be sensible to consider the "last" generation because, in such a case, household behaviour itself would change ; most of all, in such a pessimistic world, parents would not give birth to children who would extinguish in the future. In practice, we are in the middle of a historical stream which is assumed to continue forever.

$$\begin{aligned} TV^{i+1} &= BQ_t^{i} + V_{t+1}^{i+1} \\ &= [\{(1+r_{t-1})\beta^{i}\}/\{(A_t^{i})+\beta^{i}\}](X^{i}) \\ &+ [(rA_{t+1}^{i+1})/\{(A_{t+1}^{i+1})+\beta^{i+1}\}](X^{i+1}) \\ &+ [(rA_{t+2}^{i+2})/\{(A_{t+2}^{i+2})+\beta^{i+2}\}](X^{i+2}) \end{aligned} \quad (31)$$

Other generations, such as the i-th and i+2-th generations, have their own lifetime payoff functions in the same manner as (31).

<u>The Game :</u>

Let us denote the i+1-th generation's strategy in the t-th game as β_t^{i+1} and in the t+1-th game as β_{t+1}^{i+1}. This corresponds with strategies β_t^{i} and β_{t+1}^{i+2} for the opposite player. β_t^{i+1} and β_{t+1}^{i+1} may or may not coincide, depending on how the closed loop strategy alters the original strategy by backward induction. In general, a sequence of strategies is given as $\{\beta_t^{i+1}, \beta_{t+1}^{i+1}\}$. A two-shot repeated game for the i+1-th generation is defined as $\Gamma = \Gamma(\{\beta_p^k\}, \{TV^k\}, k = i,i+1,i+2, p = t,t+1)$, where p denotes the t-th or t+1-th game for each player. This game involves three generations and, for simplicity, it is assumed that the i-th generation and the i+2-th generation behave the same way as the i+1-th generation does and that their respective relations with the i-1-th and the i+3-th generations are optimally solved (i.e., terminal conditions are given).

Although the lifetime payoff function is given as in (31), it is not optimised at once. We will show that the optimal solution for this two-shot game is given by backward induction, which is, in a sense, similar to that of Bellman's optimality principle.

Let us consider the t+1-th game for the i+1-th generation, the payoff function is given,

$$V_{t+1}^{i+1} = [(rA_{t+1}^{i+1})/\{(A_{t+1}^{i+1})+\beta^{i+1}\}](X^{i+1}) + [(rA_{t+2}^{i+2})/\{(A_{t+2}^{i+2})+\beta^{i+2}\}](X^{i+2}) \quad (32)$$

As before, the i+2-th generation's payoff BQ_{t+1}^{i+1} is given as the i+1-th generation's reaction against the i+2-th generation's action. The i+1-th generation's reaction function is, thus,

$$V_{t+1}^{i+1} = [(rA_{t+1}^{i+1})/\{(A_{t+1}^{i+1}) + \beta^{i+1}\}](X^{i+1}) + (K^{i+2}\ )Y_{t+1}^{i+2} + (K^{i+2})[\{(1+r_t)\beta^{i+1}\}/\{(A_{t+1}^{i+1}) + \beta^{i+1}\}](X^{i+1}) \quad (33)$$

First and second order conditions give the same result as in the first game of the model (I). The maximal value of $^*V^{i+1}$ is achieved when β^{i+1} and β^{i+2} reach $^*\beta^{i+1}$ and $^*\beta^{i+2}$ respectively.

$$\lim_{\beta^{i+2}\to{}^*\beta^{i+2}} V^{i+1}(\beta_{t+1}^{i+1}, \beta_{t+1}^{i+2}) = {}^*V^{i+1}({}^*\beta^{i+1}, {}^*\beta^{i+2}) \quad (34)$$

Combining the result of the t-th game for the i+1-th generation which has already been analysed in the model (I), a sequence of optimal strategy is given, such that,

$$\lim_{\beta^{i+2}\to{}^*\beta^{i+2}} \beta_{t+1}^{i+1} = {}^*\beta_{t+1}^{i+1} \quad \text{and} \quad \lim_{\beta^{i+1}\to{}^*\beta^{i+1}} \beta_t^{i} = {}^*\beta_t^{i} \quad (35)$$

With the set of Nash equilibrium strategy, i.e., $({}^*\beta_{t+1}^{i+1}, {}^*\beta_{t+1}^{i+2})$ and $({}^*\beta_t^{i}, {}^*\beta_t^{i+1})$, both players gain the maximum payoff values, i.e., $({}^*V_{t+1}^{i+1}, {}^*BQ_{t+1}^{i+1})$ and

($*V_t^i$, $*BQ_t^i$) respectively. It is clear that, by backward induction, as long as the i+2-th generation takes the optimal strategy $*\beta^{i+2}$ (footnote 14), the i+1-th and i-th generations would choose their optimal strategies, $*\beta^{i+1}$ and $*\beta^{i}$. Furthermore, the i+1-th generation's optimal strategies in the t-th and t+1-th games coincide, i.e., $*\beta_{t+1}{}^{i+1}$ = $*\beta_t{}^{i+1}$ = $*\beta^{i+1}$, which is given in (25). By further induction through overlapping generations in the infinite economy, we have a sequence of optimal strategies $\{*\beta^k\}$ for all generations (k = 0,1,2,...∞).

Reciprocal Altruistic Equilibrium :

To optimise its life-time payoff function TV^{i+1} as in (31), the i+1-th generation's best strategy is to take $*\beta^{i+1}$ in both the t-th and t+1-th games. For such a strategy, the i-th or i+2-th generation does not need to threaten the i+1-th generation to choose $*\beta^{i+1}$. The i+1-th generation *voluntarily* chooses the optimal strategy.

Why is it possible to reach a Nash equilibrium without *explicit* punishment or a trigger strategy ? This is basically because each generation, shifting its positions over a lifetime, experiences reciprocal situations (i.e.,as

14. By the assumption that the two-shot game is repeated infinitely, every future generation would choose $*\beta^k$ for all k .

children and parents) with only one strategic variable (footnote 15).

By the nature of construction of the model, children (i.e., the i+1-th generation beneficiary) are selfish in a sense that their payoff function does not take account of other generation's well-being. In the first (t-th) game, children do not leave bequests in practice. Furthermore, their payoff (i.e., bequests from parents) is maximised at $*\beta^{i+1}$. As long as the children are concerned only with their payoff value, they would naturally choose $*\beta^{i+1}$. In the next period, the i+1-th generation become the parents (benefactor) and their payoff function includes children's (the i+2-th generation) well-being. The parents as altruists gain the maximum payoff in exchange for leaving the highest bequests, given the fact that i+2-th generation children would voluntarily choose

15. Badcock (1986), in his sociobiological study, defines reciprocal altruism as " one organism performs a service or makes a sacrifice for another organism which then reciprocates in some way so that the sacrifice of the provider is balanced by a corresponding service or sacrifice by the recipient " (p.37). The reciprocal altruism is contrasted with the kin altruism of pure sacrifice without compensation. Trivers (1981) point out that " the strongest argument for the operation of reciprocal altruistic selection in humans is the psychological system controlling some forms of human altruism " (p.11). As this reciprocal altruism system inherently involves cheating or free-rider problems, some psychological system would be needed to regulate both altruistic and cheating tendencies and its responses to these tendencies in others. The confucian tradition in East Asian countries could be understood in this respect. See also Becker (1986) and Taylor (1987).

$^{*}\beta^{i+2}$ as i+1-th generation children did in the previous period.

These results are based on two concepts; (1) payoff-value optimisation and (2) altruistic efficiency. To put it differently, altruistic parents' payoff value depends on children's strategy and selfish children choose the optimal strategy in exchange for the highest payoff from altruistic parents. So the parents and the children reach a Nash equilibrium in which payoff-value optimisation and altruistic efficiency are achieved simultaneously. The children in the first game play the parents' role in the second game and their children, in turn, come into the game. If the children in the first game deviate from their optimal strategy, they would not only receive a lower bequest from their parents but also receive a lower payoff value by their own children's reaction when they become parents in the next game. With two *potential punishments*, rational children would never choose any other strategy than the optimal one, $^{*}\beta$. In other words, since there is no incentive to deviate from the optimal strategy, no punishment nor trigger strategy would be used *in practice*. This mechanism is similar to the relationship between Pareto efficiency and utility optimisation in a selfish economy (footnote 16).

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16. With perfect competition in a selfish economy, a waste of resources as potential punishment could be avoided by taking a Pareto improving move.

Consistent Bequest Planning :

By now, it is evident that our result is a special case of the Goldman-Harris general theorem of consistent plans. Following Peleg and Yaari's(1973) approach, Goldman (1980) considers that a Strotz-Pollak solution to the consistent planning problem (footnote 17) is equivalent to a subgame-perfect equilibrium in general strategies dependent upon the entire past history (i.e., perfect information game). He shows the existence of a subgame-perfect equilibrium in general strategies with a finite time horizon. Harris (1985) extends Goldman's existence result to the infinite time-horizon case.

By the assumption of a complete information game, the players know in advance precisely how payoff functions change over time. In our two-shot game, each generation changes its payoff function from the children's period (i.e.,the first game) to the parent's period (i.e.,the second game). This shift can be seen as a taste-change in

17. See Strotz (1956) and Pollak (1968). They consider how the agent's optimal strategy of intertemporal consumption plan can be described when the agent's preferences do change over time. According to Strotz (1956), the strategy of consistent planning is to choose " the best plan among those he will actually follow "(*op.cit.,* p.173.). By saying that, Strotz and Pollak, in fact, suggest that the optimal planning (strategy) can be determined by means of a backwards induction of dynamic programming method. Since Peleg and Yaari (1973), it has been recognised that a Strotz-Pollak equilibrium is closely related with the concept of Nash equilibrium.

general. With such a taste-change, the only consistent bequest plan is given by a subgame-perfect Nash equilibrium. In an infinite economy, we have a sequence of perfect Nash equilibrium since no generation has an incentive to deviate from its equilibrium strategy.

Ricardian Equivalence Transfer :

Since the seminal work of Barro (1974), it has been widely recognised that, if there is a sufficiently large bequest transfer, the Ricardian equivalence proposition would hold in relation to intergenerational altruism. Our optimal strategy of bequest transfer (i.e., the optimal degree of reciprocal altruism) is determined independently of government fiscal policy in a repeated game. This optimal bequest transfer does not include the Ricardian equivalence transfer motive.

Recent literature on this topic reveals some confusion about the relationship between bequest transfer and Ricardian transfer. Weil (1987) and Feldstein (1988), for example, seem to take for granted that bequests always include the Ricardian equivalent transfer motive. Bequest transfers, in our view, are motivated by several factors, among others ; the joy-of-giving factor, altruistic motive, accidental factor, and the Ricardian equivalent transfer motive. Our model is concerned only with the joy-of-giving and altruistic motives and ignores others. Bequest transfer is made without any Ricardian transfer motive in this model.

To incorporate the Ricardian transfer with our model, it is necessary to define a new degree of altruism such that,

$$*\beta^{i\prime} = *\beta^{i} + d\beta^{i} \qquad (36)$$

where $*\beta^{i}$ = i-th generation's optimal degree of altruism without the Ricardian motive.
$d\beta^{i}$ = additional value for Ricardian equivalence transfer motive, $d\beta^{i} \geq 0$.

Whether the Ricardian equivalence proposition holds depends on whether $*\beta^{i\prime}$ is chosen as a Nash equilibrium strategy in a game between the household and the government. For such a fiscal policy game, it is necessary to specify the objective (payoff) function of the government, in addition to that of the household. This type of fiscal policy game is analysed in chapter 7. However, the Ricardian equivalence proposition is fundamentally to be tested on empirical grounds. Full empirical investigations will be conducted in chapter 6.

IV. Conclusion

This chapter provides the theoretical foundations of saving and bequest behaviour. The model is based on life-cycle saving with bequest motive in an overlapping generations economy. The model is successful in providing some important theoretical as well as empirical insights.

First, by introducing the concept of social accounting for a heterogeneous economy, our model can combine consumer behaviour of young and old generations into aggregate consumption. When considering bequest behaviour, it is quite important to consider both beneficiaries and benefactors of bequests. This model is able to do that.

Secondly, the model can distinguish strictly between life-cycle motivated savings (wealth) and bequest motivated savings (wealth). It is useful for empirically investigating the ratio of bequest wealth to total household wealth. In fact, this framework will be used in chapter 4.

Thirdly, as an extension to the basic model, an intergenerational game can determine an intergenerational weight or a degree of reciprocal altruism endogenously. The key insight from this game is that, if each generation is in the reciprocal situation, then an equilibrium is reached between selfishness and excess altruism (i.e., reciprocal altruistic equilibrium). The optimal strategy is to be honest and to follow the maximum degree of reciprocal altruism. In other words, when a generation receives the maximum bequests from their parents, it must leave the maximum bequests to their children. By the reciprocal nature of the exercise, this strategy is stable. And by repetition of this game, all generations follow the optimal strategy of maximum bequests. This theoretical result is consistent with the observed stable bequest behaviour of significant magnitude in Japan.

Fourthly, the optimal degree of reciprocal altruism turns out to be a positive function of the previous period's real interest rate or rate of returns in assets holdings. During the high economic growth period in the 1950s and 1960s, Japan had very high rates of returns in real estate holdings (4 percent per annum). Bequest transfers in the post growth period in the 1980s onward are, as a result, expected to be significant. Chapter 4 will provide empirical backing for this claim.

Fifthly, altruistic bequest transfers do not necessarily imply Ricardian equivalence transfers. The optimal degree of reciprocal altruism is determined purely by intergenerational considerations. Fiscal policy effects are not incorporated in the game. Part III (chapters 6 and 7) will analyse fiscal policy effects on household saving and bequest behaviour.

CHAPTER 4

MEASURING THE RATIO OF BEQUEST TO TOTAL WEALTH : THE IMPORTANCE OF BEQUESTS IN SAVING MODEL (I)

I. Introduction

In his Nobel Lecture (1985), Modigliani defended his life-cycle hypothesis against the recent attack from the intergenerational transfer hypothesis of saving. He argued,

> " It should be apparent, in fact, that if one could conclude that it (the pure bequest motive) accounts for a very large fraction of total wealth, then the LCH and hump saving would lose considerable interest as an explanation of private accumulation. Unfortunately, at present, we know very little on this score, and it is not even clear that we will even be able to acquire reliable knowledge."(p.21)
>
> " Considering that the overall share of inherited wealth can be placed below 1/5, we seem safe in concluding that the overwhelming proportion of wealth existing at a given time is the result of life cycle accumulation, including in it a portion reflecting the bequest arising from the precautionary motive." (p.22)
>
> (Modigliani (1987))

More recently, Modigliani (1988a,b) critically examined a paper by Kotlikoff and Summers (1981) entitled " The Role of Intergenerational Transfers in Aggregate Capital Accumulation." and showed how their estimates could be corrected in Modigliani's favour.

In Kotlikoff and Summers's reply (1988) to Modigliani, they write, " Modigliani's attacks seem to us incorrect in most cases and generally fail to address our primary method of determining the importance of intergenerational transfers "(p.53). They also argue that, " additional research investigating the nature of saving preferences rather than additional wealth accounting holds the key to understanding the very important role of intergenerational transfers as well as the contribution of pure life cycle saving motives to US wealth accumulation " (p.65).

Blinder (1988) as an arbitrator identifies the four focal points of the debate : (1) the method of calculation of intergenerational transfers ; (2) the definition of intergenerational transfers ; (3) the problem of the accumulated interest on inherited wealth ; and (4) the treatment of durables. He clarifies the true nature of the debate while not committing himself to either side.

This on-going controversy stimulated our interest in the nature of bequest transfers in Japan. We have investigated the question of whether bequests or intergenerational transfers accounted for a high proportion of total wealth holdings in Japan and the implications of bequest transfers.

This chapter contributes to the Kotlikoff-Summers-Modigliani controversy and provides new evidence from the Japanese data. The chapter is organised as follows.

Section II discusses the theoretical framework and the relationship between life-cycle and bequest models. The most important point to note here is that life-cycle wealth and bequest wealth needs to be strictly distinguished if bequest is taken as an important factor in capital formation.

In section III, a new method of estimating bequest wealth is proposed, and the ratio of bequest wealth to total wealth holdings is calculated. The Tax Bureau data of bequests are known to be substantial underestimates of the true value of bequests on two grounds: (1) low current bequest base (excluding a lot of tax exempt bequests and disclosed transfers); and (2) non-inclusion of future bequests. Our method of compensating for such problems is quite simple and less arbitrary than the procedure used by Kotlikoff and Summers.

Section IV discusses one of the most important recent issues in Japan, i.e., housing and real estate prices. On the assumption that real estate bequest transfers will rapidly increase in the future, some implications of bequests for the housing and real estate market mechanism are considered.

Brief conclusions are given in section V.

II. Measurement Problems in Bequest Wealth

II.1. The Bequest Model of Saving

We shall argue that saving behaviour is a fundamentally dynamic (intertemporal) activity which spans a lifetime. In this respect, the life-cycle hypothesis of saving captures the essence of saving behaviour. We basically agree with this hypothesis if two modifications are introduced. First, unlike what Modigliani calls, " elementary life-cycle hypothesis " [Modigliani (1986), p.127], intergenerational transfers (mainly by bequests) are taken as an important element of saving behaviour. Secondly, as shown by the life-cycle hypothesis, working (young) and retired (old) generations have different propensities to consume, thus to save. Nevertheless, the macroeconomic life-cycle model assumes that a single agent optimises his/her lifetime consumption-saving behaviour as if he/she represented society as a whole. In our view the economy is composed of both young and old generations and therefore a model in which these two generations coexist is preferred. In particular, it is important to identify the savers in the economy and their motivations for savings.

In order to incorporate the above mentioned points within the framework of a life-cycle hypothesis, the overlapping generations model with bequests motive (we call this the bequest model of saving; BQ model for short) has been considered in chapter 3. The behavioural assumptions of the bequest model are as follows:

(1) There are two generations; working (young) and retired (old). In the working period, the young generation receive bequests from their parents and save for consumption in the retirement period and for bequests to their own children. In the retired period, the old generation live on their own savings from the working period and bequeath to the next generation.

(2) Bequests are announced or actually given (as gifts) with certainty at the beginning of the children's working period so that the young generation can optimise their lifetime consumption-saving behaviour.

Making the above assumptions, the household utility optimisation problem is solved and yields the aggregate financial saving function [chapter 3, eq.(15')] such that,

$$F_t = a_1 L_t + a_2 Y_t + b_1 BQF_t + b_2 BQL_t + v_t \qquad (1)$$

where F_t = financial assets stock at t,
L_t = real estate holdings at t,
Y_t = disposable income at t,
BQF_t = financial bequest transfers at t,
BQL_t = real estate bequest transfers at t,
v_t = a white noise error.

The differences between the BQ model and the life-cycle model (LC model for short) lie in the following.

(1) In the LC model, the current generation does not receive bequests from their parents (no inheritance). In eq.(1), the

LC model must have sign conditions $b_1 = b_2 = 0$. The BQ model assumes $b_1 = b_2 > 0$.

(2) In the LC model, the current generation does not bequeath to the next generation. In eq.(1), all savings in the form of financial assets (i.e., F_t) and real estate holdings (i.e., L_t) are made purely for smoothing life-cycle consumption. The BQ model, on the other hand, assumes that savings (i.e., total wealth = $W_t = F_t + L_t$) are made for consumption in the retirement period and for bequests to the next generation.

(3) In the LC model, from (1) and (2), total wealth (W) is considered to be life-cycle savings. In the BQ model, total wealth (W) must be divided into life-cycle motivated savings (called life-cycle wealth; LCW for short) and bequest motivated savings (called bequest wealth; BQW for short).

Kotlikoff and Summers (1981) were concerned with the accounting issue of dividing W into BQW and LCW. In chapter 3, section II.2., we have discussed the concept of social accounting in the overlapping generations model with bequests.

II.2. Social Accounting with Bequest Wealth

In order to make a clear distinction between the life-cycle (LC) model and the bequest (BQ) model, life-cycle wealth (LCW) must be measured separately from bequest wealth (BQW), which is accumulated for purposes of intergenerational transfers. Chapter 3 provided the following identity [chapter 3, eq.(4)].

$$W_t = L_t + F_t = BQ_t + NBQ_t \tag{2}$$

where $BQ_t = BQL_t + BQF_t$.
NBW_t = non-bequest wealth held by the working generation at t.

This accounting method corresponds to the one used by Kotlikoff and Summers (1981). In this method, bequest wealth is counted as accumulated past bequest transfers. Life-cycle wealth is defined as non bequest-related wealth accumulation in the period.

Chapter 3 offered an alternative accounting method which was based on the forward-looking saving model. The aggregate budget at t (Z_t) is given as,

$$Z_t = C_t + S_t = C_t + W_t \tag{3}$$

where C_t = aggregate consumption.
S_t = aggregate saving.

By the assumption of the BQ model, current aggregate saving is made for consumption in the next period and for bequests to the next generation such that,

$$(1+r_t)S_t^1 = C_{t+1}^1 + BQ_{t+1}^1 \ .$$

As $S_t = W_t$, dropping the i-th generation's identity (i.e., superscript i),

$$W_t = \{1/(1+r_t)\}(C_{t+1} + BQ_{t+1}) = LCW_t + BQW_t \qquad (3')$$

where $LCW_t = \{1/(1+r_t)\}C_{t+1}$.
= discounted future life-cycle consumption.
$BQW_t = \{1/(1+r_t)\}BQ_{t+1}$.
= discounted future bequest wealth.

This concept of bequest wealth accounting is used in the following analysis. This method must be understood to be strictly different from the method used by Kotlikoff and Summers [above eq.(2)].

Although theoretically the LC model does not include bequest wealth, no one would deny the presence of a certain amount of bequest transfers in practice. The Kotlikoff-Summers-Modigliani controversy has been described as a debate on " the law of the 20/80 ". The conventional position is that life-cycle accumulation accounts for roughly 80 percent of existing wealth, whereas the new position puts forward exactly the opposite view : that bequests account for 80 percent of existing wealth. It is important to investigate how much bequest wealth accounts for in total wealth by the accounting method discussed above and to examine whether bequest transfers will increase in the future in Japan.

III. A New Estimation of Bequest Wealth

III.1. The Problem

The practical difference between the life-cycle (LC) and bequest (BQ) models lies in the interpretation of whether or not bequest wealth occupies a significant place in total wealth. To resolve this difference empirically, first, the "true" value of bequest wealth must be estimated. Bequest data are taken from The Tax Bureau Annual Report, 1965-1985(Ministry of Finance)(footnote 1). Annual bequest data were constructed as the sum of inheritance and gifts recorded by the Tax Bureau in a calendar year. The raw data and detailed description of the data sources are given in the data appendix at the end of the thesis. These figures are substantially undervalued. One reason for this is that the majority of small bequests are tax exempt. This fact becomes evident when we consider the percentage of taxable bequest benefactors against the numbers of total deaths in a year. In 1970, this figure was 3.4 percent , in 1975, it

1. This is the only publicly available information on bequests in Japan. First real estate, financial and other bequests (defined as the sum of inheritance and gifts) were calculated and negative bequests (i.e., liabilities and funeral costs) with other bequests (i.e., consisting mainly of life insurance and annuities, durables and household equipments) were netted out. This was done because we consider both negative and other bequests as accidental. The result is a more or less zero balance for such accidental bequests (see the data appendix for raw data at the end of thesis). Therefore, it was decided to consider only real-estate and financial bequests.

equalled 2.1 percent, in 1980, it was 3.7 percent and in 1985, it was 6.4 percent. On average, only about 4 percent left taxable bequests (footnote 2). As the majority of deaths relate to senior citizens (e.g., over 70 percent of annual total deaths occur in the age group above 65 years), it is easy to imagine how the distribution of bequest transfers is skewed towards the wealthy households. However, on aggregation, tax exempt bequests may not be negligible. We shall return to this point later.

Secondly, there are huge uncovered intergenerational transfers through gifts, in kind, or in other indirect forms including support from parents for college education and for expenses of wedding ceremonies. The Tax Bureau cannot detect all these transfers as they are not officially or publicly recorded wealth transfers as in the case of property and financial assets.

Thirdly, there are several legal methods to reduce the burden of bequest taxes. One method is to establish a company and to transfer the ownership of bequeathable wealth to the company. Insofar as the ownership of the company is within a family circle, this can, in practice, be considered as an intergenerational transfer with small inheritance

2. It should be noted that due to the rapid rise in property values, the number of persons leaving taxable bequests is increasing. This is illustrated by the increase in the percentage of taxable bequest benefactors to the total number of deaths per annum.

taxes (say, for the shares of the company). In such a case, the majority of transfers are not recorded as bequests by the Tax Bureau.

Fourthly, in addition to current bequests, future bequests should be included in bequest wealth (BQW). In fact, a huge proportion of real estate and financial assets will undergo intergenerational transfers in the long run (say within twenty-five years).

To sum up, it is necessary to amend the original Tax Bureau bequest figures in two respects;

(1) to increase the current bequest base,

(2) to include expected future bequests.

In practice, there is no recorded information available on these aspects. A simulation method can be used to estimate reasonable levels of "true" bequest wealth. Prior to that, however, we need to discuss the expectations formation model in relation to future bequests.

III.2. The Model of Expectations Formation

The purpose of this section is to estimate a time series of future flow of bequest transfers which will be added up as bequest wealth in the next section. In order to take account of expected bequests, a household has to have a reasonable expectations formation model. The recent development of expectations models provides several models of expectations formation. These can be categorised basically into two types of models;

(1) the structural (theory-based) model; notably, the rational expectations model, in which the agents use all the information available at the time of expectations formation. In this model, the agents form expectations with the aid of their knowledge of economic structure. And

(2) the time series econometric forecasting model in which the agents use only past and current values of the series to predict a future value (i.e., univariate model). This model could be either stochastic or deterministic.

According to Granger and Newbold, the univariate time series forecasting method deserves consideration for a number of reasons:

(1) The method is quick and inexpensive to apply, and may well produce forecasts of sufficient quality for the purposes at hand.

(2) Relevant extraneous information may be unavailable or available only at a prohibitively high cost.

(3) Univariate forecasting procedures can be useful as a yardstick against which the success or otherwise of more elaborate forecasting exercises can be judged [Granger and Newbold (1986), pp. 151-2].

On this issue, we are in agreement with Granger and Newbold.

The purpose of this section is to approximate future flow of bequest transfers. Perfect accuracy is not our objective for this exercise because there are many unknown aspects besides bequest transfers. A rough approximation by a univariate time series forecasting method is satisfactory when the theory (structure) is not known or is in dispute. A time series forecasting model of future bequests is used below.

Time series econometric forecasting :

Given a series of past and current bequests (in real estate and financial assets), it is necessary to decide on the type of time series model that is appropriate. We have adopted the following procedure;

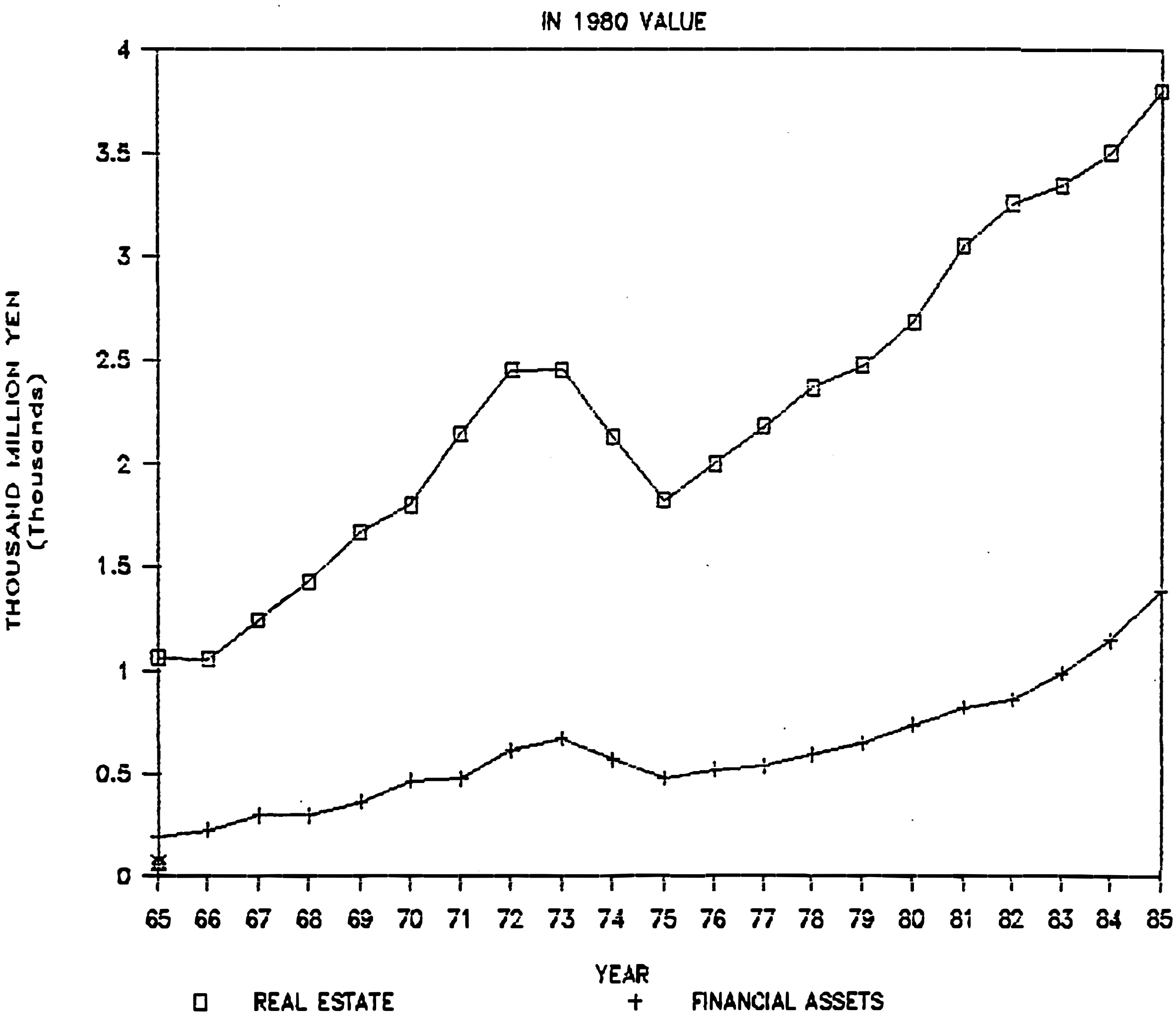
(1) To plot the series and check whether it is stationary or not and whether there is any outlier.

(2) To use a priori knowledge concerning future values of the series, such as the rapid growth in the number of old people and an increase in bequest transfers, to anticipate future trends of the series.

(3) To decide which econometric model shows the best fit to the series and to use this model for forecasting future values of the series.

The Plot : Figure 4-1 shows a plot of bequests in real value. Bequests of both real estate and financial assets are

FIGURE 4-1 : BEQUEST TRANSFER



Source : The Tax Bureau Annual Report 1965-1985.
Note : The nominal values are deflated by consumer price index (1980=1) for financial assets and by land price index (1980=1) of all urban disticts (The Japan Real Estate Institute) for real estate bequest.

non-stationary. The series shifted in 1973/4 because tax exemption limits were increased substantially (footnote 3). This shift is especially obvious in real estate bequests. Apart from the 1973/4 shift, it is difficult to identify any cyclical movement in the series by observing the figure. On taking account of the future increase in the aged population and the trend shown in the figure, it may be safe to say that the future bequests series which follow either an explosive pattern or a random walk with drift.

The Model : According to Granger and Newbold, Cramér showed a generalization of Wold's decomposition theorem. The theorem states that for *any series* X_t, there is a uniquely determined decomposition $X_t = D_t + Y_t$ where D_t and Y_t are uncorrelated and D_t is deterministic and Y_t is purely nondeterministic (footnote 4).

Prior to decomposing the series, however, let us examine an AR(2) model. The current value of the process is expressed as a finite, linear aggregate of previous of the series and an error term such that,

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3. The tax rates of inheritance and gifts are not adjusted often, but exemptions have been increased frequently (e.g., in 1966,1971 and 1973). As Figure 4-1 shows, the 1973 change seems to have had the biggest effect on bequest tax revenue among recent changes.

4. See Granger and Newbold (1986), pp 37-41 and also see Whittle (1983), pp. 23-26 and pp. 83-97. For an application to macroeconomic time series data, see Beveridge and Nelson (1981) and Nelson and Plosser (1982).

$$BQ_t = \beta_1 \; BQ_{t-1} + \beta_2 \; BQ_{t-2} + \varepsilon_t . \qquad (4)$$

As shown by Box and Jenkins (1976, p.58), the stationarity (necessity) conditions for AR(2) are

$$\beta_1 + \beta_2 < 1$$
$$\beta_2 - \beta_1 < 1 \qquad (5)$$
$$-1 < \beta_2 < 1 .$$

Stationarity conditions are not satisfied in the estimated regression of (4). This result was to be expected from Figure 4-1.

Returning to the original idea underlying the Wold's decomposition theorem, we can approximate bequest series $\{BQ_t\}$ through the following steps.

First step : To extrapolate the deterministic component of bequests series. As seen in the plot of the series, we take the deterministic component (D_t) to be a time-trend. A simple exponential growth model is fitted to the series such that the flow of future bequests is taken as an exponential growth series starting from a base year value.

$$BQ_t = \exp(\alpha \; T) \; BQ_0 + \varepsilon_t = D_t + \varepsilon_t \qquad (6)$$

$$\log \; (BQ_t / BQ_0) = \alpha \; T + \varepsilon'_t$$

where BQ_t = bequests at t.
BQ_0 = base year value of BQ.
T = time (defined as T = 1,2,3,...n).
ε_t and ε'_t = error terms.

By using the OLS estimator of α (say, α^*), the deterministic series $\{ D_t^* \}$ is calculated such that,

$$D_t^* = \exp(\alpha^* \, T) \, BQ_0 \quad . \tag{7}$$

By definition, the deterministic series D_t^* does not include any stochastic variable at all.

In practice, the model is fitted as follows (footnote 5):

Real estate bequest ; OLS 1965-1985

$\log(BQL_t/BQL_0) = 0.062\ T$	$R^2 = 0.970$
s.e.(0.0025)	DW = 0.375
t-value(25.205)	$\sigma = 0.1414$ (eq s.e.)
mean of dependent var = 0.70	RSS= 0.3999

Financial bequest ; OLS 1965-1985

$\log(BQF_t/BQF_0) = 0.090\ T$	$R^2 = 0.971$
s.e.(0.0035)	DW = 0.336
t-value(26.007)	$\sigma = 0.199$ (eq s.e.)
mean of dependent var = 1.037	RSS= 0.795

Given the OLS estimator α^*, T (=1,2,3,..) and BQ_0, the deterministic series $\{ D_t^* \}$ can be easily calculated using (7).

Second step : By Wold's decomposition theorem, we have,

$$BQ_t = D_t + Y_t$$

As we approximated $D_t \approx D_t^*$ in the first step, we now need to identify the non-deterministic component Y_t . By Wold's

5. Recent literature on co-integration [e.g., Engle and Granger (1987)] uses Durbin-Watson statistics for testing the absence of co-integration under the null hypothesis H_0 : DW = 0 . Our estimations indicate the presence of co-integration between bequest factors and a time trend at the 10 percent level. The purpose of this step is to extrapolate the deterministic component which is a time trend factor. The existence of co-integration therefore justifies our approach, namely the use of Wold's decomposition.

definition, Y_t must be uncorrelated to D_t. However it is very difficult, in reality, to find a completely uncorrelated series which can explain bequest behaviour. We apply the autoregressive process (AR(2)) to BQ_t for Y_t. The following model (footnote 6) is set up,

$$BQ_t = \alpha D_t + \beta_1 BQ_{t-1} + \beta_2 BQ_{t-2} + \varepsilon_t$$

$$\varepsilon_t \approx NID(0,\sigma^2) \qquad (8)$$

The results of estimating (8) are given below:

Real Estate Bequest: OLS 1967-1980

$$BQL_t = 0.334\, DL_t + 1.366\, BQL_{t-1} - 0.689\, BQL_{t-2} \qquad (9)$$

s.e	(0.133)	(0.221)	(0.228)
t-value	(2.517)	(6.176)	(-3.021)

$R^2 = 0.996$, DW = 1.630, $F(2,11) = 1228.15$,
Mean of dependent var = 2060.12, $\sigma = 158.21$ (eq.s.e),

where DL_t = the deterministic component for real estate bequest.

Financial Bequest: OLS 1967-1980

$$BQF_t = 0.268\, DF_t + 1.195\, BQF_{t-1} - 0.434\, BQF_{t-2} \qquad (10)$$

s.e	(0.158)	(0.275)	(0.290)
t-value	(1.692)	(4.347)	(-1.494)

$R^2 = 0.988$, DW = 1.974, $F(2,11) = 466.17$,
Mean of dependent var = 516.62, $\sigma = 64.84$ (eq.s.e),

where DF_t = the deterministic component for financial asset bequest.

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6. The other method often used is to subtract the deterministic component D_t from BQ_t and to regress the stochastic (non-deterministic) process on adjusted BQ_t (i.e., $BQ_t - D_t$). This method was also applied but it was not as good as the one we discuss below.

Both the real estate and financial bequest models show satisfactory results (footnote 7). The AR(2) process demonstrated here satisfies the stationarity conditions proposed by Box-Jenkins.

Finally a post-sample forecasting test is conducted to make sure that the above models shows consistent forecasting power.

Real estate bequest forecasting 1981-1985 :

Year	Actual(X_t)	Forecast($\underline{X}_t$)	$X_t-\underline{X}_t$	s.e	T-value
1981	3051.90	2977.57	74.33	176.32	0.422
1982	3255.70	3404.05	-148.35	180.96	-0.820
1983	3342.80	3497.02	-154.22	174.67	-0.883
1984	3500.20	3549.27	-49.07	177.83	-0.276
1985	3798.70	3782.68	16.02	181.64	0.088

Tests of Parameter constancy over 1981-1985

Forecasting $Chi^2(5)/5 = 0.43 < 2.20$ critical value at 5% level.

Chow test $(5,11) = 0.37 < 3.20 = F(5,11)$ critical value at 5% level.

Financial bequest forecasting 1981-1985 :

Year	Actual(F_t)	Forecast($\underline{F}_t$)	$F_t-\underline{F}_t$	s.e.	T-value
1981	812.80	832.96	-20.16	75.75	-0.266
1982	851.70	915.20	-63.50	76.25	-0.833
1983	982.10	951.11	30.99	78.25	0.396
1984	1141.60	1117.01	24.59	82.92	0.297
1985	1385.10	1280.53	104.57	84.33	1.240

7. However it is known that the Durbin-Watson test is biased towards 2 when lagged dependent variables are included among the explanatory variables. Durbin's h-statistic is not applicable for this model because h-statistic is only for the AR(1) process (i.e., a lagged dependent variable). Even taking account of this drawback, the estimates seem to be acceptable by conventional standards.

Tests of Parameter constancy over 1981-1985

Forecasting $Chi^2(5)/5 = 0.81 < 2.20$ critical value at 5% level.

Chow test $(5,11) = 0.72 < 3.20 = F(5,11)$ critical value at 5% level.

The post-sample goodness of fit tests are briefly explained in what follows. From (9) and (10), we have estimated parameters of the model. and by assumption, $\varepsilon_t \approx NID(0,\sigma^2)$. The prediction errors,

$$\varepsilon_{t+j} = BQ_{t+j} - \alpha D_{t+j-1} - \beta_1 BQ_{t+j-1} - \beta_2 BQ_{t+j-2} \qquad j = 1,2,..5 \qquad (11)$$

will be asymptotically $NID(0,\sigma^2)$. If σ^2 is known, the statistic

$$X(5) = \sigma^{-2} \sum_j \varepsilon_{t+j}{}^2$$

will asymptotically have a chi-square distribution. The index of numerical parameter constancy for five forecasts is therefore calculated as chi-square(5)/5 which yields an approximate F-test (footnote 8). In our case, estimated values are larger than 2.2 implying poor *ex ante* forecasts at the 5 percent level. Fortunately the values for both models are well below the critical value which means that the models have successful forecasting powers. We have also checked whether there was a structural break in between the sample and post-sample periods by using the Chow test [see

8. This index is given by David F. Hendry in his econometric program, PC-GIVE version 4.1. The critical value is also given in PC-GIVE.

Chow (1960)]. Again both models indicate no structural change (i.e., parameter constancy).

The Forecasts : From the above results, (9) and (10) can be safely chosen as the appropriate forecasting models. A calculation of point forecasts is quite straightforward by use of the Box-Jenkins method (footnote 9). Given the estimated model [i.e.,(9) and (10)] and the values of BQ_t, BQ_{t-1}, and D_{t+1} (which can be calculated deterministically), the expected value of BQ_{t+1} can be easily calculated, such that,

$$\underline{BQ_{t+1}} = \alpha D_{t+1} + \beta_1 BQ_t + \beta_2 BQ_{t-1}$$

Next, $\underline{BQ_{t+2}}$ can be obtained using $\underline{BQ_{t+1}}$, BQ_t and D_{t+2}. To repeat the same procedure, it is possible to forecast as far ahead as is required. Forecast errors are assumed to be zero as long as the structure of the model is unchanged. Below the values of BQL and BQF are forecast for twenty-five years (i.e., 1986-2010).

So far we have estimated the forecasting models based on data from 1965 to 1985. In 1985 it can be assumed that the household has the same estimated models on both theoretical and practical grounds. However, it is not easy to assume that the household had the same models in 1965. We could make one of two assumptions: (i) the household has

9. See Box and Jenkins (1976), chapter 5. See also Granger and Newbold (1986), pp. 152-157.

perfect foresight or rational expectations, and/or (ii) the models remained the same from well before 1965 and were common knowledge among households. Strictly speaking, both assumptions seem unrealistic at first sight. In individual families, however, both beneficiaries and benefactors of bequests know, implicitly or explicitly, how much and what type of family wealth will be distributed and to whom. In Japan, though the probate system (writing a last will) is not common, real estate bequests, in particular, are known *a priori* (see the survey results in section IV, Tables 4-2). It may, therefore, be concluded that the *real* content of bequests is known well before the actual transfers occur. This enables us to assume the presence of approximate perfect foresight although neither the nominal value (*via* inflation effects) nor the net value (*via* tax system change) may be known.

III.3. Simulation Results of Bequests Wealth Estimation

The purpose of this section is to approximate "true" bequest wealth and to estimate the ratio of bequest wealth to total wealth. As discussed in section III.1., however, there is no information available on "true" bequest wealth. It is necessary to simulate and to select a reasonable approximation of true bequest wealth. Recall the identity;

$$W = LCW + BQW \tag{12}$$

where W = total wealth,
LCW = life-cycle wealth, BQW = bequest wealth.

Although data on W from the National Income Accounts is available, it is not possible to know LCW and BQW until one of them is calculated. Kotlikoff and Summers (1981, 1988) and Kotlikoff (1987) are concerned mainly with the calculation of life cycle wealth (called the residual method) because, as they argue, the bequest flow approach (called the direct method) overestimates life cycle wealth due to the absence of data on a variety of transfer flows. Their accounting method for estimation of life-cycle wealth can be termed "basket accounting" because they add up several reasonable components of life-cycle wealth, which basically equal accumulated earnings minus accumulated consumption. The main problem in the basket accounting method, as Modigliani (1988a) points out, is arbitrariness of the choice of items in the basket. Modigliani's criticisms rest on three points. First, the definition of intergenerational transfers is too broad in the approach used by Kotlikoff and Summers (1981). They take all expenditure on dependent children over age 18 as intergenerational transfers while the conventional definition might consider it as parents' consumption. Secondly, the preferred age gap between the donor and the beneficiaries is taken to be 35 years by Kotlikoff and

Summers. This may be too long and Modigliani suggests 25 years instead. Thirdly, Modigliani argues that capital gains from inheritance must not be included as intergenerational transfers.

Our definition of bequest wealth is different from that of Kotlikoff and Summers. Their definition states that " BQW must equal the sum over cohorts of the accumulated value of past net intergenerational transfers " [Kotlikoff and Summers(1988), p.58]. This is in contrast with our analysis in which BQW is defined as the accumulated value of current and future bequest flows. According to our forward-looking theoretical framework, saving behaviour is influenced by current and future bequests because saving decisions are made at the beginning of the working period. This takes into account current and future inheritance and gifts from parents.

A new formula to calculate bequest wealth is proposed on the basis of the forward-looking saving model. This takes account of Modigliani's criticisms and other shortcomings of Kotlikoff and Summers' direct measurement formula (footnote

10). Two new empirical features are introduced. The first considers the ratio of bequest wealth to total wealth over time (i.e., time series change of the ratio). This series gives us information on the changing importance of bequest wealth over time. The second feature is a division of bequests into real estate and financial asset bequests. The two types of bequests move differently over time and their policy implications thus seem to be different.

In practice, the following assumptions and definitions are adopted in our formula :

(i) Intergenerational transfers are restricted to gifts and bequest transfers (BQ) which are forecast by the univariate time series model of (9) and (10). The steady-state growth formula [Kotlikoff and Summers (1981)] is replaced by an econometric forecasting model (i.e., including expected future bequests).

(ii) Tax exempt bequests and unreported gifts are included in BQ wealth by adjusting the value of tax-burden data.

(iii) An age gap of 25 years is assumed.

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10. After correction by Modigliani (1988a), the formula used by Kotlikoff and Summers (1988) is given below :

$$T = t/(r-n)\ e^{(r-n)D}[1 - e^{(n-r)(G-I)}]\ e^{(n-r)I}$$

where T = stock of intergenerational transfer wealth,
t = annual flow of transfers,
r = real interest rate, n = income growth rate,
G = age of the donor, I = age of the beneficiaries, g = G-I = age gap, D = age of death.

With r-n = 0.01 and g = 40 (45), Kotlikoff and Summers obtained the bequest ratio ϕ = 54 (63) percent .

(iv) Interspousal transfers are subtracted from BQ transfers to avoid the problem of double counting intergenerational transfers. We do not consider other possible sources of double counting. For example, some intergenerational transfers may be conducted twice or more within 25 years. It is equally possible that some gifts and bequests are not made within the 25 years period. On average, we assume that these cases cancel out.

(v) Capital gains from BQ transfers are not treated as BQ wealth. To calculate future BQ transfers, it is necessary to discount them by an expected rate of return or by a real interest rate.

For discrete data, the following formula is proposed.

$$BQW_t = A_t \sum_{i=0}^{k} R_i \; N_{t+i} \; BQ_{t+i} \qquad (13)$$

where A_t = a bequest base adjustment value. $A > 0$.
k = 25
R_i = a capital gain discount rate = $(1+r)^{-i}$, r = 0.00, 0.03 and 0.05.
N_{t+i} = an interspousal transfer discount rate.

And the bequest ratio (ϕ) is given by,

$$\phi_t = BQW_t \; / \; W_t \; . \qquad (14)$$

In order to calculate the bequest ratio, the set of parameters { A_t, k, R_i, N_{t+i} } must be specified.

The age gap k can be viewed as the length of one generation or the time horizon of bequest receivers. Japanese demographic data (e.g., the duration between the peaks of baby-boom generations) indicate that twenty-five years for k would be a good approximation.

The capital gain discount rate is given three values; 0, 3, and 5 percent. Historical value for the real rate of return from financial assets was - 0.48 percent during the period of 1965-1985 and that for real estate was 4.05 percent (see the notes in Table 4-1). It is expected that the future real interest rate for financial assets will increase due to the liberalization of financial markets. It is also expected that the increase in land values will slow down because of the government's intervention in land price formation. A 3 percent discount rate is therefore selected as the most appropriate for future BQ transfers (both financial assets and real estate).

To select the interspousal transfer discount rate N_{t+1}, historical values for the share of interspousal transfers in total bequest transfers are calculated from the Tax Bureau data for 1965-1985. Because of the increase in the spouse's tax exemption values and changes in family-structure (size), the share of interspousal transfers has increased over time. It was, on average, 6.2 percent in 1965-1971, 17 percent in 1972-1980 and 27.8 percent in 1981-1985. Until the 1960s, by tradition, the eldest son of a Japanese family inherited a major share of bequest wealth, if not all of it. In the 1970s and 1980s, the share for a spouse has improved significantly. In the 1990s, this trend is likely to continue. The share value we adopt for future transfers is 30 percent which is defined as a constant (i.e., $N_t = 1 - 0.3 = 0.7$) whereas the share for 1965-1985 is based on historical values.

The specification of A_t is the most difficult part of our formula [eq.(13)]. This is because the adjustment value has to recover bequest transfers that are missing from the Tax Bureau bequest data. The actual procedure used to calculate A_t is complicated and it is given in appendix of this chapter. The logic of the procedure is as follows. First, actual wealth holdings at the death of the head of the household and of widows aged over 65 is estimated. Secondly, the actual wealth left is compared with the Tax Bureau bequest data. This gives an approximation of the number of times (A_t) actual transfers were unaccounted.

The estimated value A_{Ft} for financial assets is 2.93 and A_{Lt} for real estate is 2.66. The variances of these values over 1965-1985 remained quite low (0.26 for A_{Ft} and 0.29 for A_{Lt}). It is thus possible to choose a single value throughout the period (i.e., we do not assume parameter shifts within the period).

We have now identified th parameter values as (A_{Ft} = 2.93, A_{Lt} = 2.66, k = 25, $R_t = (1+r)^{-1}$ with r = 0.00, 0.03 & 0.05 , and N_t = 0.7) needed to calculate the bequest ratios (ϕ_t) and the results are given in Table 4-1.

TABLE 4-1 THE BEQUEST RATIO TO TOTAL WEALTH (PERCENT)

	REAL ESTATE			FINANCIAL ASSETS		
	DISCOUNT RATES					
YEAR	0 %	3 %	5 %	0 %	3 %	5 %
1965	52.40	34.31	26.60	60.65	38.38	29.30
1966	52.67	34.58	26.87	58.89	37.50	28.42
1967	48.94	32.19	25.00	58.01	36.92	28.13
1968	48.94	32.19	25.00	55.96	35.45	26.96
1969	50.54	33.25	25.80	51.86	32.82	24.91
1970	64.11	42.03	32.72	53.33	33.70	25.78
1971	66.23	43.36	33.78	52.45	33.11	25.20
1972	56.66	36.97	28.73	44.83	28.42	21.39
1973	59.58	38.84	30.32	45.42	28.42	21.68
1974	76.87	50.01	38.57	53.91	33.99	25.49
1975	72.62	47.08	36.44	56.84	35.45	26.66
1976	71.82	46.55	35.91	57.14	35.75	26.96
1977	73.42	47.88	36.97	59.48	37.21	28.13
1978	72.09	46.82	36.44	58.01	36.33	27.54
1979	68.89	44.95	34.85	58.60	36.92	27.84
1980	71.02	46.28	35.91	62.70	39.26	29.59
1981	75.54	49.21	38.30	64.17	40.14	30.47
1982	82.73	54.00	41.76	65.93	41.61	31.35
1983	90.17	58.79	45.75	66.51	41.61	31.64
1984	94.70	61.71	47.88	67.10	42.19	31.94
1985	97.62	63.84	49.48	68.56	43.07	32.52
AVERAGE						
65-85	68.93	44.99	34.91	58.11	36.58	27.71
81-85	88.15	57.51	44.63	66.45	41.72	31.59

Notes : (1) The above figures are calculated for A_{Lt} = 2.66 and A_{Ft} = 2.93 during the period 1965-1985.

(2) Between 1965 and 1985, the real interest rate (approximated by the nominal one-year time deposit interest rate minus inflation rate) was - 0.48 % on average. For financial assets, it is assumed that the discount rate lies in the range 0 to 3 percent.

(3) For the real estate discount rate, the net real estate inflation rate (real estate inflation rate minus consumer price inflation rate) is calculated. On average, net inflation was 4.05 % during the 1965-85 period. But, as is well known, that period was unusually inflationary and a 3 % discount rate may not be a bad approximation.

Looking at the average values of the ratio over the period 1965-85, with r = 0.03, the ratio for financial bequests equalled 36.58 percent and that for real estate bequests was 44.99 percent. These values are a little smaller than 54.0 percent which was obtained by Kotlikoff and Summers as a result of the direct method (1988, p.64). The result here is rather closer to Modigliani's error corrected estimate [the ratio was 40.5 percent (1988, p.35)]. The important point is, however, that bequest wealth occupies a substantial portion of total wealth even by our results.

The recent five year average (i.e., for 1981-85) of the ratio is higher than the overall average (i.e., for 1965-85). This is marked in the case of the real estate bequests ratio which rises by about 10 percentage points between 1982 and 1985. In 1985, 63.84 percent of real estate was expected to become current and future bequests wealth. These results have important implications for controversial phenomena in Japan. In particular, housing and land problems seem to be closely related to real estate bequest transfers. We will consider this point in the next section.

IV. Bequests, Housing and Land Price

In recent years, land prices of residential areas, especially in large cities, have been shooting up. Land prices in most of the prestigious areas of Tokyo have risen so that a housing plot is beyond the average person's lifetime earnings. In spite of this fact, demand for such land never ceases. Why and how can anyone buy real estate which is worth more than their lifetime earnings ? The main explanation for this is that, as over 60 percent of households are currently homeowners, most of the demand for such property comes from those who already own expensive land which can be sold or be provided as collateral for a loan (mortgage)(footnote 11). As the number of children per

11. However we do not argue that the main cause of high land prices in residential areas comes from land (home)-owners' demands. The original cause of land price inflation at this time comes from the speculative demands of firms which conducted *zaitech* activity to raise profits by financial and real estate investments and, especially in the case of Tokyo, it comes from demands for office space. This is due to Tokyo's emergence as one of the most important international financial centres. Such demands for offices, which are accompanied by astronomical compensations, push those who live in the centre of Tokyo or other large cities to residential areas in the suburbs or quasi-centres of the cities. In order to enjoy tax-exemption, those who are pushed out have to use the equivalent monetary value of the amount they received for their central city lands in their new homes. That, in turn, raises the land price of residential areas substantially. This is the basic mechanism by which land price inflation is transmitted from the central city office area to residential areas. For this mechanism, for example, see, Miyao (1988a,b) and Tsuru (1988).

household has declined steadily (the average number is now 1.8 children) while homeownership has increased, the percentage of children who receive real estate bequests can be expected to increase. Our research clearly indicates this trend and we suspect that the recent inflation in land prices is linked to the increase in real estate bequests. An obvious consequence of the rise in bequests is that market transactions of real estate will decrease, given the available real estate at a point in time. Land price formation through the market mechanism would therefore be distorted. The coefficient of correlation between inflation in land prices and bequests was strongly positive (0.4038) during the period 1970-1983 while it was weakly negative (-0.1935) during the period 1958-1973. This result seems to support our conjecture that there is an important positive relationship between inflation in land prices and real estate bequests. In the post growth period (1970-1983), the saving rate and inflation in land prices are negatively correlated (as shown in chapter 2, Table 2-8). The two results together imply that the saving rate and real estate bequests are negatively correlated in this period. Savings made for land/housing purchase seem to be substantially reduced by an increasing prospect of real estate bequest receipts. As long as real estate is transferred through bequests, the high inflation rate in land prices does not motivate benefactors of bequests to save except for the purpose of taxes on inheritance and gifts. The key issue is, therefore, that in the post growth period, the majority of younger households expect to acquire their real estate not by their own savings but by bequests from their parents.

Many proposals for solving high land prices and for land-housing problems in general are suggested by, for example, Harada(1988), Miyao (1988a,b), Noguchi (1984,1988) and Tsuru (1988). Most of them are concerned with deregulation of land uses, changes in property and inheritance taxes and proper indexation of land prices for tax evaluation. Given the strong bequest motive of households, it is questionable whether these proposals can reduce land prices. When over 60 percent of private real estate is to be transferred *via* bequests, real estate bequests will be the biggest supply constraint on the market. This factor must be a key determinant of land prices. A further thorough study is needed to investigate the mechanism between land prices and real estate bequests.

Indirect support for our argument that bequests are increasingly important comes from Izumi's (1986) very interesting survey results. Some of his results are reproduced below in Tables 4-2,4-3 and 4-4. The questions in the survey were mainly about the possibilities of bequest receipts and were addressed to Tokyo based businessmen.

TABLE 4-2 POSSIBLE BEQUEST RECEIPTS (PERCENT)

START WORKING YEAR	YES	NO	DON'T KNOW	OTHER
1955 (AGE 52)	14.0	70.1	14.0	1.9
1960 (AGE 47)	27.8	63.6	7.9	0.7
1965 (AGE 42)	32.2	55.9	7.7	4.2
1970 (AGE 37)	46.3	46.3	5.4	2.0
1975 (AGE 32)	53.5	38.6	5.9	2.0

TABLE 4-3 HOUSEOWNERSHIP BY POSSIBILITY OF BEQUEST RECEIPTS (PERCENT)

START WORKING YEAR	HOUSEOWNER AMONG "POSSIBLE"	HOUSEOWNER AMONG "NOT POSSIBLE"
1955 (AGE 52)	73.3 %	86.7 %
1960 (AGE 47)	69.2	84.3
1965 (AGE 42)	43.5	71.3
1970 (AGE 37)	60.3	64.7
1975 (AGE 32)	30.5	32.2
1980 (AGE 27)	9.2	6.8
AVERAGE	39.2	63.4

TABLE 4-4 HOUSEOWNERSHIP ADJUSTED BY INCLUDING EXPECTED REAL-ESTATE BEQUESTS (PERCENT)

START WORKING YEAR	WITH ADJUSTMENT [INCLUDING EXPECTED BEQUESTS]	WITHOUT ADJUSTMENT
1955 (AGE 52)	89.7 %	86.0 %
1960 (AGE 47)	90.0	81.4
1965 (AGE 42)	80.4	62.2
1970 (AGE 37)	81.6	63.3
1975 (AGE 32)	67.3	30.1
1980 (AGE 27)	64.7	7.9
AVERAGE	78.4	53.7

Source : Izumi, T. (1986) pp.111-120. Figures 3-10,3-11 and 3-12 are taken from the survey report (Tokyu Housing Life Institution) of October 1985.

Notes (1) The questionnaires were distributed to Tokyo-area businessmen in companies which were listed in the first division of the Tokyo Stock Exchange in October 1985.(2) The survey data are classified by the year in which a person entered the company. We converted this into the approximate age-classification by assuming that the working year started at 22 years of age for such companies.

Table 4-2 shows the percentage of business men who expected to receive bequests from their parents (including their wives' parents). The results show that bequest transfers and the possibility of their occurrence have increased significantly since the 1970s. Those aged 30 or less are expected to receive higher percentages (say, 60 percent) than those above the age of 30.

In relation to housing demands, Table 4-3 clearly indicates that those who expect to receive bequests have significantly lower house ownership than those who do not. On average, the difference equals as much as 24.2 percentage points.

Table 4-4 tells us that the "true" (potential) house ownership is, on average, 25 percentage points higher than the current ownership rate. Izumi concludes that, as the "true" house ownership rate is very high, replacement demands for housing will increase substantially among those seeking a better living environment in the future (*op.cit.*,p.120).

Two points are worth mentioning. First, our results in Table 4-1 refer to the ratio of bequest wealth to total wealth at the national level while the results in Table 4-2 refer to the percentage of population in the Tokyo area who expect to receive bequests in the future. The implications of both results are, however, surprisingly similar. That is to say, bequest transfers are increasing at a significant speed and magnitude. And as Tables 4-3 and 4-4 show, this fact clearly affects household behaviour (in this case, housing demands and probably saving behaviour) (footnote 12).

The second point is that, as Izumi argues, the number of child births has declined and the two child family now constitutes the typical household (on average 1.8 children per household). If the biological chance of having male and female babies is nearly equal (as it is), the typical family has a boy and a girl. Through well-managed marriages, both the boy and the girl could have a high chance (or higher quantities per couple) of receiving real estate bequests either from their own parents or from their spouse's parents (footnote 13). The results can be seen, in a sense, as a logical consequence of demographic structural change.

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12. Ando *et al.* (1986) show the importance of real estate transfers in Japan by using other panel data for approximately fifty thousand households. Among aspects of their micro study, they analyse the mechanism of how old people (age above 60) decide whether or not to live with the family of their son or daughter and find that old people benefit from being taken care of by young families. Young families, in turn, benefit from receiving *de facto* bequests, especially real estate, from their parents. This story also matches with our findings and Izumi's survey results.

13. For a theoretical justification, see Bernheim and Bagwell (1988) who consider an operative family linkage which creates fiscal neutrality and non-neutrality results.

V. Conclusion

Since the publication of the paper by Kotlikoff and Summers (1981), the role of intergenerational transfers has been the focus of controversy. In this chapter, some new evidence from Japan on bequest transfers was brought to bear on the controversy.

In doing so, we first discussed the root of the measurement problem and then proposed a new method of estimating bequest wealth. The new method was used to calculate the ratio of bequest wealth to total wealth. The estimated ratio for bequests of financial assets was 36.58 percent and that for real estate bequests was 44.99 percent on average during 1965-1985. We further found that the values of the bequest ratio increased rapidly in the 1980s. This was especially so in the case of the real estate bequests ratio which reached 63.84 percent in 1985. Our findings were supported by complementary information from the survey reported by Izumi (1986).

We also pointed out that there seemed to be a strong positive correlation between the increase in real estate bequests and the recent inflation in land prices. However, this chapter did not attempt to identify a behavioural relationship between them. This aspect needs further research.

Although the importance of bequest wealth in total wealth was amply demonstrated above, we have to examine whether or not bequest wealth is a more important explanatory variable than life-cycle wealth in household saving behaviour from the econometric point of view. Needless to say, the significance in accounting values is a different matter from the significance in statistical tests. The former concept refers to the quantitative (stock) importance and the latter refers to the sensitivity (change) of variables in explaining a dependent variable. The latter aspect is considered in the next chapter.

APPENDIX. THE ESTIMATION OF THE BEQUEST BASE ADJUSTMENT VALUE

The Tax Bureau data on bequest transfers underestimate the "true" transfers. The majority of unreported transfers come from tax exempt bequests. In this appendix, we try to approximate the ratio between the taxed bequest and the "total" (tax and tax exempt) bequest transfers. Gifts given by donors below the age of 65 are ignored. Those who depend on their children before the age of 65 are also excluded. Thus the ratio (A_t) should be understood as the lower bound. The estimation procedure is given below.

(1) Average wealth holdings for those over 65.

Financial assets holdings (FA_t) are taken from the age-group data in Family Saving Survey (All households, 1966-1984, Statistics Bureau).

Real Estate holdings (RE_t) for those over 65 are not readily available in the published data. The calculation of RE_t is made as follows;
The aggregate real estate holdings data (L_t) is divided by the number of homeowner households ($\#L_t$) such that,

$L_t / \#L_t = ARE_t$

ARE_t is the average value of real estate holdings *per homeowner household.* The homeownership rate for households age over 65 is given by,

$\#L65_t / \#65$.

Where $\#L65_t$ is the number of homeowner households aged over 65 and #65 is the number of total households aged over 65. We assume that the average homeowner aged over 65 holds the same value as ARE_t (which is overall average). The aggregate value of real estate holdings held by a household over 65 is thus given by,

$ARE_t \times \#L65_t = TRE65_t$.

The average value of real estate holdings *per household aged over 65* (RE_t) which is the average of both homeowners and nonowners is obtained by,

$TRE65_t / \#65 = RE_t$.

Sources : L_t is taken from National Accounts (EPA), $\#L_t$ and #65 are taken from Japan Statistical Yearbook 1987 (Statistical Bureau, pp.512-513). #L65 is taken from Family Saving Survey 1986.

(2) Number of deaths age over 65.

The total male deaths of those over 65 (D_{Mt}) are calculated from Japan Statistical Yearbook 1987, pp.51-55. We assume that they are the heads of households and own the wealth given above (i.e., FA_t + RE_t). The interspousal transfers rate (w_t) is calculated from The Tax Bureau Annual Report on inheritance and gifts. Male over 65 who die are to bequeath $(1-w_t)(FA_t+RE_t)D_{Mt}$ as intergenerational transfers in aggregate.

Widows aged over 65, are also assumed to leave bequests. First, total female deaths, aged over 65, are calculated (D_{Ft}) from Japan Statistical Yearbook 1987 , pp.51-55. About 20 percent of them die before their husbands. This figure (20%) is estimated as follows; from The Life Table (published every five years by the Ministry of Welfare and Health, we use 12th to 16th tables from 1965 to 1985). The probability of a wife dying before her husband's mean life expectancy is about 40 percent. There is a life expectancy gap of about 3.5 years. We ignore the actual age gap between the wife and the husband. The husband's probability of dying before his wife over such a period (i.e., until the mean of his life expectancy) is about 50 percent (it will be higher when he lives beyond his mean life expectancy). Then the probability of a wife dying before her husband would be 40 x 50 (percent) = 20 percent at most. We assume that wives who die before their husbands do not leave bequests. The number of widows aged over 65 who leave bequests is given by $0.8\ D_{Ft}$.

The share of bequests received by a widow from her husband (w_t) is calculated from The Tax Bureau Annual Report on inheritance and gifts. This is used to estimate the widow's average wealth holdings. Here we use, for simplicity, the share value and bequeathed wealth (i.e., FA_t+RE_t) which correspond to the year of the widow's death rather than to that of her husband's death. This is partly because there is no information about the period gap between the year of the widow's receipt of a bequest from her husband and the year of the widow's death and partly because the share value, in fact, does not change much within , say, five years. Note, however, that this simplification may give a slight overestimation of A_t .
The widow's bequest wealth is given by $w_t(FA_t+RE_t)\ 0.8\ D_{Ft}$.

(3) The bequest base adjustment value

Total intergenerational bequest wealth is divided by the Tax Bureau data to obtain a proxy value of the "true" transfers. The value for financial assets (A_{Ft}) is,

$$A_{Ft} = [FA_t\{(1-w_t)D_{Mt} + 0.8\ w_tD_{Ft}\}]/[(1-w_t)BQF_t]$$

The value for real estate (A_{Lt}) is,

$$A_{Lt} = [RE_t\{(1-w_t)D_{Mt} + 0.8\ w_tD_{Ft}\}]/[(1-w_t)BQL_t]$$

The calculated values and other variables are shown in Table A-1 below.

TABLE A-1

YEAR	RE_t	FA_t	D_{Mt}	Adj D_{Ft}	A_{Lt}	A_{Ft}
1965	3.45	--	198.5	11.1	3.82	--
1966	3.75	1.25	189.9	7.0	3.71	3.05
1967	4.58	1.26	191.4	12.5	3.62	2.35
1968	5.53	1.38	194.8	13.8	3.35	2.47
1969	6.57	2.00	196.8	12.7	2.84	2.82
1970	6.53	1.95	221.4	12.6	2.39	2.24
1971	7.66	2.85	212.7	8.4	1.89	2.84
1972	10.59	3.12	212.4	28.3	2.18	2.49
1973	13.27	3.28	220.2	24.6	2.15	2.20
1974	13.49	3.12	220.7	25.6	2.00	2.05
1975	14.23	4.16	227.5	40.3	2.81	3.17
1976	15.35	5.61	227.8	43.8	2.76	3.67
1977	16.44	6.57	223.6	44.9	2.57	3.82
1978	18.46	6.61	225.5	47.6	2.58	3.41
1979	21.83	6.62	223.6	43.5	2.66	2.93
1980	25.03	7.83	253.8	47.7	2.81	3.23
1981	27.74	8.91	252.7	77.0	2.67	3.46
1982	29.05	9.70	249.9	73.5	2.36	3.44
1983	29.54	10.56	259.7	81.1	2.33	3.36
1984	30.84	10.38	259.7	82.7	2.25	2.80
1985	31.97	--	264.0	85.3	2.13	--

Notes : (1) The unit values for RE and FA are both a million yen. Those for D_{Mt} and adj D_{Ft} are a thousand persons.
(2) Adj D_{Ft} is defined as $0.8\ w_t/(1-w_t)\ D_{Ft}$.
(3) The mean of A_{Lt} = 2.66, its variance = 0.29 and the mean of A_{Ft} = 2.93, its variance = 0.26 over the sample period.

CHAPTER 5

ECONOMETRIC MODELLING OF DYNAMIC SAVING BEHAVIOUR : THE IMPORTANCE OF BEQUESTS IN SAVING MODEL (II)

I. Introduction

Two recent empirical papers [i.e., Ando *et al.* (1986) and Hayashi (1986)] on Japanese savings acknowledge the importance of bequests in Japanese household saving behaviour. Both mainly discuss micro (panel data) analysis of saving behaviour with bequest transfers.

The work done by Ando *et al.*(1986) reports a lot of new empirical findings. These findings were based on a massive panel data set of some fifty thousand households over all of Japan. Their research points out that the saving behaviour of old households in Japan cannot be fully explained without the help of the bequest motive. In their conclusion, however, Ando *et al.* remark that " to supply reliable information for policy analysis, we need another work to combine such a micro study result as this [Ando *et al.* (1986)] with macroeconomic time series data "(p.113).

Indeed, after all, most policy makers are interested in macroeconomic aspects of Japanese savings and its implications. Macroeconomic policy effects are examined usually by using time series data (e.g., inflation effect, tax change effect and debt finance policy effect).

In this chapter, the above suggestion by Ando *et al.* to build a macroeconomic time series model with the bequest motive is taken up. We also try to settle the controversy between the life-cycle model and the bequest model of saving by providing new evidence to show that bequest transfers are an important explanatory variable from the viewpoint of econometrics.

The chapter is organised as follows. In section II, we discuss the recent development of econometric methodology, especially Hendry's method of progressive research strategy. In section III, the data on Japan are analysed. This section finds a rather negative aspect which is that, as the variance of the saving rate is low over the sample period, no single explanatory variable is able to account for the high Japanese saving rate by a conventional statistical method. Section IV provides the model selection process. Section V compares the bequest model with a pure life-cycle model of saving. The model is judged with the help of encompassing tests. In section VI, using the model selected in section IV, the future course of Japanese household saving rate is forecast. In section VII, the findings are critically evaluated. In addition, some alternative explanations for the high saving rate are explored since the selected model can not directly explain it. There is a brief conclusion in section VIII.

II. Progressive Research Strategy and Methodological Issues

There have been several theoretical as well as practical developments in econometrics which have penetrated and changed the way in which econometric research has been conducted in recent years.

First, econometric work is not considered as an *ex post* justification of economic theory. The empirical model itself adds new information to our knowledge of the actual economy.

Secondly, as a consequence of the above point, econometric modelling improves itself by considering a much wider range of statistical properties with rigorous tests.

Thirdly, with the advanced study of forecasting and policy evaluation methods on the grounds of parameter constancy, we know, at least, which models cannot be used for policy analysis and for forecasting.

This chapter follows a new methodology (called the Hendry method) of progressive research strategy in econometric modelling (footnote 1) which is summarised below.

Given the present state of economic science, we have already accumulated substantial knowledge of economic behaviour on the basis of which many theories and models have been constructed. However, at the same time, we do not precisely understand the nature of the economy which generates the observable variables of interest. This unknown (black-box) mechanism is called the actual data generation process (DGP). The objective of econometric works is the characterisation of the actual DGP with the property of parameter constancy. Note, however, that the DGP will evolve at some stage in the future, thus the DGP should not be taken as fixed forever.

In order to identify the actual DGP, it is necessary to transform the original data as well as the theory model. In doing so, approximating, conditioning and marginalizing operations are implicitly used in order to reduce the dimensionality of the analysis (i.e., simplification). With limited observations, the model must avoid obvious serial correlations and heteroscedasticity of residuals. Model selection criteria are listed in section IV below.

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1. A good introduction of this methodology is Gilbert (1986). For more details, see Hendry (1985a,b,1987,1988), Hendry and Richard (1982,1983,1987), Hendry, Pagan and Sargan (1984), Hendry and Neale (1988), Mizon (1984), Mizon and Richard (1986), Davidson *et al.*(1978, DHSY in short), Spanos (1986) and Baba *et al.*(1988).

The other important aspect of this method is to consider the encompassing of rival models. If we choose a model as an approximation of DGP, then it must account for the results obtained by other models because, by definition, the actual DGP encompasses all other models. Integrating nested and non-nested hypothesis tests into a unified framework, the encompassing test is the first serious empirical application in economics of the Popper-Lakatosian method of falsification. Although by doing this, the "best" model cannot be chosen straightaway, the worst models can be eliminated and the less bad models retained. The application of this principle yields, therefore, a progressive sequence of models, which at worst are summaries of previous research and at best may characterise certain new features of the economy.

The method used here incorporate the concept of DGP, the model selection for approximating the actual DGP, and the encompassing of rival models.

III. The Data Analysis

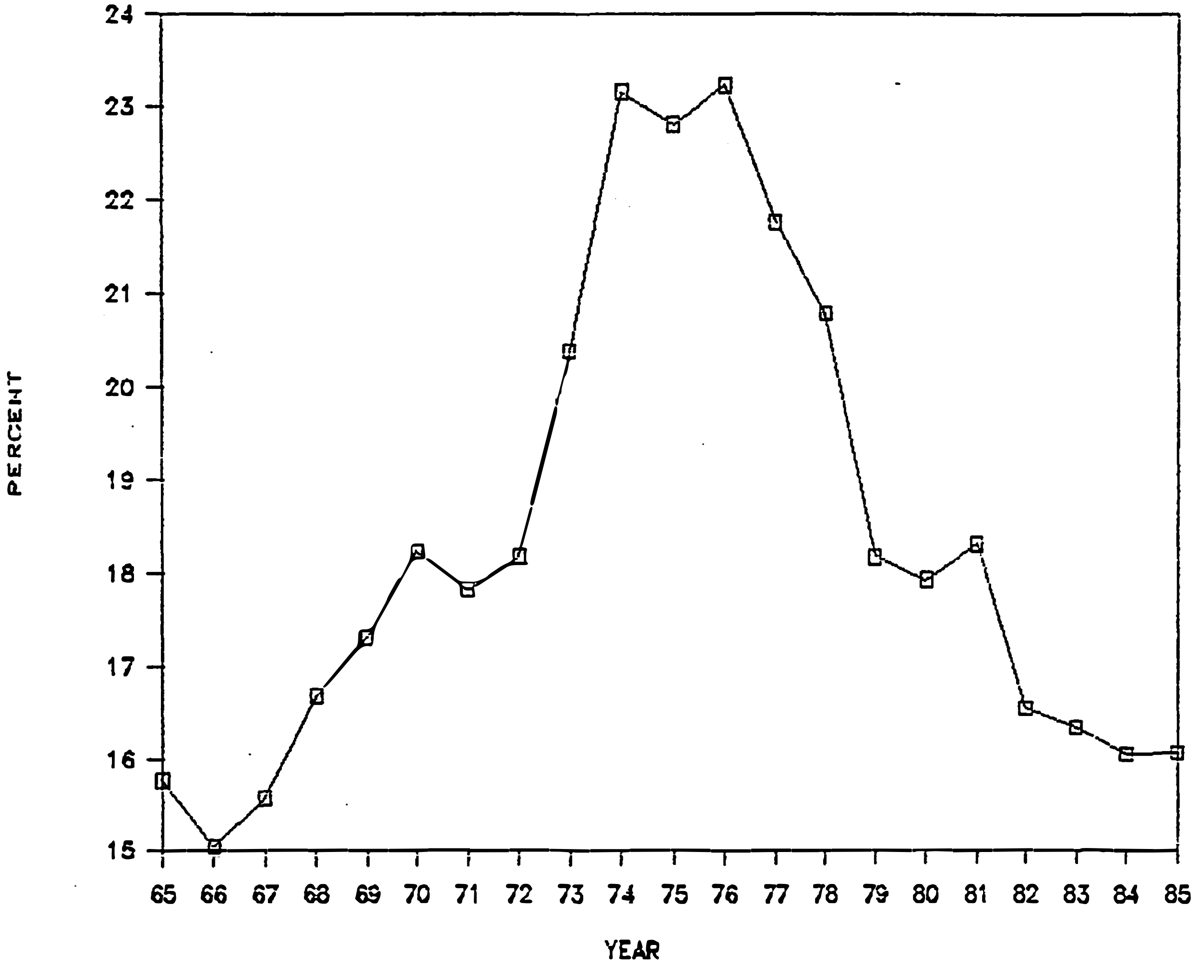
The data used in this chapter come from Annual Report on National Accounts 1987, Report on Revised National Accounts on The Basis of 1980 (Economic Planning Agency) and Economic Statistics Annual 1987 (The Bank of Japan). Bequests data are taken from Tax Bureau Annual Report, 1965-1985 (Ministry of Finance). The land price deflator (used for real estate bequests and total real estate holdings) is taken from the Land Price Index of All Urban Districts (The Japan Real Estate Institute). Financial assets stock from 1965 to 1968 are taken from The Flow of Funds (Application Table) (The Bank of Japan) and real estate holdings from 1965 to 1968 are calculated by subtracting net annual increase (flow) of real estate holdings (from National Accounts (the old series)) from a benchmark stock level in 1969 since the national accounts stock data only start from 1969. The original (raw) data set is reported in data appendix at the end of the thesis.

Annual data for a calendar year (at the end of year value) deflated by the 1980-base price indices (i.e., the consumer price and land price indices) are used for the period 1965-1985. The raw data is recorded at a unit value of billion yen. Quarterly data cannot be used because data on bequests are available only annually, though all other data are available on a quarterly basis. The year 1965 is the starting year of the new system of national accounts.

As is known, savings (S) and disposable income (Y) have strong time trends which are an undesirable property for time series modelling. That is to say, the time series model provides a description of the random nature of the stochastic process that generated the observed data, so it is desirable that the series satisfy some concept of stationarity. We divide savings (S) by disposable income (Y) and this yields the saving rate (shown in Figure 5-1). This series is far from being stationary (e.g.,there is an almost straight upward trend until 1975 and an almost straight downward trend after 1976). Next, we take a first-order difference of the saving rate as suggested by Box and Jenkins (1976). This is shown in Figure 5-2. This series seem to be stationary. The change in saving rate, d(S/Y), is used as the dependent variable on which it is hoped the time-invariant parameters of regressors can be estimated. Note, however, that a stationary stochastic process is not a necessary condition for econometric modelling [for this, see Hendry (1986, p.9)].

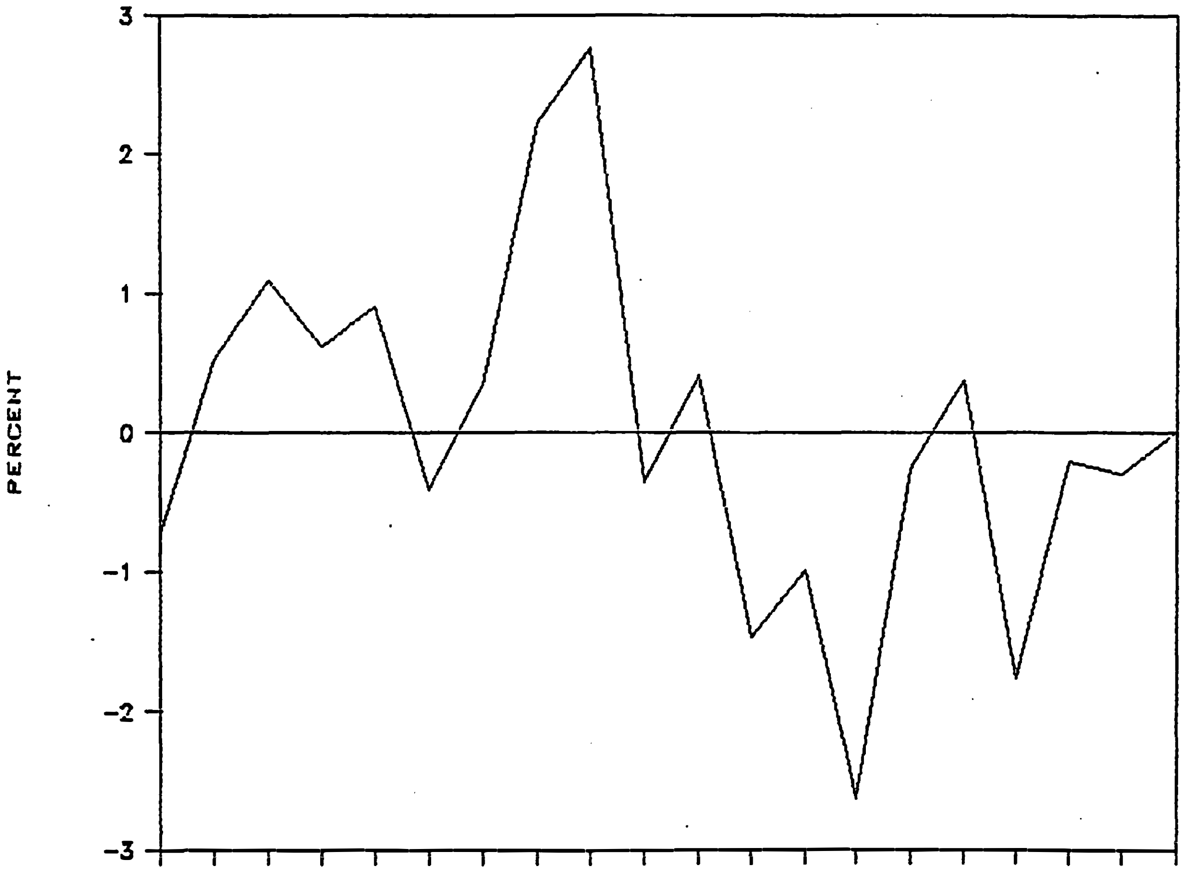
Prior to econometric modelling, it is worthwhile investigating characteristics of the saving rate (S/Y) and the change in saving rate d(S/Y). The mean, variance, standard deviation, maximum and minimum of the series are as follows:

FIGURE 5-1 : SAVING RATE



Source : Annual Report on National Accounts 1987.

FIGURE 5-2 : CHANGE IN SAVING RATE



Source : Annual Report on National Accounts 1987.

Sample period 1965-1985 (percent)

	The saving rate (S/Y)	The change in saving rate d(S/Y)
mean	18.4	0.01
variance	6.5	1.50
stad dev	2.6	1.22
maximum	23.2 (1976)	2.77 (1974)
minimum	15.1 (1966)	-2.63 (1979)

Note : The saving rate (S/Y) is expressed in percentage throughout the thesis.

The above figures characterise the high Japanese household saving rate on two grounds: (1) a very high mean saving rate and (2) a low variance of the saving rate. The minimum saving rate is as high as 15.1 percent during the sample period. The variables in the econometric models can only explain the change or variance in the saving rate which is equivalent to 35 percent of the mean saving rate on average. Furthermore the mean of the change in saving rate is 0.01 percent and its variance is 1.50 percent. These facts imply that annual change in the saving rate is very small. In fact, smaller variance implies lower explanatory power of non-constant variables in econometric models. The unexplained part of the saving rate would be included in the constant term.

What becomes clear from the above analysis is that the reason why no single factor (explanatory variable) has, so far, successfully explained the high saving rate in Japan is that the saving rate has not fluctuated enough to be explained by a specific factor. As Ishikawa and Ueda (1984) concluded " we have confirmed in the present paper that the bonus payment system has exerted a statistically significant effect on Japanese personal savings. However, the quantitative magnitude of its contribution to the aggregate rate of personal savings is rather small, at most three percentage points for the period of 1958-78, when the aggregate rate of personal savings averaged 20% "(*op.cit.*,p.174). Any serious econometric work has to reach a similar conclusion to Ishikawa and Ueda irrespective of the explanatory variables used.

To anticipate our conclusion, bequest transfers are statistically important and the bequest model can encompass the life-cycle model. But this fact does not imply that the bequest model can statistically explain why the Japanese household saving rate is so high. The high Japanese household saving rate should be attributed to a constant term, rather than to any explanatory variable because about 65 to 70 percent of the saving rate is unexplainable by means of conventional statistical method. We will consider the meanings of the constant term in section IV.

In the following econometric model, it should be understood that the model intends to explain not the high saving rate but the change in the saving rate during the sample period.

Chapter 4 demonstrated the importance of bequest wealth in total household wealth holdings when flows of bequests were accumulated over twenty-five years. Theoretically speaking, it is desirable to include expected future bequest flows with discount in "true" bequest wealth. Statistically speaking, however, the inclusion of expected values estimated by means of a univariate time-series model does not add any new information about bequest transfers but increases standard errors (i.e., error-in-variable case). In fact, we used both (raw and accumulated) variables to estimate d(S/Y) and we found that the annual raw data as a proxy variable gave a better fit than the artificially constructed data as proxy [for a similar point, see Hendry (1988)]. Although this fact does not mean that the findings in the previous chapter are invalid, from the statistical point of view (footnote 2), it is better to use the raw data on bequests.

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2. For a validity of proxy variables, see Krasker and Pratt (1986).

IV. Model Selection

IV.1. Diagnostic Tests

The general consensus about model selection criteria is to be formed in the Hendry method. This includes: (1) theory consistency , (2) goodness of fit, (3) predictive ability, (4) robustness, (5) encompassing and (6) parsimony.

For meanings and implications of above criteria, see, for example, Harvey (1981), Hendry (1987) and Spanos (1986). In this section, only brief descriptions of test statistics are given. Test statistics used here are all available in PC-GIVE.

(1) Statistics for goodness of fit: We note the equation standard error (σ) and its percentage of error in an appropriate variable (usually a dependent variable). We also consider R^2, F-statistics, RSS (the residual sum of squares) and information criteria [SC = Schwartz, HQ = Hannan-Quinn, FPE = Final Prediction Error. For definitions of these statistics, see Judge *et al.* (1985, pp.243-247)]. Parameter t-values are in parentheses, [.].

(2) Statistics for predictive ability and parameter constancy: We use the index of numerical parameter constancy for H forecasts. It is calculated using the formula $CHI^2(H)/H$ which yields an approximate F-test. We denote it by $Z_2(H)$. The Chow test of parameter constancy over the forecasting period H is also employed. It is denoted by

$Z_1(H, T-H-K)$ where T= total observations and K = number of regressors.

(3) Statistics for robustness: The Durbin-Watson test (DW) for serial correlation and the chi-square test for normality of residual distribution are used. The chi-square test is denoted as $Z_3(2)$. The Chow test of parameter constancy is used when the model seems to break down over the sample period. Heteroscedasticity-consistent standard errors are considered in parentheses,(.).

(4) Statistics for encompassing: We use the Cox test, the Ericsson test on instrumental variables, the Sargan test and F-test. For definitions of these statistics, see Ericsson (1983).

IV.2. Model Transformation

Prior to the model selection, we must note that in this chapter the government policy variables are not considered. The analysis of policy effects is put aside until chapter 6 as it is another complete exercise. The econometric modelling in this chapter is, thus, restricted to the closed economy without government policy effects.

We use *a theory model* as a starting point to approximate a data generation process (DGP). As discussed in chapter 3 [eq.(16)], the theory model is given as follows;

$$S_t = a_1 F_{t-1} + a_2 L_{t-1} + a_3 L_t + a_4 Y_{t-1} + a_5 Y_t + b_1 BQF_{t-1} + b_2 BQF_t + b_3 BQL_{t-1} + b_4 BQL_t + \varepsilon_t \quad (1)$$

where S_t = annual financial savings at t.
F_t = financial assets stock at t.
L_t = real estate holdings at t.
Y_t = annual disposable income at t.
BQF_t = financial assets bequests at t.
BQL_t = real estate bequests at t.
ε_t = an error term (a white noise).

This model is *based on* a static level equilibrium model with a lag structure (error correction mechanism). As Mizon (1977) remarked, " economic theory is rich in information concerning the long run or equilibrium behaviour of economic agents, but usually the econometrician's problem is the specification of models to represent short run disequilibrium behaviour " (p.116). Indeed, the above equilibrium model [eq.(1)] does not give any prior information for the adequate representation of short-run data generation processes. It is necessary to dynamise this model to capture the nature of short-run disequilibrium. In doing so, model transformation requires a careful analysis of residuals (errors). The presence of heteroscedasticity or autocorrelation of residuals makes estimation inefficient. Before any transformation, it is important to examine whether or not the error term in (1) is a white noise.

The result of a direct regression of (1) is given below.

OLS : 1966-1985 less 3 years forecasts

$$S_t = -\underset{\substack{(0.039)\\ [-1.256]}}{0.049}\,F_{t-1} - \underset{\substack{(0.0120)\\ [-0.0358]}}{0.00043}\,L_{t-1} - \underset{\substack{(0.0122)\\ [-2.5082]}}{0.0306}\,L_t$$

$$-\underset{\substack{(0.1677)\\ [-1.4234]}}{0.2387}\,Y_{t-1} + \underset{\substack{(0.1380)\\ [4.9920]}}{0.6889}\,Y_t + \underset{\substack{(13.881)\\ [1.921]}}{26.669}\,BQF_{t-1}$$

$$+\underset{\substack{(18.3162)\\ [0.7932]}}{14.5287}\,BQF_t - \underset{\substack{(4.0392)\\ [-2.1488]}}{8.6795}\,BQL_{t-1} - \underset{\substack{(4.383)\\ [-1.440]}}{6.310}\,BQL_t \qquad (2)$$

$R^2 = 0.999$, $\sigma = 1281.78$ (4.7 % σ) $F(8,8) = 935.39$,
DW = 2.546, RSS = 13143806.79, SC = 15.06, HQ = 15.41,
$Z_1(3,8) = 1.59$, $Z_2(3) = 33.42$, $Z_3(2) = 0.633$.

Analysis of scaled residuals : sample size = 17
Mean = -0.009, Standard deviation = 0.707,
Skewness = -0.059, Excess Kurtosis = -1.373,
Minimum = -1.048, Maximum = 1.115.

As far as heteroscedasticity and autocorrelation of residuals are concerned, there is no strong sign of violation of a white noise assumption. However, the high value of $Z_2(3)$ fails to satisfy the parameter constancy condition. This problem probably arises from the non-stationarity of the data and consequently from dynamic misspecification of the model (i.e., omitting a dynamic structure).

There are two popular procedures to achieve stationarity of the model or parameter constancy: differencing and taking ratios. We consider them in turn.

<u>The first-order difference model :</u>

The theory model [eq.(1)] is modified by using the first-order difference operator (denoted d). The new regression result is given below.

OLS : 1967-1985 less 3 years forecasts

$$
\begin{aligned}
dS = & - \underset{\substack{(0.0759)\\ [-1.9974]}}{0.1516}\, dF_{t-1} + \underset{\substack{(0.0147)\\ [1.8299]}}{0.0269}\, dL_{t-1} - \underset{\substack{(0.0170)\\ [-1.2588]}}{0.0214}\, dL_t \\
& + \underset{\substack{(0.2109)\\ [0.4400]}}{0.0928}\, dY_{t-1} + \underset{\substack{(0.1699)\\ [2.5362]}}{0.4309}\, dY_t + \underset{\substack{(10.1335)\\ [2.0843]}}{21.1217}\, dBQF_{t-1} \\
& + \underset{\substack{(18.6383)\\ [0.7110]}}{13.2515}\, dBQF_t - \underset{\substack{(4.5488)\\ [-0.8927]}}{4.0606}\, dBQL_{t-1} - \underset{\substack{(4.0656)\\ [-1.0129]}}{4.1182}\, dBQL_t \qquad (3)
\end{aligned}
$$

$R^2 = 0.835$, $\sigma = 1596.94$ (139.5 % σ), $F(8,7) = 4.42$,
DW = 1.718, RSS = 17851465.0, SC = 15.48, HQ = 15.90,
$Z_1(3,7) = 0.03$, $Z_2(3) = 0.10$, $Z_3(2) = 0.345$.

Analysis of scaled residuals : sample size = 16
Mean = −0.088, Standard deviation = 0.677,
Skewness = 0.390, Excess Kurtosis = −0.758,
Minimum = −1.062, Maximum = 1.340.

Plosser, Schwert and White (1982, PSW hereafter) suggest the use of a differencing procedure on a linear model as a test of specification. The basic idea goes as follows; if the model is correctly specified, the estimators from the differenced and undifferenced models should have the same probability limit, so the results should corroborate one another. Although we do not conduct the PSW-test here, a comparison of the estimated coefficients of (2) and (3) shows no sign of misspecification. In addition, the stationarity of the model now seems to be satisfied. Several problems remain. First, the standard error of the model is too high (139.5 % σ). The other goodness of fit statistics such as R^2 and F-value show a rather poor fit of the model. Secondly, by differencing the model, the error process is also altered from ε_t to $u_t = \varepsilon_t - \varepsilon_{t-1}$. The DW-statistic indicates a slight autocorrelation of u_t although it is not at a harmful level. Thirdly, as is often discussed, the differenced model loses all important long-run level information.

This simple first-order differenced model is still far from a proxy of DGP.

The ratio (saving rate) model :

The theory model [eq.(1)] is divided by current disposable income. The saving rate becomes the dependent variable in the transformed model.

OLS : 1966-1985 less 3 years forecasts

$$
\begin{aligned}
S_t/Y_t = \; & \underset{\substack{(15.6672)\\ [4.8654]}}{76.2269} - \underset{\substack{(3.9105)\\ [-0.5010]}}{1.9590}(F_{t-1}/Y_t) - \underset{\substack{(0.9926)\\ [-0.4244]}}{0.4213}(L_{t-1}/Y_t) \\
& - \underset{\substack{(0.9560)\\ [-3.0977]}}{2.9614}(L_t/Y_t) - \underset{\substack{(17.840)\\ [-1.935]}}{34.515}(Y_{t-1}/Y_t) + \underset{\substack{(1038.585)\\ [2.058]}}{2137.442}(BQF_{t-1}/Y_t) \\
& + \underset{\substack{(1640.057)\\ [0.108]}}{177.475}(BQF_t/Y_t) - \underset{\substack{(290.226)\\ [-2.266]}}{657.646}(BQL_{t-1}/Y_t) - \underset{\substack{(409.799)\\ [-1.115]}}{456.872}(BQL_t/Y_t) \qquad (4)
\end{aligned}
$$

$R^2 = 0.930$, $F(8,8) = 13.24$, $\sigma = 0.978$ (5.17 % σ),
DW = 2.647, RSS = 7.655, SC = 0.702, HQ = 1.06,
FPE = 1.46, $Z_1(3,8) = 0.97$, $Z_2(3) = 8.08$,
$Z_3(2) = 0.672$.

Analysis of scaled residuals : sample size = 17
Mean = 0.00, Standard deviation = 0.707,
Skewness = 0.057, Excess Kurtosis = -1.415,
Minimum = -1.039, Maximum = 1.127.

As noted in section III, the saving rate data have strong trends (i.e., the upward trend until 1975 and the downward trend since 1976). The forecasting values after 1983 tend to exaggerate this downward trend as indicated by the value of $Z_2(3) = 8.08$. The ratio model, thus, does not achieve the stationarity condition. This is probably because it lacks short-run dynamic (disequilibrium) behaviour.

In addition, some variables are insignificant (irrelevant) in the model but we retain them until a final model specification is selected.

Both the first-order difference model and the ratio model are not satisfactory by our diagnostics. A further transformation is needed. We could consider the ratio of the first-order difference model (i.e., dS/Y) or a second-order difference model (i.e., d^2S/Y). These models, however, have two serious drawbacks: (1) long-run level information is missing from the models and (2) an economic theoretical interpretation is difficult.

The difference in saving rate model can solve both problems without losing too much information. Let us explain how this model works.

<u>The difference in saving rate model :</u>

The ratio (saving rate) model is differenced by the first-order difference operator (d). As the ratio model does not show any serious sign of heteroscedasticity and autocorrelation of residuals (denote ε_t'), we take ε_t' as a white noise. Then the difference in saving rate model has a first order white noise error term (i.e., $u_t' = d\varepsilon_t' = \varepsilon_t' - \varepsilon_{t-1}'$). The nature of the error process u_t' is an empirical matter.

$$\begin{aligned} d(S/Y)_t = {} & (a_1-1)\ d(F_{t-1}/Y_t) + a_2\ d(L_{t-1}/Y_t) \\ & + a_3\ d(L_t/Y_t) + a_4\ d(Y_{t-1}/Y_t) \\ & + b_1\ d(BQF_{t-1}/Y_t) + b_2\ d(BQF_t/Y_t) \\ & + b_3\ d(BQL_{t-1}/Y_t) + b_4\ d(BQL_t/Y_t) + u_t' \quad (5) \end{aligned}$$

where $u_t' = \varepsilon_t' - \varepsilon_{t-1}'$ = an error term.

Note that, so far, through our *transformation* (one-to-one mapping), coefficients of the model remain the same (i.e., the only information we throw away is a_5).

Criticisms derived from the Hendry method on differencing techniques are based on the fact that a simple differencing loses all important long-run level (equilibrium) information [see, for example, DHSY (1978), p.680]. Taking this point, we *partition* (approximate) a variable such that,

$$\begin{aligned} d(F_{t-1}/Y_t) & = F_{t-1}/Y_t - F_{t-2}/Y_{t-1} \\ & = F_{t-1}/Y_t - (F_{t-1} - S_{t-1})/Y_{t-1} \\ & = F_{t-1}(1/Y_t - 1/Y_{t-1}) + (S/Y)_{t-1} \quad (6) \\ & \approx (S/Y)_{t-1} \quad (6') \end{aligned}$$

For large Y , the first term in (6) will reach zero from the negative direction (since usually $Y_t > Y_{t-1}$). Substituting

(6') into (5) and adding a constant term k_0 to pick up unexplained factors, we have now altered the values of parameters by dropping some information in the process of partitioning (6).

$$
\begin{aligned}
d(S/Y)_t = {} & k_0 + k_1 (S/Y)_{t-1} + k_2 d(Y_{t-1}/Y_t) \\
& + k_3 d(L_{t-1}/Y_t) + k_4 d(L_t/Y_t) \\
& + l_5 d(BQF_{t-1}/Y_t) + l_6 d(BQF_t/Y_t) \\
& + l_7 d(BQL_{t-1}/Y_t) + l_8 d(BQL_t/Y_t) + u_t^* \qquad (7)
\end{aligned}
$$

This is our baseline *empirical model* which preserves most theory information and includes level information (in the first two terms, i.e.,$(S/Y)^* = -k_0/k_1$). This model shares the idea espoused by Wickens and Breusch (1988) in better dynamic specification. They argue that it would be better to estimate the long-run equilibrium directly as well as short-run dynamics without arbitrary restrictions as in the error correction model.

The aim of an *empirical model* is not to justify a *theory model* but to seek a model with constant parameter representation as an approximation to the data generation process (DGP). In this way, the empirical model may add new insights which may have been neglected by the theory model.

To start with, it is important to check whether or not the baseline empirical model satisfies diagnostic tests for misspecification or for the error process. It is also necessary to examine whether other important variables are omitted. A direct regression of the baseline model [eq.(7)] gives the following results:

OLS : 1967-1985 less 3 years forecasts

$$
\begin{aligned}
d(S/Y)_t = {} & \underset{\substack{(2.302)\\ [2.613]}}{6.016} \; - \underset{\substack{(0.111)\\ [-2.739]}}{0.304} (S/Y)_{t-1} \; - \underset{\substack{(0.018)\\ [-0.111]}}{0.002} d(Y_{t-1}/Y_t) \\
& + \underset{\substack{(0.7089)\\ [1.1089]}}{0.7861} d(L_{t-1}/Y_t) \; - \underset{\substack{(1.4625)\\ [-1.1029]}}{1.6130} d(L/Y)_t \\
& - \underset{\substack{(0.0408)\\ [-0.8358]}}{0.0341} d(BQL_{t-1}/Y_t) \; - \underset{\substack{(0.0372)\\ [-0.5269]}}{0.0196} d(BQL_t/Y_t) \\
& - \underset{\substack{(1.0017)\\ [-0.3778]}}{0.3784} d(BQF_{t-1}/Y_t) \; - \underset{\substack{(0.9877)\\ [-0.5952]}}{0.3784} d(BQF_t/Y_t) \qquad (8)
\end{aligned}
$$

$R^2 = 0.6677$, $\sigma = 1.176$, $F(8,7) = 1.76$, $DW = 1.789$,
$RSS = 9.6795$, $SC = 1.06$, $HQ = 1.47$, $FPE = 2.16$,
$Z_1(3,7) = 0.18$, $Z_2(3) = 0.22$, $Z_3(2) = 0.125$.

Analysis of scaled residuals : sample size = 16
Mean = 0.00, Standard deviation = 0.683,
Skewness = -0.236, Excess kurtosis = -0.453,
Minimum = -1.249, Maximum = 1.285.

By this transformation, parameter constancy conditions are now fulfilled in Z_1 and Z_2 . However, the goodness of fit statistics show rather poor values in F-statistic, t-statistic, the standard error (σ) and R^2. Autocorrelation of the residuals may exist. Our diagnosis of this problem is that it is a consequence of some omitted variables.

<u>The Omitted variables :</u>

The theory model cannot comprehend all the relevant variables in the real world. Theoretical optimisation is undertaken within a limited framework, so it is quite likely that some important variables were omitted from the theory model. However, note that omitted variables in the theory model must be limited to those which the theory really cannot incorporate (such as the economic structural change due to the oil shock). Otherwise the theory model must be replaced by an alternative theory.

In general it is known that true omitted variables are hard to detect. A simple way of finding omitted variables is to examine the variables claimed to be significant by other econometric research on the same subject.

According to Deaton (1977), DHSY (1978), Hendry and von Ungern-Stenberg (1981) and Pesaran and Evans (1984), inflation effects on saving and consumption behaviour in the 1970s are significant and dummy variables are of importance if there are some shifts in economic structure. In fact, inflation in Japan in the 1970s was an unprecedented experience for many households. In addition, two oil shocks (i.e., in 1973 and 1979) are said to have altered the structure of the Japanese economy in general and Japanese society was forced to accept a shift to a lower economic growth path.

On this basis, three new variables are added to our empirical model:

dCPINF = the first-order difference of consumer price inflation rate

DUMMY345 = the first oil shock dummy ; 1 for 1973,1974 and 1975 and 0 for the rest of the periods

DUMMY90 = the second oil shock dummy ; 1 for 1979 and 1980 and 0 for the rest of the periods.

Inclusion of the inflation factor is expected to have a strong positive effect on the saving rate. It may be justifiable to use these omitted variables on the grounds that the theory model [eq.(1)] cannot take account of the inflation factor and structural changes in the economy.

IV.3. Model Specification

Hendry's model selection method is known as a "general to specific" approach. It is summarized as *intended overparametrization with data-based simplification* as opposed to the usual "specific to general" approach which can be described as *excessive presimplification with inadequate diagnostic testing* [see Hendry (1979)]. The key point of the Hendry method is that hypothesis testing can be meaningfully done only after the model characterises the data generation process. This overparametrized "general to specific" approach is surprisingly *efficient* in reaching a final simplified model.

First, the general model (i.e., eq.(8) with dCPINF and two DUMMIES) is estimated.

OLS : 1967-1985 less 3 years forecasts

$$d(S/Y)_t = \underset{\substack{(2.915)\\ [1.366]}}{3.983} - \underset{\substack{(0.131)\\ [-1.694]}}{0.223} (S/Y)_{t-1} + \underset{\substack{(0.01487)\\ [0.00940]}}{0.00014} d(Y_{t-1}/Y_t)$$

$$+ \underset{\substack{(0.763)\\ [0.933]}}{0.711} d(L_{t-1}/Y_t) - \underset{\substack{(0.982)\\ [-0.675]}}{0.663} d(L/Y)_t$$

$$- \underset{\substack{(0.903)\\ [-1.375]}}{1.242} d(BQF_{t-1}/Y_t) + \underset{\substack{(1.295)\\ [0.054]}}{0.069} d(BQF/Y)_t$$

$$- \underset{\substack{(0.028)\\ [-0.654]}}{0.019} d(BQL_{t-1}/Y_t) + \underset{\substack{(0.049)\\ [1.181]}}{0.058} d(BQL/Y)_t$$

$$+ \underset{\substack{(0.103)\\ [1.687]}}{0.174} dCPINF + \underset{\substack{(2.097)\\ [1.449]}}{3.039} DUMMY345 - \underset{\substack{(0.688)\\ [-1.936]}}{1.333} DUMMY90 \quad (9)$$

$R^2 = 0.907$, $\sigma = 0.821$, $F(11,4) = 3.57$, $DW = 2.364$,
$RSS = 2.696$, $SC = 0.299$, $HQ = 1.14$, $FPE = 1.18$,
$Z_1(3,4) = 0.01$, $Z_2(3) = 0.03$, $Z_3(2) = 0.664$.

Analysis of scaled residuals : sample size = 16
Mean = 0.00, Standard deviation = 0.516,
Skewness = -0.927, Excess kurtosis = 0.740,
Minimum = -1.343, Maximum = 0.771.

This general model has a standard error which improves on that from (8) by 30.2 percent. The indices of parameter constancy (i.e., Z_1 and Z_2) show the best possible values which, in turn, imply that this general model may possibly qualify as a proxy of DGP. However, some improvements to this model are possible.

First, let us consider partial regression coefficients (i.e., r^2 = partial R^2) of some variables. The calculated values are given as follows. $d(Y_{t-1}/Y_t)$; $r^2 = 0.000$, $d(BQF/Y)_t$; $r^2 = 0.0008$, $d(L/Y)_t$; $r^2 = 0.082$, $d(L_{t-1}/Y_t)$;

0.101, and $d(BQL/Y)_t$; $r^2 = 0.231$. These variables are likely to be irrelevant in explaining $d(S/Y)_t$. It is better to have a parsimonious model as long as it satisfies diagnostic tests. The inclusion of irrelevant variables makes parameter estimation inefficient. For a small sample regression, it may also lead to inconsistent estimation because of the lack of a degree of freedom.

Secondly, the residual distribution is strongly skewed which indicates the presence of an outlier (this is in fact 1982).

Taking account of these points, we simplify (9) and finally choose the following model as our best approximation for DGP.

OLS : 1967-1985 less 3 years forecasts

$$\begin{aligned} d(S/Y)_t = \underset{\substack{(1.209)\\ [3.642]}}{4.403} &- \underset{\substack{(0.058)\\ [-3.759]}}{0.218}\,(S/Y)_{t-1} - \underset{\substack{(0.021)\\ [-1.048]}}{0.022}\,d(BQL_{t-1}/Y_t) \\ &- \underset{\substack{(0.331)\\ [-2.239]}}{0.741}\,d(BQF_{t-1}/Y_t) + \underset{\substack{(0.041)\\ [4.927]}}{0.202}\,dCPINF \\ &+ \underset{\substack{(0.324)\\ [3.059]}}{0.991}\,DUMMY345 - \underset{\substack{(0.483)\\ [-3.168]}}{1.530}\,DUMMY90 \qquad (10) \end{aligned}$$

$R^2 = 0.868$, $\sigma = 0.653$, $F(6,9) = 9.87$, $DW = 2.246$,
$RSS = 3.842$, $SC = -0.214$, $HQ = 0.041$, $FPE = 0.614$,
$Z_1(3,9) = 0.58$, $Z_2(3) = 0.83$, $Z_3(2) = 0.360$.

Analysis of scaled residuals : sample size = 16
Mean = 0.00, Standard deviation = 0.775,
Skewness = −0.481, Excess kurtosis = 0.188,
Minimum = −1.770, Maximum = 1.468.

This model satisfies all the selection criteria and the standard error improves by 44.5 percent as compared to (8) and 20.5 percent as compared to (9). The values of all information criteria are reduced significantly. Actual and fitted values of d(S/Y) are shown in Figure 5-3.

An interesting finding which emerges is that the signs of the DUMMY are reversed from the first to the second oil shock. This may imply that households learned a lesson from the first oil shock and did not panic the second time it occurred.

For further parsimony, we drop bequest factors from (10) and see whether or not the model without bequest factors satisfactorily explains saving behaviour. The following model is estimated.

OLS : 1967-1985 less 3 years forecasts

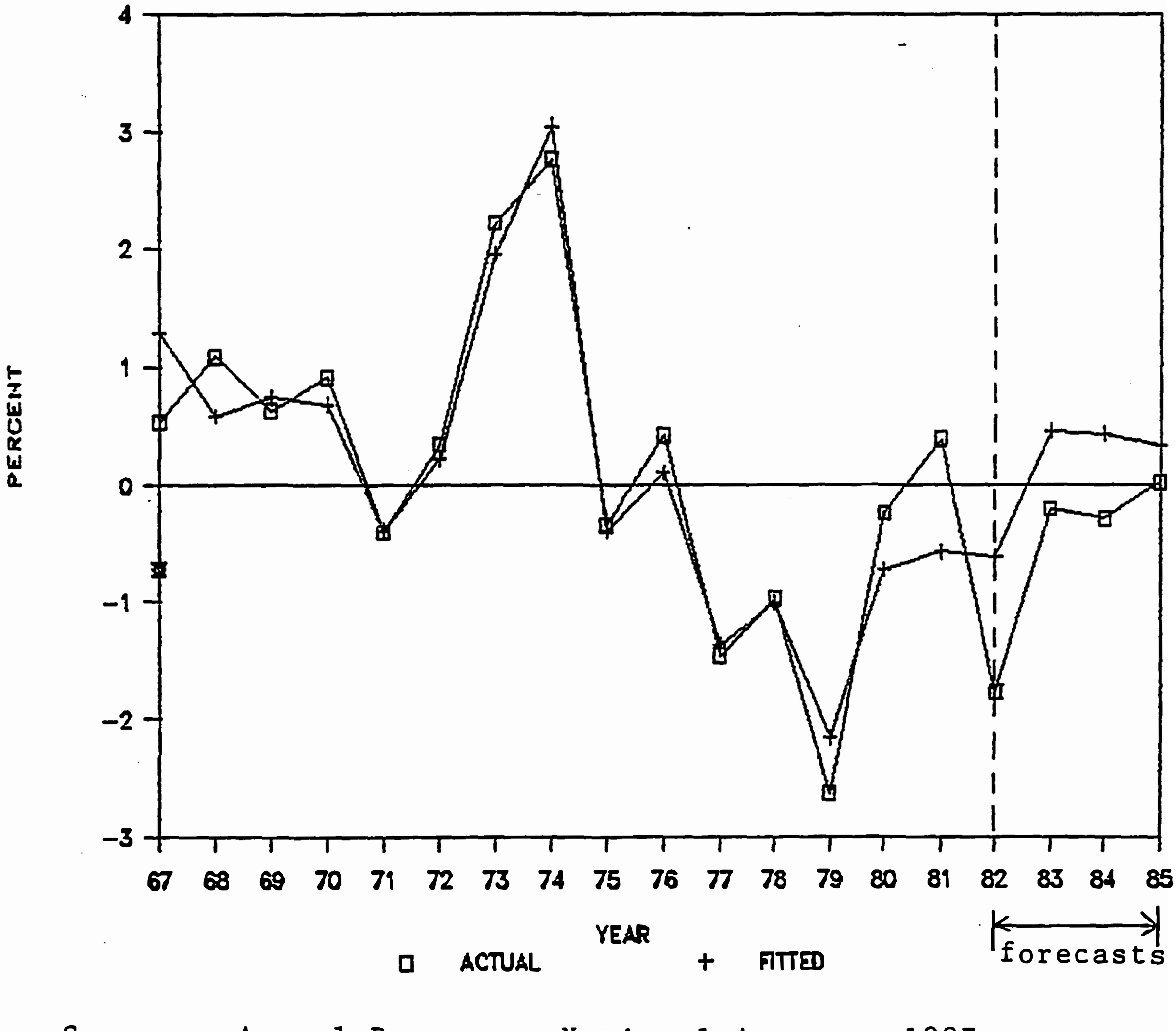
$$\begin{aligned} d(S/Y)_t = \underset{\substack{(1.691)\\ [1.821]}}{3.079} &- \underset{\substack{(0.096)\\ [-1.656]}}{0.159}\,(S/Y)_{t-1} + \underset{\substack{(0.027)\\ [5.370]}}{0.145}\,dCPINF \\ &+ \underset{\substack{(0.436)\\ [3.365]}}{1.467}\,DUMMY345 - \underset{\substack{(0.654)\\ [-2.440]}}{1.596}\,DUMMY90 \qquad (11) \end{aligned}$$

$R^2 = 0.771$, $\sigma = 0.778$, $F(4,11) = 9.28$, $DW = 1.966$,
$RSS = 6.656$, $SC = -0.106$, $HQ = 0.135$, $FPE = 0.794$,
$Z_1(3,11) = 0.46$, $Z_2(3) = 0.65$, $Z_3(2) = 0.882$.

Compared with model (10), this model is inferior in terms of goodness of fit (i.e., σ, R^2, F, RSS). Thus this model can not parsimoniously encompass model (10). Furthermore, dropping one of two bequest variables does not encompass either of the two previous models [i.e., eq.(10) and

FIGURE 5-3 : ACTUAL AND FITTED VALUES

OF CHANGE IN SAVING RATE



Source : Annual Report on National Accounts 1987.

eq.(11)]. Consequently, we may be able to conclude that the selected model [eq.(10)] is the most parsimonious model without being encompassed.

Let us now calculate a long-run saving rate from our selected model, assuming that there is no crisis such as the oil shock (i.e., DUMMY = 0).

$$S = k\,Y \qquad (12)$$

where $k = (4.403 - 0.022\,\mu_{L-1} - 0.741\,\mu_{F-1} + 0.202\,\mu_P - \mu_S\,)/\,0.218$

μ_{F-1} = the mean of $d(BQF_{t-1}/Y_t)$
μ_{L-1} = the mean of $d(BQL_{t-1}/Y_t)$
μ_P = the mean of dCPINF
μ_S = the mean of $d(S/Y)_t$

Substituting actual mean values for the period 1965-1985, we get k = 0.1908 which is the average propensity to save (APS). The marginal propensity to save (MPS) is calculated as $\delta S/\delta Y = 0.2020$ which confirms our conventional knowledge that MPS is higher than APS (i.e., MPC is smaller than APC where C means consumption).

When the economy is known to reach a steady-state path, it makes sense to calculate and consider a long-run steady-state saving rate as a future value. But in our case, bequest variables are very likely to increase substantially in the future. It is necessary to investigate a future course for the saving rate allowing exogenous variables to change in non-steady-state paths. We will take up this task in section VI.

V. Encompassing

As the theory model [eq.(1)] shows, the life-cycle model is nested within the bequest model. However, as a result of the model selection, the life-cycle factors are eliminated from the selected model as seen in (10). Does it mean that the bequest model without life-cycle factors can explain or account for at least as much of the saving behaviour as obtained from the life-cycle model without bequest factors ? How can we compare and evaluate non-nested competing models ?

Ever since Cox (1961,1962), statistical tests for the choice between competing models have been explored in the literature. They are known as "non-nested hypothesis tests" [for a survey, see MacKinnon (1983)]. In a case where a model (M_1) is nested within an other model (M_2), then M_2 automatically encompasses M_1. But as Hendry and Richard (1987) remarked, " this (possibility) is of little interest in worlds where limited sample evidence enforces parsimony in model specification " (p.14.).

In practice, we are interested in reconciling the claims of rival models with separate families of hypotheses explaining a specific economic phenomenon. The concept and application of encompassing tests has been developed by Mizon (1984), Mizon and Richard (1986) and Hendry and Richard (1987). As discussed earlier, their idea is based on the Popper-Lakatosian method of progressive research strategies in which historical evolution and falsification play important roles.

The concept of encompassing is briefly explained as follows [see Hendry and Richard (1987) for greater details].

Consider a variable $\{y_t\}$ which is generated by the data generation process (DGP). The actual DGP is not known. Let us further consider two rival models M_1 and M_2 as tentative empirical approximations of DGP, being represented by the density functions $f(y_t \mid \alpha)$ for M_1 and $g(y_t \mid \beta)$ for M_2 where α and β are finite-dimensional, identifiable and sufficient parameterizations. Let α^* and β^* denote estimators which are consistent within their respective models so that,

$$\text{plim}_{M1}\ \alpha^* = \alpha \qquad \text{plim}_{M2}\ \beta^* = \beta \tag{13}$$

A reinterpretation of β within M_1 can be based on the notion of pseudo-true value [on this, see Sawa (1978)] whereby M_1 is treated as a tentative DGP and

$$\beta_\alpha = \text{plim}_{M1}\ \beta^* \tag{14}$$

The statistic,

$$\phi^* = \beta^* - \beta_\alpha^* \tag{15}$$

compares the actual value of β^* with an estimator of its plim on M_1 . If ϕ^* is not significantly different from zero, then (sampling) M_1 (parametrically) encompasses M_2 with respect to β^*

The suggested encompassing tests can be divided into two categories. The first type (e.g., the Cox test) tests whether a model (M_1) directly encompasses a rival model (M_2). The second type of tests (e.g., the Sargan, the Ericsson, and the F tests) examine whether the model encompasses a "minimal" nesting (i.e., a joint model of M_1 and M_2) model. If so, then by transitivity (footnote 3), M_1 encompasses M_2. For definitions of above tests, see Ericsson (1983).

Let us consider an empirical application of encompassing tests to the controversy between the bequest model and the life-cycle model of saving. Naturally our selected bequest model [eq.(10)] is tested against a reasonable life-cycle model. In fact, two life-cycle models are examined.

One is a model within the framework of our theory model. The theory model [eq.(1)] without bequest factors is transformed into an empirical model [i.e.,eq.(9) minus bequest variables] and it is, in turn, simplified by diagnostic tests. The following model is selected.

OLS : 1967-1985 less 3 years forecasts

$$\underset{}{d(S/Y)_t} = \underset{\substack{(0.235)\\ [4.234]}}{0.995} - \underset{\substack{(0.004)\\ [-1.750]}}{0.007}\, d(Y_{t-1}/Y_t) - \underset{\substack{(0.004)\\ [-2.250]}}{0.009}\, d(TLF_{t-1}/Y_t)$$

$$+ \underset{\substack{(0.022)\\ [9.955]}}{0.219}\, dCPINF + \underset{\substack{(0.238)\\ [5.193]}}{1.236}\, DUMMY345 - \underset{\substack{(0.783)\\ [-1.112]}}{0.871}\, DUMMY90 \qquad (16)$$

3. The encompassing property satisfies a partial ordering, i.e., transitive, reflexive and antisymmetric.

where TLF stands for total household financial assets (footnote 4).

$R^2 = 0.842$, $\sigma = 0.678$, $F(5,10) = 10.66$, $DW = 1.925$,
$RSS = 4.60$, $SC = -0.21$, $HQ = -0.012$, $FPE = 0.632$,
$Z_1(3,10) = 0.34$, $Z_2(3) = 0.56$, $Z_3(2) = 1.20$.

Except for the normality test (i.e., Z_3), this life-cycle (LC) model seems quite competent in explaining dynamic saving behaviour, although this model does not provide a convenient means of implementing the long-run equilibrium solution (i.e., level information). This is a typical life-cycle model where saving is explained mainly by disposable income, financial assets stock and income growth factors.

The second model is derived independently from our theoretical framework. This is taken from the standard life-cycle model of Deaton (1977) and Pesaran and Evans (1984) (footnote 5).

---

4. This variable is often used as life-cycle financial wealth. However, it includes bequest wealth in our definition. In this chapter, as we avoid using artificially constructed bequest data, we cannot deduct bequest factors from total financial wealth. We have decided to use this raw data as it is.

5. The use of this formula for the encompassing test was suggested to me by Professor David Hendry. This is because the life-cycle model we have chosen [eq.(16)] is not a standard one and the use of (16) may be unfair to the life-cycle hypothesis.

OLS : 1967-1985 less 3 years forecasts

$$d(S/Y)_t = \underset{\substack{(1.972)\\ [0.962]}}{1.897} - \underset{\substack{(0.089)\\ [-2.562]}}{0.228} (S/Y)_{t-1} - \underset{\substack{(0.029)\\ [-8.690]}}{0.252} CPINF$$

$$+ \underset{\substack{(6.415)\\ [2.086]}}{13.379} g_t \qquad (17)$$

where CPINF = consumer price inflation rate
g_t = disposable income growth rate.

$R^2 = 0.841$, $\sigma = 0.622$, $F(3,12) = 21.13$, $DW = 2.595$,
$RSS = 4.637$, $SC = -0.545$, $HQ = -0.441$, $FPE = 0.483$,
$Z_1(3,12) = 0.80$, $Z_2(3) = 1.70$, $Z_3(2) = 0.461$.

This well established model satisfies most of the diagnostic tests except for a slightly high value of the index of parameter constancy (i.e., $Z_2(3) = 1.70$). The model is parsimonious and it is easy to interpret the parameters.

Using PC-GIVE's encompassing tests package, we compare our selected bequest model [eq.(10)] with the selected life-cycle models [eq.(16) and eq.(17)]. Let us define the models being involved in encompassing tests; model 1 = BQ model [eq.(10)], model 2 = LC model [eq.(16)] and model 3 = a joint model of M_1 and M_2 models. model 4 = LC model [eq.(17)] and model 5 = a joint model of M_1 and M_4

Encompassing test statistics are given in Table 5-1 (A) and (B).

TABLE 5-1(A) : ENCOMPASSING TEST STATISTICS

Model 1 ε Model 2	Form	Test	Form	Model 2 ε Model 1
- 1.283	N(0,1)	Cox	N(0,1)	- 2.586
0.865	N(0,1)	Ericsson IV	N(0,1)	1.659
0.682	Chi^2 (2)	Sargan	Chi^2 (2)	2.280
0.287	F(2,7)	Joint Model	F(3,7)	0.689
4.737	F(2,7)	Crit Values	F(3,7)	4.347

TABLE 5-2(B) : ENCOMPASSING TEST STATISTICS

Model 1 ε Model 4	Form	Test	Form	Model 4 ε Model 1
- 1.566	N(0,1)	Cox	N(0,1)	-2.345
1.015	N(0,1)	Ericsson IV	N(0,1)	1.611
1.122	Chi^2 (2)	Sargan	Chi^2 (2)	3.296
0.498	F(2,7)	Joint Model	F(5,7)	0.530
4.737	F(2,7)	Crit Vals	F(5,7)	3.971

Notes : The preferred value for all test statistics is zero. There is no standard critical value for normal distribution and Chi^2 distribution. As a rule of thumb, we take the absolute value of statistic $|\phi| \leq 1$ as an acceptable level.

In Table 5-1 (A), apart from the Cox test, all other test statistics indicate that the BQ model (M_1) clearly encompasses the LC model (M_2) and that the BQ model also parsimoniously encompasses the joint model (M_3). In Table 5-1 (B), test statistics are indeterminate except for the F-test. However, as a matter of comparison, in the case of every test statistic, the bequest model (M_1) is more likely to encompass the life-cycle model (M_4) than *vice versa*. At least, we can conclude that the life-cycle model (M_4) can not encompass the bequest model (M_1).

Of course this is not the demise of the life-cycle model. The above encompassing tests are not the final verdict. It may be possible to find a life-cycle model which encompasses the bequest model (M_1). An implication of the above result is that we should take the bequest model at least as seriously as the life-cycle model. There is no justification for rejecting the bequest model as Modigliani (1988) does.

VI. A Projection for Future Saving Rates

In the previous section, it is argued that a steady state long run equilibrium solution for the saving rate would not help to map the future course of the saving rate when relevant variables in the economy grow disproportionally. In this section, a simple projection analysis for future saving rate is carried out. The projection relies on the approximate data generation process (DGP), assuming parameter constancy over the predicting period.

The best simulation method is probably a Monte Carlo procedure. It is, however, rather costly to write a sophisticated Monte Carlo programme for this small exercise. Instead a simpler Box-Jenkins forecasting method is used. The actual procedure is reported in appendix of this chapter.

VI.1. The Results

The forecast is made for the period 1986-2010 on the basis of the 1980 values. The results are shown in Table 5-2 and Figure 5-4.

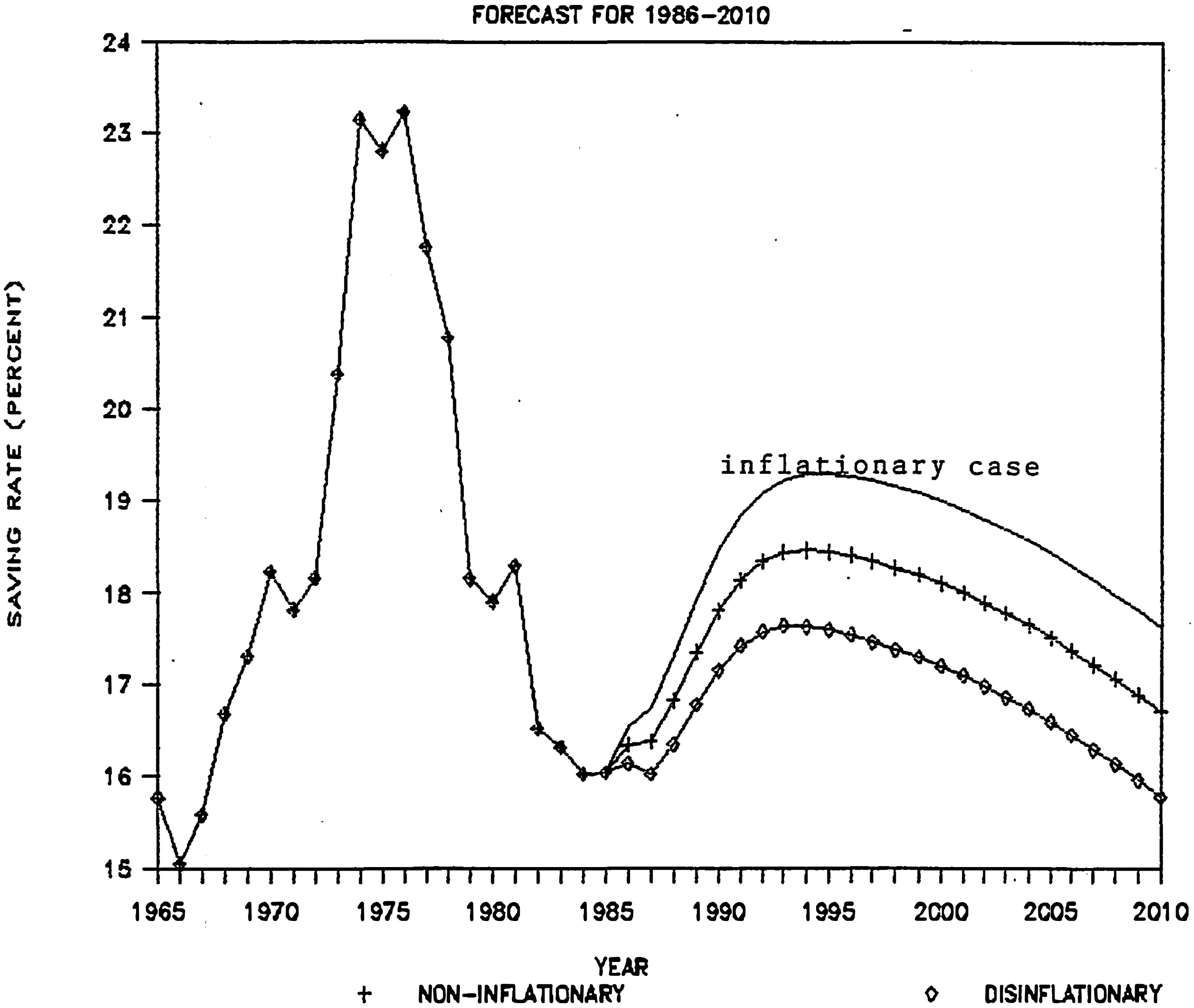
TABLE 5-2 : SAVING RATE PROJECTION (PERCENT)

Year	Inflationary (dCPINF=1)	Non-inflationary (dCPINF=0)	Deflationary (dCPINF=-1)
1986	16.54	16.34	16.13
1987	16.74	16.38	16.02
1988	17.31	16.83	16.34
1989	17.94	17.36	16.78
1990	18.47	17.81	17.16
1991	18.85	18.14	17.42
1992	19.10	18.34	17.58
1993	19.24	18.44	17.64
1994	19.29	18.47	17.64
1995	19.30	18.45	17.60
1996	19.27	18.41	17.54
1997	19.22	18.34	17.47
1998	19.16	18.27	17.38
1999	19.09	18.19	17.30
2000	19.01	18.10	17.20
2001	18.91	18.00	17.09
2002	18.81	17.89	16.98
2003	18.69	17.78	16.86
2004	18.57	17.65	16.73
2005	18.44	17.52	16.60
2006	18.29	17.37	16.45
2007	18.14	17.22	16.29
2008	17.98	17.06	16.13
2009	17.81	16.89	15.96
2010	17.63	16.70	15.78
AVG(86-10)	18.47	17.68	16.88

AVERAGE ANNUAL GROWTH RATES IN FIVE YEAR PERIODS

Year	Income	BQL	BQF
1986-90	2.81 %	6.74 %	6.14 %
1991-95	3.02	5.28	8.58
1996-2000	3.04	5.74	8.69
2001-05	3.04	5.60	8.66
2006-10	3.04	5.64	8.66

FIGURE 5-4 : SAVING RATE PROJECTION



Source : Annual Report on National Accounts 1987.

VI.2. Findings and Evaluation

Some interesting and unexpected findings emerged from the analysis.

First, from 1986 to 1995, the saving rate increased slightly by about 1 to 3 percentage points. This is probably because the real estate bequest (BQL) growth rate dropped from 6.74 to 5.28 percent during the period 1991-1995 as contrasted with the income growth rate which rose from 2.81 to 3.02 percent over the same period. The variable, $d(BQL_{t-1}/Y_t)$, thus, contributed to raise the saving rate during 1986-1995.

Secondly, after 1996, our forecast variables nearly reached steady-state growth rates (for income, 3.04 percent; for BQF, 8.66 percent; and for BQL, 5.64 percent), and the saving rate started declining slowly, implying that significant bequest transfers were being made. We can argue that the Japanese economy will enter the stage of substantial intergenerational transfers after 1996. Although the saving rate is expected to decrease after 1996, it will not fall as much as the static solution indicates (annual decline of 1.58 percent). In the year 2010, the saving rate will be about 16 percent (nearly the same as in 1985).

To sum up, this forecast suggests that the Japanese household saving rate will remain at the 16-19 percent level at least until 1995 and that, even after 1996, it will not decline as rapidly as the increase in bequests. It is certainly true, however, that the economic environment will change at some stage, and we cannot forecast exactly how the saving rate will change after 1996.

An immediate policy implication is that Japan will probably remain the leading capital exporter in the world because of the sluggishness of domestic investment in both the private and public sectors. For example, the IMF forecasts that Japan's saving surplus over domestic investment as a percentage of GNP will stay at about 5 percent during 1987-91 (see, World Economic Outlook 1987). As long as the Japanese propensity to save remains at a high level, this situation will continue even if the trade balance is altered by increasing imports which crowd out home products from the domestic market (assuming a relatively constant propensity to consume).

There are not many forecasts available of Japanese household savings in the twenty first century. Only one study by Fukao and Doi (1986) dealt with this problem. They used a life-cycle simulation model with special emphasis on the social security system. Their model is similar to the model used by Auerbach and Kotlikoff (1987). Fukao and Doi conclude that the saving rate will, more or less, steadily decline from 1985 to 2025. In the year 2010, their estimates [they have four cases according to the starting year of social security payments (age 60 or 65) and whether saving propensity is high or low] lie between 12 and 14 percent while our estimates are about 3 percent higher on average. Note, however, that the general trend after 1995 is downward as our results indicate.

There are two fundamental differences between the Fukao and Doi model and our model.

First, while bequest factors are included in Fukao and Doi's theoretical model, they do not play a significant role in the simulation. In our model, bequests are the most important variable, together with disposable income and change in inflation.

Secondly, while our model is based on econometric tests over historical data, Fukao and Doi's model is constructed on purely theoretical grounds with several arbitrary and untested assumptions. As the historical analysis shows in chapter 6, the social security effect on saving is inconclusive mainly due to the prematurity of the system. Of course, social security may prove to have a significant effect on savings in the future and such a possibility is not denied. Nevertheless, Fukao and Doi's argument for their choice of approach (i.e., the social security model) is not convincing.

The White Paper on Japanese Economy 1982 (Economic Planning Agency) has a section on household saving (i.e., Part II, chapter 1, section 2). The White Paper tries to explain household saving behaviour in terms of various factors. The Japanese household's high saving rate is explained in terms of (1) high income growth, (2) saving incentive for retirement, (3) housing demand, and (4) saving for education expenditure. Although the White Paper does not conduct a complete forecast, it is argued that the Japanese household saving rate has a downward trend. The level, however, would continue to be high.

The methodology of analysing saving behaviour in the White Paper is very different from our model. In our view, their approach is wrong and it misinterprets a lot of points in the model and the data [e.g., it neglects to interpret the constant term in the econometric saving model (p.242) whereas the constant term is the factor which explains a large part of the high saving rate in Japan as discussed in section III of this chapter]. However, the conclusion shares our view that the Japanese household saving rate will remain at a high level (at around 16-18 percent) in the foreseeable future.

Finally, OECD Economic Outlook 42 (December 1987) conducts projections for the Japanese economy. In the shadow of the October stock market crash (19th October 1987), the OECD forecasts a modest growth in 1988-1989. However, the household saving rate is expected to be nearly the same as our results in the inflationary case (dCPINF=1) except in 1987. That is to say, the OECD projection of the saving rate equals 17.25 percent in 1986, 18.25 percent in 1987, 17.75 percent in 1988 and 17.50 percent in 1989 with nominal disposable income growth rates of 5 percent in 1986, 5 percent in 1987, 4.75 percent in 1988 and 4.75 percent in 1989. A jump in the OECD forecast for 1987 reflects their assumption of an income tax reduction at the end of 1987. This assumption did not hold true. The OECD expects the Japanese household saving rates to rise slightly higher in the second half of the 1980s than it did in the first half of the 1980s. This is consistent with our view of changes in the Japanese saving rate.

VII. Evaluation

The basic motivation for investigating Japanese household saving in this chapter is to examine whether or not the bequest model explains the Japanese saving behaviour better than the life-cycle model from the econometric point of view.

This motivation is, in our view, satisfied in the above analysis. We have shown that the bequest model satisfies diagnostic tests of the Hendry method and that the bequest model can encompass the life-cycle model and not *vice versa*. The parameter constant representation of the bequest model [eq.(10)] can be used as a proxy of DGP of the Japanese household saving behaviour. In section VI, this model is used for the projection of future saving rates in Japan.

Several points are to be noted from our selected model [eq.(10)]:

(1) The inflation effect is significant in the saving model. *Ceteris paribus*, a change of 1 percent in the inflation rate makes the household raise its saving rate by 0.93 percent. In the high inflation period, for example, in 1974, the inflation factor raised the saving rate by 9.9 percent.

(2) Dummy variables are also important. DUMMY345 is meant to capture the effect of the first oil shock in 1973-75. During that period, in addition to the oil shock, various other socio-economic changes occurred. For example, the social

security system was substantially improved and it shifted from the "fully funded" to the "pay-as-you-go" system. The bequest tax exemption level was increased in 1973. Also, with the collapse of the Smithsonian agreement, the general floating exchange rate system started in early 1973. The period of the second oil shock overlaps with Japan's emergence as the leading world economic power (notably, in December 1980, the new Foreign Exchange Law was introduced). The two dummy variables show opposite signs ; *ceteris paribus*, DUMMY345 raised the saving rate by 4.5 percent while DUMMY90 reduced the saving rate by as much as 7.0 percent. As mentioned earlier, we could interpret these differences to mean that the household sector learned a lesson from the first oil shock and adjusted smoothly to a lower economic growth path in the case of the second oil shock. Dummy variables, however, capture other factors as well. We cannot attribute all the magnitude of the sign change to the oil shocks.

(3) For current saving behaviour, only the previous year's (lagged) bequest transfers matter. This was confirmed by empirical results. Bequest transfers, however, have very a small effect on the saving rate over the sample period. On average, *ceteris paribus*, a unit change in real estate and financial bequests put together reduced the saving rate only by about 0.57 percent, although in 1975 it was raised by 2.9

percent and, in the period 1980-85, it was reduced by 1.58 percent.

(4) It should be noted that as a *statistically* satisfactory model, it is not necessary to introduce anything special for Japan (e.g., cultural and institutional factors). The neoclassical framework is perfectly applicable. However, the high constant term in eq.(10) implies that a kind of habit formation in Japanese savings may exist. This habit is not fully explainable by the neoclassical framework (see the discussion below).

For the rest of this section, we would like to discuss the puzzle of the high Japanese saving rate.

In section III, characteristics of the series of saving rate during the period 1965-85 were summarised on two grounds : (1) a very high mean saving rate (i.e., 18.4 percent) and (2) a low variance of the saving rate (i.e., 6.5 percent). We pointed out that because of low variance, any single explanatory variable could not successfully explain the high saving rate by means of conventional statistical method. This simple fact has been neglected by almost all economists who are concerned with the puzzle of the high saving rate in Japan.

The high saving rate in Japanese households should be attributed to a constant term that picks up unexplainable factors. In eq.(12), the marginal propensity to save (MPS) is about 20 percent. Other variables explain minor changes in the saving rate within a plus/minus 6 percent range from MPS. The constant term, in fact, explains most of the saving rate (over 65-70 percent). What explanation can we give to the high value of the constant term ? Theoretically it implies that a high proportion of savings are not influenced by short-run economic fluctuations. This fact explains why short-run variables such as interest rates and the Maruyu system (tax exemption on interest income from savings) do not influence the saving behaviour [for this aspect, see Ishikawa (1987) and Yoshino (1984)].

The majority of savings must be made for some long-run reasons. In practice, the major reasons generally proposed for saving in Japan can be categorised in three groups:

(1) The economic environment such as high economic growth, inflation and demographic (aging) factors.

(2) Institutional factors such as bonus system, social security system, the high labour force participation rate among the elderly, and consumption-saving habit by institutional contracts.

(3) Lifetime motivations such as preparing for illness or unexpected disaster, education and marriage, old age (retirement), and land and housing purchases.

The first group is concerned with short-run fluctuations, so this group cannot offer long-run reasons. The factors in the second group are also not long enough to explain a high constant term over twenty years. In addition, these factors are difficult to incorporate in neoclassical theory, in particular, with lifetime utility optimisation framework [however, see Ishikawa and Ueda (1984) and Ishikawa (1987)]. Only the third group seems to give sensible long-run reasons for savings. According to The Annual Public Opinion Survey on Saving 1987 (Source : The Central Council for Savings Promotion, The Bank of Japan), the five consistently important motives for household savings are those relating to (1) illness/unexpected disaster, (2) children's education and marriage, (3) after retirement, (4) land/housing purchases and (5) peace of mind. These motives can be roughly grouped by our theoretical framework; life-cycle motivated savings [(1)(3)(5)] and intergenerational transfer (bequests) motivated savings [(2)(4)].

In chapter 3, the stock aggregate saving function is given by [chapter 3, eq.(15)],

$$S_t = \alpha_1 Y_t + \alpha_2 BQ_t + v_t , \quad \alpha_i > 0 . \qquad (18)$$

and savings are made for the purpose of consumption in the retired period and for bequests to the next generation such that,

$$(1+r_t)S_t = C_{t+1} + BQ_{t+1} . \qquad (19)$$

If current bequests (BQ_t) are large, then current savings (S_t) are also large and by the intergenerational game (section III, chapter 3), maximum bequests (BQ_{t+1}) are expected to be transferred. In this stock concept of savings, large bequest receipts (BQ_t) imply large savings (S_t) and large savings induce large bequest transfers (BQ_{t+1}). The high saving rate is, therefore, explained by relatively large bequest receipts ($\bar{BQ}_t$) and by a high motivation to leave relatively large bequests (BQ_{t+1}). Chapter 4 showed that the bequest wealth ratio to total wealth was around 40-50 percent excluding expenses on children's education and marriage (inclusion of such expenses would raise the ratio up to, at least, 60 percent). This result implies that life-cycle motivated savings (wealth) and bequest motivated savings (wealth) are about the same. If the constant term, implicitly, represents the above two categories of long-run savings, then one half of the constant term (i.e., 10 percent of the saving rate) can be explained by bequest motivated savings.

The problem in this chapter was that the dynamic saving model [eq.(10)] did not show this implication as clearly as the stock saving model [a variation of eq.(18)]. In fact, the selected model [eq.(10)] indicated the negative effect of bequests on saving rate, although this effect was relatively small. It implied that an increase in bequest-income ratio reduced the change in saving rate.

We can interpret this as follows; if the bequest-income ratio is high, then future benefactors of bequests are not obliged to save (flow savings) for the sake of future bequests as the bequest-income ratio approaches its steady-state value. From the result of future projections (section VI), we would expect the bequest-income ratio to reach its steady-state value around 1996. Until then there remains a strong incentive to accumulate household wealth. So the dynamic saving model implies that a large portion of flow savings are also motivated by bequest wealth accumulation.

VIII. Conclusion

With the aid of recent econometric methodology and rigorous statistical tests, the bequest model turns out to be a successful model of dynamic saving behaviour.

Along with one period lagged bequest variables and one period lagged saving rate, the change in the inflation rate and two oil shock dummies have been important factors in Japanese household savings over the last twenty years.

A pure life-cycle model of saving is encompassed by the bequest model. The bequest model also parsimoniously encompasses the joint model of bequest and life-cycle saving. This result is probably the first result to show that the bequest model is diagnostically superior to the life-cycle model of saving. Together with the results in chapter 4, the importance of bequests in the saving model has been amply demonstrated.

However, an important limitation of this model is that it cannot *directly* explain why the saving rate is so high in Japanese households. The reason for the high saving rate in Japan has been a puzzle that has attracted many economists' attention. This puzzle is, after all, ascribed to the constant term in econometric models. Indeed, the constant term does not tell its meaning explicitly. However, we interpret that at least one half of the constant term can be attributed to the bequest motive; that is about 10 percent of the saving rate out of the average saving rate of 18.4 percent.

The proof of a good econometric model is its forecasting power. The saving rate up to the twenty-first century was projected. Despite the increase in bequest transfers, until 1995, we forecast that the saving rate will rise slightly by about 1 to 3 percentage points (i.e., 17-19 percent). This is because the income growth rate will increase relatively (not absolutely) faster than the bequest growth rate. After 1996, the saving rate will decline steadily and slowly. However, it will decline so slowly that, even in 2010, the rate will remain at around 16 percent, which is nearly the same as in 1985.

The policy implication of this forecast is that Japan will probably continue to be the leading capital exporter to the rest of the world unless domestic investment opportunities (including public investment) increase to absorb most of household savings.

APPENDIX. THE PROJECTION PROGRAMME.

The context of the programme can be described as follows;

(1) The approximated data generation process

We use our selected saving model, estimated in the period 1967-1985 and exclude dummy variables, assuming that unexpected shocks will not occur.

$$d(S/Y)_t = 4.403 - 0.218\ (S/Y)_{t-1} - 0.022\ d(BQL_{t-1}/Y_t) - 0.741\ d(BQF_{t-1}/Y_t) + 0.202\ dCPINF \qquad (A\text{-}1)$$

(2) Exogenous variables forecasting

We use the Box-Jenkins univariate time series forecasting method for BQL, BQF and Y . For BQL and BQF, we utilise estimations made in chapter 4. For Y, we have a AR(2) process (statistical notations are the same as before),

$$\underset{\substack{(0.29)\\ [5.86]}}{Y_t = 1.70\ Y_{t-1}} \ \underset{\substack{(0.30)\\ [-2.30]}}{-\ 0.69\ Y_{t-2}} \qquad (A\text{-}2)$$

$R^2 = 0.999$, $\sigma = 3610.35$ (% s.e.= 2.64%),
$F(1,14) = 24185.48$, $DW = 2.17$, $SC = 16.60$, $HQ = 16.64$,
$Z_1(3,14) = 0.06$, $Z_2(3) = 0.06$, $Z_3(2) = 0.278$.

We assume that, during the forecasting period, Y_t would remain balanced (neither stationary nor explosive) by approximating $1.70 - 0.69 \approx 1$ (i.e., lies on the unit circle of difference equation solution). We could employ the Box-Jenkins method of forecasting as we did for BQL and BQF for the sake of practical simplicity.

dCPINF, on the other hand, indicates a random walk without drift and the mean = - 0.138. So past information does not help to forecast future dCPINF. We decided to use three cases of fixed value for dCPINF, namely dCPINF = 1.0 (i.e., inflationary situation), dCPINF = 0.0 (i.e., zero-inflationary situation), dCPINF = - 1.0 (i.e., deflationary situation). We assume modest inflation changes and thus do not include such a high-inflation change as in 1973-75. In practice, we do not expect the rate of change in inflation to remain constant over time, so our case should be understood as modest upper and lower boundaries of dCPINF.

Given independently estimated BQL, BQF and Y, assuming covariances of residuals of these variables over different periods and covariances of residuals and lagged variables are both zero, we can create point estimates for $\underline{d(BQL_{t-1}/Y_t)}$ and $\underline{d(BQF_{t-1}/Y_t)}$ where the underline indicates estimated values.

(3) Endogenous variables generation

We have two endogenous variables in this program : $d(S/Y)_t$ and $(S/Y)_t$.

First, let us consider the first year of the forecast period, given the actual value of the previous year's saving rate $(S/Y)_{t-1}$, together with created variables, $\underline{d(BQL_{t-1}/Y_t)}$, $\underline{d(BQF_{t-1}/Y_t)}$ and $\underline{dCPINF}$. We can generate,

$$\underline{d(S/Y)_t} = 4.403 - 0.218\ (S/Y)_{t-1} - 0.022\ \underline{d(BQL_{t-1}/Y_t)} - 0.741\ \underline{d(BQF_{t-1}/Y_t)} + 0.202\ \underline{dCPINF}$$

Second, since $d(S/Y) = (S/Y)_t - (S/Y)_{t-1}$, we can generate the current saving rate by,

$$\underline{(S/Y)_t} = \underline{d(S/Y)_t} + (S/Y)_{t-1}$$

With the newly generated $\underline{(S/Y)_t}$, we can generate $\underline{d(S/Y)_{t+1}}$ in turn. Repeating this process, a sequence of forecasts $\{\underline{d(S/Y)_k,\ (S/Y)_k}\}_{k=t,...T}$ is obtained. It completes our programme.

PART III POLICY

CHAPTER 6

FISCAL POLICY EFFECTS ON SAVING AND BEQUEST BEHAVIOUR : AN ECONOMETRIC POLICY EVALUATION

I. Introduction

Since the first oil shock (1973), the Japanese government has relied heavily on public debt issues for financing budget deficits. During the same period, the household saving rate has declined steadily (see Figure 5-1 in chapter 5). Many economists wondered if there were any causal relationships between deficits and household savings.

Economists' thinking on this problem in recent years has been influenced and stimulated by the work of Barro (1974). He revived the fiscal policy neutrality proposition of Ricardo. This proposition states that a rational household is indifferent between current deficits and future taxes due to current deficits. If this proposition holds, deficits would induce households to save for future taxes and would fail to stimulate aggregate demand. However, a first glance empirical evidence from the USA and Japan seems to contradict this proposition (it shows decreases in savings alongside fiscal deficits) and after a decade's debate, the validity of the Ricardian equivalence proposition is still inconclusive. As Aschauer (1985) pointed out, econometric model misspecification and lack of rigorous diagnostic tests might result in conflicting results regarding the potency of fiscal policy. In particular, empirical work on Ricardian equivalence proposition on Japan has been insufficient in terms of quantity (number of works) and technical quality (econometric method).

The purpose of this chapter is to examine Ricardian equivalence proposition by means of rigorous econometric tests. In doing so, we use new tests of causality and co-integration developed by Granger and those of encompassing developed by Hendry. The major finding from our empirical research is that there is no active fiscal policy effect on household savings and bequests. This result rejects both Ricardian equivalence and Keynesian multiplier story. Saving and bequest decisions are likely to be carried out without involving any fiscal policy variables. Effective tax rates are shown to be fairly stable over the sample period, so there is no evidence of tax policy influence on household savings and bequests (although it should be noted that taxation could directly change household disposable income).

The chapter is organised as follows. Section II surveys historical data on fiscal policy activities and clarifies characteristics of fiscal policy used by the Japanese government during the period 1965-1985. In section III, a series of econometric tests, i.e., Granger-causality tests, co-integration tests and encompassing tests, are carried out. Section IV summarises empirical findings and their implications.

II. The Historical Data Analysis

The data are taken from Annual Report on National Accounts 1987, Report on Revised National Accounts on The Basis of 1980 (Economic Planning Agency), Economic Statistics Annual 1987 (The Bank of Japan) and Tax Bureau Annual Report 1965-1985 (Ministry of Finance).

The data series are annual (calendar year) for the period 1965-1985. These are deflated by the 1980-base price indices (i.e., the consumer price and land price indices). The unit value for raw data is billions of yen. The raw data are available in data appendix at the end of the thesis.

II.1. The Government Fiscal Activities

Fiscal policy refers to the actions of the government in collecting and spending private resources.

The government's budget identity is defined as,

$$G = T - rD + \delta D \qquad (1)$$

where G = total government expenditure (consumption and public investment),
T = total tax revenue,
r = an interest rate for government bonds (D),
δD = deficits = new issues of government bonds.

Given the stock of government bonds and its interest payments (i.e., rD), this identity is determined by two of other three variables (i.e., G, T and δD).

In fact, it is helpful to identify which two variables are discretionary since fiscal policy analysis, including the Ricardian equivalence proposition, often uses a fiscal policy identity similar to (1) without investigating the behavioural structure of it. If one of the discretionary fiscal variables reacts to structural variables in our economic model but is included in consumption or saving function for a Ricardian equivalence test, then OLS estimation could be biased as well as inconsistent. It may also face a Lucas critique situation with a shift of such a policy variable [i.e., non-super exogenous, for which concept, see Engle *et al.* (1983)]. These points are examined in section III.3.

Before conducting econometric investigations, it is important to understand how the government fiscal activities have actually changed over the last twenty years.

First, look at Table 6-1. The composition of government expenditure between 1965 and 1985 is shown. Notable changes are (1) decreases in government consumption and saving (including public investment) and (2) increases in interest payments and social security benefit payments. Other factors remain more or less constant. As both interest payments and social security benefit payments have a contractual (institutional) nature, the degree of freedom for finetuning stabilization has decreased. The fiscal expenditure pattern shifted clearly in 1975 (e.g., the social security system and government saving).

TABLE 6-1 : THE COMPOSITION OF GOVERNMENT EXPENDITURE (%)

YEAR	CONSUMP -TION	INTEREST PAYMENT	SOCIAL SECURITY	SAVING OR INVESTMENT	OTHERS	TOTAL
1965	42.0	2.1	16.8	27.5	11.7	100.0
1966	42.1	2.4	17.3	25.7	12.6	100.0
1967	39.8	2.9	16.4	28.3	12.6	100.0
1968	38.2	3.2	16.4	29.1	13.2	100.0
1969	37.6	3.2	16.4	30.1	12.7	100.0
1970	36.0	3.0	16.3	32.2	12.5	100.0
1971	36.9	3.1	16.2	31.4	12.4	100.0
1972	37.9	3.7	17.5	27.9	13.2	100.0
1973	36.9	3.9	16.4	30.3	12.4	100.0
1974	37.3	3.9	18.7	25.7	14.3	100.0
1975	41.8	5.0	24.7	13.2	15.4	100.0
1976	41.8	6.5	27.6	8.4	15.6	100.0
1977	39.9	7.7	27.8	9.2	15.4	100.0
1978	39.5	9.1	29.7	5.8	16.0	100.0
1979	36.8	10.0	29.0	9.1	15.0	100.0
1980	35.6	11.4	28.6	9.4	15.0	100.0
1981	34.2	12.3	28.7	10.5	14.3	100.0
1982	33.7	13.1	29.7	9.5	13.9	100.0
1983	33.5	14.3	31.0	7.8	13.4	100.0
1984	32.5	14.7	30.4	10.7	11.7	100.0
1985	31.2	14.5	29.3	13.7	11.3	100.0

Source : Annual Report on National Accounts. Calendar Year.

Table 6-2 shows the composition of government revenue. Property income (i.e., interest income and rents) has increased over the sample period. Social security tax shifted upward in 1975. Its percentage share has remained constant since then. The proportion of direct tax (especially income tax) has been stable over the period. Indirect tax, on the other hand, decreased by 12 percent so that the ratio between indirect tax and direct tax was reduced from 1 to 0.65.

TABLE 6-2 : THE COMPOSITION OF GOVERNMENT REVENUE (%)

YEAR	(1)	(2)	(3)	(4)	(5)	(6)	TOTAL
1965	3.4	37.5	38.6	37.8	19.7	0.9	100.0
1966	3.7	37.4	36.8	36.1	21.2	0.9	100.0
1967	3.8	36.9	36.9	36.1	21.6	0.8	100.0
1968	4.0	36.5	38.0	37.0	20.9	0.7	100.0
1969	4.0	35.1	39.5	38.4	20.8	0.6	100.0
1970	4.2	34.4	39.7	38.7	20.9	0.8	100.0
1971	4.6	32.8	40.4	39.4	21.4	0.9	100.0
1972	5.1	32.6	39.8	38.5	21.6	0.9	100.0
1973	5.1	31.2	42.2	41.0	20.6	0.8	100.0
1974	5.1	28.2	44.9	43.7	21.1	0.8	100.0
1975	5.7	27.3	39.5	38.2	26.7	0.8	100.0
1976	5.9	27.7	38.3	36.8	27.2	0.9	100.0
1977	5.9	28.2	37.4	35.9	27.6	0.9	100.0
1978	6.3	27.8	37.3	35.8	27.7	0.9	100.0
1979	6.4	27.8	37.5	36.0	27.5	0.8	100.0
1980	7.0	26.7	39.1	37.7	26.4	0.8	100.0
1981	7.6	26.0	38.8	37.5	26.8	0.8	100.0
1982	7.8	25.5	38.6	37.4	27.2	0.8	100.0
1983	8.0	24.7	39.0	37.7	27.4	0.8	100.0
1984	8.2	25.3	38.9	37.5	26.8	0.8	100.0
1985	8.5	25.2	39.0	37.6	26.5	0.8	100.0

Source : Annual Report on National Accounts. Calendar year.
Notes : Column (1) = property income, (2) = indirect tax, (3) = direct tax [of which (4) = income tax]. (5) = social security tax, and (6) = other income.

When tax revenue is insufficient to finance government expenditure, the government must borrow money from the private sector or from abroad. Borrowing (i.e., debt finance) is made through government bond issues. Until 1974 debt finance was limited. From 1975 to 1980, reliance on debt finance increased rapidly, partly because tax revenue (especially corporate tax) decreased as a result of the economic depression caused by the first oil shock and partly because expansionary fiscal policy aimed at stimulating the economy was taken by the Miki and Fukuda governments (1975-78). After 1981, the government tried to reduce its huge public debt by tightening its fiscal stance. Table 6-3 reports such shifts in fiscal policies.

The peak of deficit-government expenditure ratio [column(1)] was in 1979. Ever since it has declined steadily. This has been done by cutting public investment and consumption as shown in Table 6-1. In this sense, fiscal policy in the 1980s could be seen as contractive. However, the debt-GNP ratio [column(3)] increased as long as deficits remained positive. Increases in both the tax-GNP ratio and the debt-GNP ratio imply that the role of the government in the economy has expanded over the sample period despite the effort made to be a "small" government.

Column(5) shows a Ricardian equivalence tax burden ratio [i.e., (household direct tax + social security tax - social security benefits + deficit) ÷ household total income * 100 (%)]. To satisfy the Ricardian equivalence condition, households must optimise consumption/saving and bequest behaviour with respect to Ricardian equivalence budget constraints (i.e., total income minus the "true" or "expected" tax).

TABLE 6-3 : DEFICIT FINANCE AND DEBT (%)

YEAR	(1)	(2)	(3)	(4)	(5)
1965	3.1	0.6	5.4	18.8	10.0
1966	9.2	1.8	7.0	18.3	12.5
1967	8.3	1.6	8.6	18.4	12.7
1968	4.5	0.9	9.1	18.7	11.4
1969	3.4	0.7	8.8	18.6	11.2
1970	2.3	0.5	8.5	19.7	11.0
1971	6.8	1.5	9.4	20.5	13.5
1972	9.8	2.1	12.7	20.3	14.1
1973	7.0	1.6	11.7	21.1	13.7
1974	6.6	1.6	11.7	23.1	12.6
1975	14.8	3.6	15.4	22.5	14.1
1976	18.3	4.3	19.6	22.0	14.5
1977	20.9	5.2	24.8	23.0	16.0
1978	21.3	5.2	30.5	22.7	15.4
1979	23.1	6.1	35.0	24.4	18.2
1980	21.4	5.9	39.6	25.4	17.9
1981	17.2	5.0	41.6	26.7	17.0
1982	17.7	5.2	45.0	26.9	17.1
1983	16.2	4.8	48.9	27.1	16.1
1984	14.1	4.3	50.3	27.6	15.2
1985	12.6	3.9	51.6	28.2	15.2

Source : Annual Report on National Accounts (Economic Planning Agency) and Economic Statistics Annual (Bank of Japan).

Notes :(A) Deficit is measured on the basis of general account which is restricted to the central government's budget. Total government expenditure is measured, on the other hand, on the basis of the general government sector.

(B)(1) = the ratio of deficit to total government expenditure. (2) = the ratio of deficit to GNP. (3) = the ratio of debt to GNP. (4) = the ratio of total tax revenue to GNP. Ricardian net tax burden in (5) is defined as the net household tax (i.e., household direct tax + social security tax - social security benefits) plus deficits (such as future taxes) divided by household total income (i.e., wage income + capital income).

II.2. Taxation on The Household Sector

We now turn to investigate direct effects of taxation on the household sector. There are three major taxes imposed on households ; income tax (including local inhabitant's taxes), property tax and social security tax. Tax bases for income and social security taxes are wage and capital incomes. That for property tax is the officially evaluated value (about 30-50 percent of market values) of households' property holdings. Bequest tax is also considered. Needless to say, this tax is imposed on a household once or twice in a lifetime.

An effective tax rate is calculated for each type of taxation (i.e., each tax revenue is divided by a respective tax base). In general, the effective tax rate remains fairly stable, although each tax rate increases slightly. Results are shown in Table 6-4.

A notable change is found in the social security tax rate [column(2)] after 1975. This reflects the fact that the social security system shifted from the fully funded system to the pay-as-you-go system in 1975. Note that the pay-as-you-go system was still too immature to draw any policy implications from it.

The effective income tax rate [column(1)] has been stable and very low by international standards. It is therefore misleading to argue that the income tax rate in Japan is high in general. The problem lies in horizontal inequalities between different occupations. Although this issue is worthy of further research it is ignored in this thesis.

The effective property tax rate [column(3)] is, on average, 0.4 percent which is extremely low. This low tax rate makes property assets by far the most attractive form of wealth holdings in Japan. Although property tax is imposed on property assets, actual tax payment is usually made out of household income. We calculated an alternative property tax rate based on household income [column(4)]. It is surprising to find that this tax rate has decreased steadily (i.e., in 1985, it is 65 percent lower than in 1965). It implies *de facto* tax reduction. We may infer that the government's property tax policy *directly* distorts the household's wealth holdings [i.e., it makes property holding relatively attractive, for this aspect, see, for example, Noguchi (1984, 1988)].

The bequest tax schedule has been fixed throughout the sample period except for some increases in tax exemption limits (notably in 1973). Nonetheless the effective tax rate [column(5)] has increased rather rapidly as the large value of variance indicates. It shows a striking contrast with other stable effective tax rates. In fact, it reflects our major point that bequest transfers have increased significantly in terms of quantity and monetary value. The effective bequest tax rate, on average, is 17.4 percent which is not as high as is usually believed. When we take into account tax exempt and unreported bequests (the appendix in chapter 4 indicate "true" bequests are 2.66-2.93 times as high as the Tax Bureau bequest data), a "true" effective bequest tax rate would be around 6 - 6.5 percent which is, again, very low.

The bequest tax system also treats property (real estate) transfers advantageously because property bequests are evaluated at 50-70 percent of their market value while financial bequests are evaluated at market value. It must be stressed that both property and bequest tax systems make real estate holdings unnecessarily attractive. In our view, these government tax policies are partly to blame for high land prices and housing problems in Japan. In this sense, they give real effects on real estate holdings and its transfers and on the price mechanism of real estate. However, note that these tax policies itself do not increase/decrease savings and bequests but distort wealth holdings (i.e., composition of savings and bequests).

Column(6) measures net total household tax burden. It is defined as (direct tax + social security tax - social security benefits) divided by (wage and capital income). Direct tax mainly consists of income (including local inhabitant's taxes) and property taxes. While individual effective tax rates have followed a slightly upward trend over the sample period, the figures in column(6) remain remarkably stable. Taking an extended Japanese family view (i.e., regarding social security transfers as intrafamily redistribution of income), the net household tax burden has been kept constant at around 9 percent. This measure is, in fact, known as *the Kasumigaseki-rule* (Kasumigaseki is where the government is located)(footnote 1). Although it has never been approved officially as the fiscal authority's *rule*, such a stable measure, shown by its low variance (0.9), seems to be eloquent evidence of it.

1. *The Kasumigaseki-rule* is reported in Akabane (1981, pp.206-8). The version of Kasumigaseki-rule by Akabane is, however, different from ours. He defined the rule such that the ratio {i.e., (household savings + net household tax burden)/(wage income + capital income)} remained constant. His measure, in fact, is not as stable as the one reported in column (6) in Table 6-4. It is noteworthy that the government bureaucrats (Akabane is one of them) are fully aware of this rule and seem to pay attention to this measure in their fiscal policy making.

TABLE 6-4 : EFFECTIVE TAX RATES (%)

YEAR	(1)	(2)	(3)	(4)	(5)	(6)
1965	7.37	7.72	0.26	5.4	11.40	8.8
1966	7.07	8.25	0.26	5.0	10.13	8.9
1967	7.06	8.58	0.24	4.6	11.07	9.4
1968	7.36	8.58	0.25	4.3	11.52	9.6
1969	7.53	8.54	0.27	4.1	13.79	9.8
1970	7.70	8.82	0.34	3.7	16.28	10.1
1971	8.16	8.75	0.38	3.5	19.97	10.7
1972	8.13	8.49	0.35	3.3	21.52	10.3
1973	8.75	8.23	0.40	3.1	26.70	10.9
1974	8.57	8.49	0.48	2.4	26.64	10.0
1975	7.33	10.00	0.47	2.2	16.51	8.6
1976	7.37	9.98	0.46	2.1	15.62	7.8
1977	7.40	10.65	0.47	2.0	15.30	7.9
1978	7.16	10.92	0.45	2.0	15.27	7.0
1979	8.48	11.66	0.44	2.0	15.97	8.4
1980	9.09	11.35	0.44	1.8	17.54	8.7
1981	9.56	11.99	0.45	1.7	18.69	9.3
1982	9.71	12.30	0.50	1.8	20.08	9.1
1983	9.94	12.32	0.55	1.8	20.76	8.9
1984	9.84	12.42	0.58	1.8	20.45	8.7
1985	9.97	12.77	0.60	1.9	20.81	9.2
AVG	8.3	10.0	0.4	2.9	17.4	9.1
VAR	1.1	2.8	0.0	1.4	20.4	0.9

Source : Annual Report on National Accounts, Economic Statistics Annual and Tax Bureau Annual Report on Inheritance and Gifts.

Notes : Column (1) = income tax rate, (2) = social security tax rate, (3) = property tax rate, (4) = income based property tax rate, (5) = net bequest (inheritance and gifts) tax rate and (6) = net household total tax burden rate defined as (household direct tax + social security tax - social security benefit)/(wage income + capital income).

II.3. A Historical Summary of Fiscal Policy Changes

When the fiscal policy effect is analysed, it is quite important to understand *a priori* what has actually happened in regard to specific fiscal policies over recent years.

According to Ihori (1986, chapter 1), historical fiscal activities in Japan are summarised as follows:

(1) In the 1950s and the 1960s, the size of fiscal activities was kept to a small scale by regularly reducing the effective income tax rate. Fiscal policy was used only for built-in stabilisation.

(2) In the 1970s, government expenditure (especially social security and public welfare transfers) increased. It was financed by deficits (i.e., bond issues) because of the lack of tax revenue after 1975.

(3) In the 1980s, the government aimed at a reduction of budget deficits by means of cutting down public investment and consumption.

Alternatively Japanese fiscal policy can be considered in terms of the adjustment process of the balance of payments or external shocks:

(1) In the 1950s and 1960s, under the fixed exchange rate regime, tight monetary policy (e.g., a high prime rate) was used to reduce the balance of payments deficits due to the rapid economic growth. This policy was known as "stop-and-

go" monetary policy. Public investment policy was known to complement this policy.

(2) In the 1970s, the floating exchange regime started from February 1973 and there were two oil shocks in 1973 and 1979. The fiscal authorities took expansionary fiscal policy in 1972-73 to stimulate the economy in response to the fear of a "yen appreciation" depression. This policy turned out to accelerate the very high inflation of 1973-75. In 1977-78, again expansionary fiscal policy was taken. This time, the policy was intended to support sluggish aggregate demand because of the first oil shock depression. During the period 1975-79, economic growth had been sustained by net exports and public investment.

(3) In the 1980s, the current account surplus grew alongside rapidly appreciating yen values and government budget deficits. The trade-off situation between current account surplus and government budget deficit was seen in Figure 2-1 (chapter 2). The major fiscal policy objective during 1980-86 was a reduction of budget deficits. After 1986, an expansionary fiscal stance was introduced to reduce the apparently rigid current account surpluses. The government intended to shift the economy from the external demand led growth to the domestic demand led growth [as documented in the MITI report(1985)].

Judging from the results from sections II.1 and II.2, further research areas in fiscal policy effects on savings and bequest transfers are found in the following:

(1) Effective tax (burden) rates remained fairly stable and generally low in level during the sample period as is shown in Table 6-4. The basic tax structure had not been revised during the period 1965-1985 (footnote 2). Several research questions in this area can be asked. Is there any relationship between low tax rates and the high saving rate ? Do stable tax rates help to create a low variance of the saving rate ? Is disposable income co-integrated with savings and, if so, what measures of taxes are appropriate to obtain disposable income ?

(2) Debt finance has increased since 1975 and debt-GNP ratio has also increased rapidly as a result. In the 1980s, the government intended to reduce budget deficits. It is natural

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2. Some historical episodes may give uncompromising accounts of the Ricardian equivalence proposition. Because of the increasing debt burden, the Japanese government has tried at least three times to increase tax revenues by introducing new indirect taxation of a VAT type. The Ohira government (1979) and the Nakasone government (1986) were said to have fallen because of their tax-increase proposals. The Takeshita government (1988) is now struggling to pass Takeshita's proposal through the Diet under strong opposition including some from his own party ; the Liberal Democratic Party. If households or the private sector in general are Ricardian (i.e., taking the government's intertemporal budget constraint as an integrated part of their own budget constraint), why does the private sector oppose the tax-increase proposal ?

to ask whether the Ricardian equivalence proposition is supported by the Japanese data on savings and bequests. Is there any causal relationship between deficits and savings ? If so, which direction does it follow ?

(3) Government expenditure increased steadily, although as shown in Table 6-1, the share of each component has changed. An important question is whether government expenditure influences household savings and consumption.

(4) The distortional effects of property and inheritance (bequest) taxes on wealth holdings were pointed out above. It would be interesting to investigate how distortional these taxes are and to identify the causal relationship between high land prices and these taxes.

Of the many questions we raised above, we will concentrate our investigation in the next section on the questions relating to Ricardian equivalence [i.e., the questions given in (2)] and to the relationship between fiscal policies and savings/bequests [i.e., the questions given in (3) and a part of (1) on co-integration with savings].

III. Econometric Evaluation of Fiscal Policies

III.1. Alternative Approaches

Most empirical work on the Ricardian equivalence proposition is based on the consumption function approach in which the null hypothesis is that coefficient of deficits is zero [see, Bernheim (1987c) and Nicoletti (1988) for lists of empirical results in the literature using the consumption function approach]. There are several empirical problems with this approach:

(1) A consumption function including several explanatory variables cannot isolate statistical effects of Ricardian equivalence from other macroeconomic effects. A change in consumption/saving due to fiscal policy can be explained by various factors other than Ricardian equivalence (footnote 3).

(2) It is necessary to distinguish between deficit finance with tax reduction and deficit finance without tax reduction. As shown in section II, deficit finance was

3. Poterba and Summers (1987) argued that " historical time series data do not contain the experimental variation needed to evaluate the (Ricardian equivalence) theory. Since most previous changes in U.S. budget deficits are associated with cyclical fluctuations, inflation, or wars, and since these factors act directly on both nominal and real interest rates as well as the national saving rate, it is difficult to use observed fluctuations in deficits to evaluate the validity of Ricardian equivalence "(p.389).

carried out without significant tax reduction in Japan. In this case, the logic of the Ricardian equivalence proposition cannot be tested by the null hypothesis of zero coefficient of deficits. The coefficient must be negative in consumption and positive in savings as long as the effective tax rate remains constant (i.e., disposable income does not increase as in the case of tax reduction).

(3) Deficits, government expenditure and other fiscal variables can be endogenous in the economic system. In that case, simultaneity bias is involved in a single equation approach.

In order to avoid these problems, we propose two alternative approaches; namely the direct econometric test approach and the model selection approach. The direct econometric test approach is based on the idea of Granger who developed the statistical methods to test theory-propositions directly, without involving auxiliary hypotheses from other variables. These tests are best used as preliminary investigations before conducting a model selection. The model selection approach is based on the idea of Hendry. He argued, " until the model adequately characterises the data generation process, it seems rather pointless trying to test hypothesis of interest in economic theory "[Hendry (1979), p.226]. The validity of a theory-proposition can be tested if the estimated empirical model is a proxy of the data generation process (DGP).

III.2. Direct Econometric Tests for The Ricardian Equivalence

Prior to econometric tests, it is necessary to define the Ricardian equivalence proposition. It states that a rational household is indifferent between current deficits and future taxes due to current deficits. Seeing through the intertemporal veil, a current deficit does not increase a household's lifetime budget constraint, a household simply increases savings to compensate for future taxes. If the time horizon of a household is its own lifetime, intertemporal substitution *via* savings would be undertaken. If the time horizon goes beyond one's lifetime, intergenerational substitution *via* bequests would be carried out. In empirical investigations, Ricardian equivalence transfers through both savings and bequests must be examined.

Given the above definition of Ricardian equivalence, necessary (not sufficient) conditions for it are (1) Granger-causality from deficits (debt) to saving/bequests and (2) the co-integration between deficit-adjusted income and savings. If one of the two is violated, then the

Ricardian equivalence must be refuted (footnote 4). Let us first consider the Granger-causality test.

Granger-causality :

The Granger-causality test is defined as follows. Consider a linear regression model,

$$Y_t = \sum_{i=1}^{k} \alpha_i Y_{t-i} + \sum_{i=0}^{l} \beta_i X_{t-i} + u_t .$$

If $\beta_i = 0$ (i=0,1,..l), then X_{t-i} fails to Granger-cause Y_t . The test-statistic is an F-test. Autoregressive (Y_{t-i}) and distributed (X_{t-i}) lags (k and l) are arbitrarily chosen. Granger-causality implies that Y_t is better predicted with X_{t-i} . In other words, we could see that Y_t is the reaction against the action X_{t-i} .

Empirical application of this test is made to following variables ; public debt (D), deficits (δD), total bequests (BQ), financial bequests (BQF), savings (S), consumption (C) and government expenditure (G). All variables are raw data (footnote 5). The results are given in Table 6-5.

4. Granger (1986, p.218) showed that if some variables were co-integrated, then there was at least one-direction Granger causality between the variables. In fact the co-integration test is necessary for Granger causality of Ricardian equivalence. But we need to examine both tests if a direction of Granger causality is to be identified..

5. Transformed data were also tested but they do not change major findings. Pierce and Haugh (1977) suggested using transformed (de-trended) data for causality tests. But Sims

TABLE 6-5 : GRANGER-CAUSALITY TESTS FOR RICARDIAN EQUIVALENCE

EQ	FROM	distributed lags	TO	autoregressive lags	F-VALUE
1	D	0 to 3	BQ	1 to 3	F(4,10)=2.25
2	D	0 to 2	BQ	1 to 2	F(3,11)=1.66
3	D	0 to 3	BQF	1 to 3	F(4,10)=2.18
4	D	0 to 3	S	1 to 3	F(4,10)=4.42
5	D	0 to 2	S	1 to 2	F(3,11)=5.88
6	D	0 to 3	C	1 to 3	F(4,10)=0.89
7	δD	0 to 3	BQ	1 to 3	F(4,10)=2.17
8	δD	0 to 2	BQ	1 to 2	F(3,11)=0.64
9	δD	0 to 3	BQF	1 to 3	F(4,10)=1.82
10	δD	0 to 3	S	1 to 2	F(4,11)=18.14***
11	δD	0 to 2	S	1 to 2	F(3,11)=16.61**
12	δD	0 to 3	C	1 to 3	F(4,10)=0.16
13	S	0 to 3	δD	1 to 3	F(4,10)=34.26***
14	S	0 to 2	δD	1 to 2	F(3,13)=44.24***
15	G	0 to 3	S	1 to 3	F(4,10)=0.19
16	G	0 to 3	BQ	1 to 3	F(4,10)=1.17
17	G	0 to 3	C	1 to 3	F(4,10)=2.12
18	G	0 to 3	δD	1 to 3	F(4,10)=0.62
19	C	0 to 3	δD	1 to 3	F(4,10)=1.61
20	C	0 to 3	D	1 to 3	F(4,10)=3.04
21	C	0 to 3	G	1 to 3	F(4,10)=4.05

Notes : (1) ** denotes 5 % significance level and *** denotes 1 % significance level.
(2) any other lag structure does not change F-value significantly.

There is no significant causality from debt to the household variables (i.e., BQ, BQF, S and C). Bequest transfers seem to be conducted independently from government

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(1977b) pointed out that this approach obtained non-causality results more often than necessary. Our results show that as long as the data is transformed in a coherent way among variables, the causal relationship remains. Needless to say, overdifferenced (purely stochastic) data do not make sense for causality analysis.

fiscal policy. The Barro model of Ricardian equivalence transfers through bequests can be refuted by the above result.

As EQs. (10),(11),(13) and (14) show, deficits and savings have instantaneous (two-way) causality. We may assume that deficits savings are determined simultaneously or sequentially. Note that the causality from savings to deficits is much stronger than the other way round. We will investigate this causal relationship further in the next section.

Government expenditure does not Granger-cause any variable at significant level.

Now let us turn to the co-integration test.

Co-integration :

The concept of co-integration allows us to estimate directly, and test the existence of, the equilibrium relationship implied by economic theory. According to Granger (1986) who developed this concept, the intuition behind this concept is explained as " at the least sophisticated level of economic theory lies the belief that certain pairs of economic variables should not diverge from each other by too great an extent, at least in the long-run. Thus, such variables may drift apart in the short-run or according to seasonal factors, but if they continue to be too far apart in the long-run, then economic forces, such as a market mechanism or government intervention, will begin to bring them together again." (*op.cit.*,p.213).

In practice, the theory of co-integration is simple and direct. A series x_t, with no deterministic component, which has a stationary, invertible, ARMA representation after differencing d times, is said to be integrated of order d, denoted x_t --> I(d). Suppose a pair of series x_t and y_t are both I(1) and have no drift or trend, then, in general any linear combination of these series is also I(1). However, if there exists a non-zero constant A such that, $z_t = x_t - Ay_t$ is I(0), then x_t and y_t are said to be co-integrated with A called the co-integrating parameter. As the above quotation from Granger implies, two variables, x_t and y_t move so closely that z_t does not drift too far away from zero.

For empirical application, first it is necessary to examine whether each time series variable represents the I(1) process. The variables we consider are public debt (D), government deficits (δD), government expenditure (G), government interest payment (GINTPAY), social security tax (SSTAX), social security benefit (SSB), bequest tax (BQTAX), property tax (PROPTAX), income tax (INCTAX), direct tax (DIRTAX), gross-tax1 (GRTAX1 = INCTAX + SSTAX), gross-tax2

(GRTAX2 = INCTAX + SSTAX - SSB), gross-tax3 (GRTAX3 = INCTAX + SSTAX - SSB + PROPTAX), gross income (GY), disposable income (Y), deficit-adjusted income (i.e., Y-δD = DEFY), deficit-government expenditure-adjusted income (i.e., Y-δD-G = DEFGY), real estate holding (RELSTK), net foreign asset stock (NFOASS), savings (S), bequests (BQ) and consumption (C). A simplified Dicky-Fuller test for unit roots (footnote 6) is conducted and all variables are found to satisfy the I(1) process, as many other macroeconomic time series do [e.g., see Nelson and Plosser (1982), Hall (1978) and Jenkinson (1986)].

Next, the Durbin-Watson (DW) statistic is used for the co-integration test. If the Durbin-Watson statistic is sufficiently large, two series are co-integrated because the residuals from their difference are stationary (the null hypothesis is non-co-integration, i.e., H_0: DW = 0). The direction of regression does not make a significant difference in most cases because, in the bivariate context, the statistic is virtually identical (we report two-way

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6. We consider the following model $x_t = \alpha x_{t-1} + u_t$ with the null hypothesis $H_0: \alpha = 1$. Hypothesis is examined by t-test on α with t-value table in Dicky and Fuller (1981). Nearly all t-values are lower than two which are insignificant at 10 percent level. For a general theoretical justification of the use of t-test, see Phillips (1987).

regressions if necessary). The results are reported in Table 6-6.

TABLE 6-6 : CO-INTEGRATION TESTS FOR FISCAL POLICY AND HOUSEHOLD VARIABLES

EQ	Dependent variable	Coefficient of Regressor (standard error)			R^2 / DW
Ricardian co-integration					
1	S	0.108	(0.027)	D	0.364 / 0.142
2	S	1.257	(0.210)	δD	0.596 / 0.360*
3	S	0.770	(0.091)	G	0.692 / 0.242
4	S	0.215	(0.020)	DEFY	0.815 / 0.208
5	S	0.292	(0.026)	DEFGY	0.843 / 0.201
6	S	0.223	(0.019)	Y	0.877 / 0.371*
7	S	0.171	(0.019)	GY	0.764 / 0.210
8	C	0.640	(0.055)	D	0.856 / 0.108
9	C	5.707	(0.610)	δD	0.822 / 0.336*
10	C	3.560	(0.088)	G	0.990 / 0.706***
11	C	0.913	(0.023)	DEFY	0.980 / 0.349*
12	C	1.203	(0.044)	DEFGY	0.958 / 0.329*
13	C	0.810	(0.017)	Y	0.987 / 0.234
14	C	0.755	(0.012)	GY	0.992 / 0.658***
15	BQ	0.023	(0.002)	D	0.870 / 0.320
16	BQ	0.167	(0.031)	δD	0.563 / 0.293
17	BQ	0.116	(0.011)	G	0.846 / 0.284
Fiscal policy co-integration					
18	D	0.096	(0.014)	δD	0.755 / 0.279
19	D	4.799	(0.458)	G	0.862 / 0.132
20	D	11.307	(0.165)	GINTPAY	0.995 / 0.580***
21	D	4.624	(0.768)	NFOASS	0.448 / 0.247
22	NFOASS	0.097	(0.036)	D	0.448 / 0.572***
23	δD	0.530	(0.042)	G	0.870 / 0.498**
24	G	1.092	(0.052)	DIRTAX	0.934 / 0.687***
25	SSB	1.230	(0.027)	SSTAX	0.992 / 0.549***

(continue)

Taxation co-integration

26	INCTAX	0.111	(0.007)	Y	0.910 / 0.228
27	INCTAX	0.105	(0.005)	GY	0.944 / 0.328*
28	BQTAX	0.243	(0.006)	BQ	0.901 / 0.595***
29	SSTAX	0.152	(0.009)	Y	0.935 / 0.221
30	SSTAX	0.143	(0.006)	GY	0.959 / 0.256
31	PROPTAX	0.008	(0.001)	RELSTK	0.831 / 0.739***
32	GRTAX1	0.249	(0.010)	GY	0.964 / 0.160
33	GRTAX2	0.075	(0.004)	GY	0.893 / 0.615***
34	GRTAX3	0.096	(0.004)	GY	0.930 / 0.604***

Notes: (1) Critical values are taken from Granger and Engle (1987, p.269). If we use those for small sample from Engle and Yoo (1987, p.158), there is no significant co-integration except C and G .
(2) * denotes 10 % significant level, ** denotes 5 % level and *** denotes 1 % level.

There are several interesting findings in Table 6-6.

First, as to Ricardian co-integration, both bequest transfers and savings are not co-integrated with fiscal policy variables, except the co-integration between S and δD which is significant at 10 percent level. We will further investigate this relationship in section III.3. Consumption (C), on the other hand, is co-integrated with government expenditure (G) and gross income (GY). Deficit-adjusted income (DEFY) and deficit-government expenditure-adjusted income (DEFGY) correspond to Ricardian disposable incomes of Jäger (1987). Both DEFY and DEFGY are not co-integrated with savings while they are co-integrated with consumption at 10 percent level. The above results of co-integration tests imply that the Ricardian equivalence proposition, in particular, the Barro model of bequest transfers does not hold on empirical grounds. An exception is, again, a co-integration between deficits (δD) and savings (S).

Secondly, the policy co-integrations exist among several fiscal variables. The results support a conventional observation that the fiscal variables move together very closely. Debt (D) and government interest payments (rD) are co-integrated which implies the interest rate (r) for government bonds remains fairly stable. EQ.(21) and EQ.(22) show quite the unusual results that NFOASS regressed on D has a small DW while D on NFOASS has a significantly high DW. The latter result may imply that financial assets increase together. A trade-off relationship between D and NFOASS must be observed in changes in the stock levels. Social security benefit is co-integrated with social security tax which means the social security is the pay-as-you-go system.

Thirdly, taxation co-integration exists at a significant level. In general, this implies that effective tax rates remain constant as shown in section II. Bequest tax and property tax are clearly co-integrated with respective tax bases. Income tax and social security tax are not significantly co-integrated with gross income. But, when these taxes are put together with social security benefit adjustment, GRTAX2 and GRTAX3 are highly co-integrated with gross income (GY). As discussed in section II, the GRTAX3 is known as *the Kasumigaseki rule*. The econometric significance of this rule is demonstrated in EQ.(34). In sum, the appropriate measures of taxation show that the effective tax rates for the household sector remain fairly constant (in equilibrium). This implies that taxation can be considered as fully integrated in the household sector. Before and after taxes, tax bases (i.e.,wage income, real estate, financial assets and bequests) would show, more or less, the same statistical inference in a regression.

Table 6-7 gives a schematic summary of the above tests.

TABLE 6-7 : THE RELATIONSHIP BETWEEN CAUSALITY AND CO-INTEGRATION TESTS

		CAUSALITY X --> Y	
		YES	NO
CO-INTEGRATION X & Y	YES	Ricardian equivalence transfer δD -> S ?	No Ricardian Reversed causality e.g., C -> G ?
	NO	No possibility	No Ricardian transfer from D and δD to BQ

Notes (1) X = a fiscal policy variable and Y = a household sector outcome (i.e. savings, consumption, bequests).
(2) Co-integration is a necessary condition for one-direction causality (either X->Y or Y->X). No co-integration (NO) and causality (YES) case is logically impossible.

The results are evaluated in the following:

(1) There is no sign of intergenerational transfer due to the Ricardian equivalence motive. Bequest transfers are made independently of fiscal policy. Why are bequest transfers so insensitive to fiscal policy variables ? We give two possible explanations for this result.

First, if debt repayments are to be made quite rapidly (say, in 20 years), then it would be meaningless to conduct bequest transfers for the purpose of Ricardian equivalence. As substantial debt finance policy has been used for just over a decade, the household's time horizon in response to such a fiscal policy may not go beyond one's lifetime.

Secondly, which is probably a more plausible reason, the average amount of bequest transfers per household (approximately 50 million yen in 1985) is so high compared with the debt/deficit burden each household bears (3.7 million yen per household for debt stock burden and 0.32 million yen per household for deficit in 1985). In this situation, it may be rational *not to react* against marginal fiscal policy changes since bequest transfers exceed more than ten times the accumulated debt burden (footnote 7). In

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7. A somewhat similar idea is discussed by Bar-Ilan and Blinder (1988) who argued that doing nothing could often be more rational than continuous reoptimising when transaction costs of all sorts were involved.

other words, it is unnecessary to worry about future tax burdens when sufficient bequests are to be transferred.

(2) No Granger causality from government expenditure (G) to consumption (C) [EQ.(17) in Table 6-5] is found while C is co-integrated with G [EQ.(10) in Table 6-6]. These results indicate that there must be a Granger causality from C to G. But as EQ.(21) in Table 6-5 shows, this causality is still not significant enough. This result might reflect the following linkage; government expenditure (G) moves with gross domestic product (GDP), GDP moves closely with gross household income (GY) and GY moves with C. Thus G and C are co-integrated without significant direct causality from either side. However significant co-integration between G and C still remains a puzzle. One thing we could say is that a simple Keynesian multiplier effect (i.e., G->Y->C) is not at work in Japan.

(3) A possible Ricardian equivalence transfer occurs only from deficits (δD) to savings (S). It is necessary to investigate the validity of this relationship by diagnostic tests. Note, however, that stronger Granger causality exists from savings (S) to deficits (δD). This relationship could be either a simultaneous system or a recursive system. We will focus our analysis specifically on deficit effects on savings in the next section III.3.

III.3. Model Selection

The Hendry method of model selection procedure is used in this section for econometric evaluation of fiscal policies. As the model selection method and actual selection process of the dynamic saving model have been fully explained in chapter 5, we avoid repeating them. Our empirical interest lies in the question of whether the selected model [eq.(10), chapter 5] is encompassed by an alternative model with deficit variables. If that is the case, then a new model with deficit variables must be selected as a new proxy of the data generation process (DGP) and the theory model used in chapter 5 must also be replaced by a model which incorporates fiscal policy effects. If, on the other hand, a new model does not improve or encompass the selected model, then we could conclude that (1) deficit variables are not included in the household decision making, and (2) Ricardian equivalence transfers *via* savings do not exist.

This research strategy is based on the assumptions that the model selection in chapter 5 is correct and that the selected model as a proxy of DGP cannot be encompassed by alternative models. THe alternative model in this chapter should be considered as having been obtained independently of the model in chapter 5. Note, however, for the sake of encompassing, the data transformation is consistent with the variables in the selected model.

<u>A single equation saving model :</u>

Instead of starting the model selection process with deficit variables from the beginning, we present a reasonable model straightway which is comparable to that of chapter 5.

OLS : 1967-1985 less 3 years forecasts

$$d(S/Y)_t = \underset{\substack{(1.472)\\ [2.404]}}{3.539} - \underset{\substack{(0.089)\\ [-1.800]}}{0.160}\,(S/Y)_{t-1} - \underset{\substack{\\ [-2.427]}}{1.369}\, d(BQF_{t-1}/Y_t)$$

$$+ \underset{\substack{(0.511)\\ [1.808]}}{0.924}\, DUMMY345 - \underset{\substack{(0.777)\\ [-1.972]}}{1.532}\, DUMMY90 + \underset{\substack{(0.037)\\ [4.622]}}{0.171}\, dCPINF$$

$$- \underset{\substack{(0.144)\\ [-1.167]}}{0.168}\, d(D/Y)_t + \underset{\substack{(0.085)\\ [1.388]}}{0.118}\, d(D_{t-1}/Y_t) \qquad (2)$$

$R^2 = 0.880$, $\sigma = 0.660$, $F(7,8) = 8.41$, $DW = 2.278$,
$RSS = 3.486$, $SC = -0.138$, $HQ = 0.189$, $FPE = 0.654$,
$Z_1(3,8) = 0.29$, $Z_2(3) = 0.43$, $Z_3(2) = 0.646$.

where $d(D/Y)_t$ = annual change in debt-income ratio as a proxy of deficit growth.
$d(D_{t-1}/Y_t)$ = annual change in lagged debt-income ratio as a proxy of a lagged deficit growth.
all other statistical notations are the same as in chapter 5 .

This model satisfies all diagnostic tests and the goodness of fit measures are very close to the selected model [eq.(3) below]. This model refutes the Ricardian equivalence proposition because the current deficit variable has a negative effect on savings although t-value is insignificant (as noted in section III.1, it must have a significantly positive impact on savings if the Ricardian equivalence holds). The above model does imply that current deficits have wealth effects but it does not imply that this model is actually a DGP. It is necessary to conduct encompassing tests against the selected model of chapter 5 [eq.(10)].

OLS : 1967-1985 less 3 years forecasts

$$d(S/Y)_t = \underset{\substack{(1.209)\\ [3.642]}}{4.403} - \underset{\substack{(0.058)\\ [-3.759]}}{0.218}(S/Y)_{t-1} - \underset{\substack{(0.021)\\ [-1.048]}}{0.022}\, d(BQL_{t-1}/Y_t)$$

$$- \underset{\substack{(0.331)\\ [-2.239]}}{0.741}\, d(BQF_{t-1}/Y_t) + \underset{\substack{(0.041)\\ [4.927]}}{0.202}\, dCPINF$$

$$+ \underset{\substack{(0.324)\\ [3.059]}}{0.991}\, DUMMY345 - \underset{\substack{(0.483)\\ [-3.168]}}{1.530}\, DUMMY90 \qquad (3)$$

$R^2 = 0.868$, $\sigma = 0.653$, $F(6,9) = 9.87$, $DW = 2.246$,
$RSS = 3.842$, $SC = -0.214$, $HQ = 0.041$, $FPE = 0.614$,
$Z_1(3,9) = 0.58$, $Z_2(3) = 0.83$, $Z_3(2) = 0.360$.

Compared with (2), this model is parsimonious and shows slightly better goodness of fit in statistics σ and F. Encompassing results are reported below [eq.(2) = model 1 and eq.(3) = model 2].

TABLE 6-8 : ENCOMPASSING TEST STATISTICS

Model 1	Form ε Model 2	Test	Form Model 2 ε Model 1	
-4.662	N(0,1)	Cox	N(0,1)	-8.010
3.078	N(0,1)	Ericsson IV	N(0,1)	5.350
0.930	$Chi^2(1)$	Sargan	$Chi^2(2)$	1.784
0.921	F(1,7)	Joint Model	F(2,7)	0.865
5.591	F(1,7)	Crit Vals	F(2,7)	4.737

Note : For the concept of encompassing tests, see section V of chapter 5.

The results imply that neither model 1 nor model 2 encompasses the other. There is no clear-cut encompassing result as obtained with the life-cycle model in chapter 5. It is, however, obvious that the model with deficit variables [eq.(2)] does not improve or encompass the selected model [eq.(3)]. Furthermore, this model [eq.(2)] rejects the Ricardian equivalence proposition (i.e., a positive impact of deficits).

Taking account of parsimony and goodness of fit, the selected model can be retained as a proxy of DGP. By refuting (2), the implication of the selected model is that the saving behaviour is determined independently of fiscal policy effects and thus the saving function is neither Ricardian nor Keynesian. This result could be anticipated from the results of chapter 5 in which Japanese household saving behaviour was shown to be insensitive to short-run fluctuations of the economy. The majority of savings was determined by deep-rooted long-run motivations such as bequest motive.

However the co-integration and Granger causality tests showed that there was a causality from saving to deficit even when the causality from deficits to savings was statistically insignificant. We will investigate this claim by considering a system equation model.

A system equation model :

The objective of this section is to examine whether savings and deficits are determined simultaneously or recursively. Although a single equation model implied that deficit variables were not necessarily included in a household saving function, encompassing tests were inconclusive. If deficit policy is endogenously determined, then the model with deficit variables [eq.(2)] would involve simultaneity bias and encompassing test results in the previous section would be invalid. In this case, (2) should be estimated by the instrumental variables method and we must conduct encompassing tests again.

Prior to that, it is necessary to specify a dynamic deficit policy model. We consider the behavioural assumption of the government, namely : the government tries to reduce current account surplus and budget deficits subject to the IS-current account constraint. This behavioural assumption reflects historical observations summarised in section II.3 (see appendix of this chapter for a theoretical derivation and a model transformation). The following model is finally selected.

OLS : 1967-1985 less 3 years forecasts

$$\begin{aligned} d(D/Y)_t = {} & \underset{\substack{(0.640)\\ [4.645]}}{2.973} + \underset{\substack{(0.118)\\ [4.203]}}{0.496}\, d(D_{t-1}/Y_t) - \underset{\substack{(0.307)\\ [-7.290]}}{2.238}\, d(T/Y)_t \\ & - \underset{\substack{(0.330)\\ [-4.182]}}{1.380}\, d(S/Y)_t - \underset{\substack{(0.188)\\ [-1.819]}}{0.342}\, d(F_{t-1}/Y_t) \end{aligned} \qquad (4)$$

$R^2 = 0.841$, $\sigma = 1.511$, $F(4,11) = 14.56$, $DW = 2.221$,
$Z_1(3,11) = 0.76$, $Z_2(3) = 0.85$, $Z_3(2) = 0.422$.

where $d(F_{t-1}/Y_t)$ = annual change in foreign assets-income ratio as a proxy of current account surplus growth.
$d(T/Y)_t$ = annual change in tax-income ratio.

This model satisfies all diagnostic tests and shows reasonable goodness of fit. Most parameters are significant at 1 percent level. This model, satisfying parameter constancy conditions, indicates that there can be a stable optimal rule of deficit policy as approximated by (4). This model is all differenced and has no long run information. We have tried several alternative models with long run information, including a long run "desired" debt-income ratio model [i.e., $k_0 + k_1(D_{t-1}/Y_t)$], a debt-foreign assets error correction model [i.e., $k_0 + k_1(D_{t-1}-\alpha F_{t-1})$] and a modification [i.e., $k_0 + k_1(D_{t-1}/Y_t - \alpha F_{t-1}/Y_t)$]. All these models are unsatisfactory compared with the selected model [eq.(4)].

In the following analyses, this model [eq.(4)] is used as a proxy of deficit policy of the government.

Let us examine whether the saving model [eq.(2)] estimated by the instrumental variables (IV) method encompasses the selected model [eq.(3)]. The IV estimation of (2) is given as follows.

IV : 1967-1985 less 3 years forecasts

$$\begin{aligned} d(S/Y)_t = {} & \underset{\substack{(2.699)\\ [1.382]}}{3.731} - \underset{\substack{(0.176)\\ [-0.986]}}{0.173}(S/Y)_{t-1} - \underset{\substack{(0.564)\\ [-2.401]}}{1.354}\, d(BQF_{t-1}/Y_t) \\ & + \underset{\substack{(0.969)\\ [1.028]}}{0.996}\, DUMMY345 - \underset{\substack{(0.777)\\ [-2.018]}}{1.568}\, DUMMY90 + \underset{\substack{(0.070)\\ [2.516]}}{0.176}\, dCPINF \\ & - \underset{\substack{(0.265)\\ [-0.544]}}{0.144}\, d(D/Y)_t + \underset{\substack{(0.126)\\ [0.870]}}{0.110}\, d(D_{t-1}/Y_t) \qquad (5) \end{aligned}$$

$\sigma = 0.662$, $DW = 2.244$, $RSS = 3.501$, $Z_2(3)$ 0.49, $Z_3(2) = 0.650$.

instruments : $d(T/Y)_t$ and $d(F_{t-1}/Y_t)$.

All parameter values are virtually the same as those in (2). Encompassing results against the selected model [eq.(3)] are given below [model 1 = eq.(5) and model 2 = eq.(3)].

TABLE 6-9 : ENCOMPASSING TEST STATISTICS

Model 1	Form ε Model 2	Test	Form Model 2	ε Model 1
-3.518	N(0,1)	Cox	N(0,1)	-2.159
2.327	N(0,1)	Ericsson IV	N(0,1)	1.528
1.795	$Chi^2(2)$	Sargan	$Chi^2(2)$	1.780
0.859	F(1,7)	Joint Model	F(2,7)	0.386
5.591	F(1,7)	Crit Vals	F(2,7)	4.737

Still neither model 1 nor model 2 encompasses the other. In general, the test statistics of the IV estimation imply that model 1 is less likely to encompass model 2 than *vice versa,* although most statistics are at unacceptable levels. From this exercise, we conclude that (1) the saving model with deficit variables [eq.(2)] does not suffer simultaneity bias and that (2) the model [eq.(5)] cannot encompass the selected model [eq.(3)].

Next, the IV estimation of (4) is another way of checking the existence of simultaneity bias. If household savings depend on deficit policy, then the OLS estimation of (4) is biased. (4) is estimated by the IV method, using instrumental variables from (2) and (3). Together with the OLS estimate, the results are reported in Table 6-10.

TABLE 6-10 : DEFICIT POLICY MODEL ESTIMATIONS

Period 1967-1985	dependent variable = $d(D/Y)_t$		
Estimation Method (standard error)	OLS	IV with eq.(3)	IV with eq.(2)
constant	2.973 (0.640)	3.036 (0.665)	3.039 (0.667)
$d(D_{t-1}/Y_t)$	0.496 (0.118)	0.475 (0.168)	0.474 (0.169)
$d(T/Y)_t$	-2.238 (0.307)	-2.205 (0.834)	-2.203 (0.834)
$d(S/Y)_t$	-1.380 (0.330)	-1.460 (0.362)	-1.465 (0.367)
$d(F_{t-1}/Y_t)$	-0.342 (0.188)	-0.350 (0.250)	-0.350 (0.250)
R^2	0.841	n.a.	n.a.
σ	1.511	1.515	1.515
DW	2.221	2.209	2.209
$Z_1(3,11)$	0.76	n.a.	n.a.
$Z_2(3)$	0.85	0.83	0.83
$Z_3(2)$	0.422	0.435	0.434
Z_4	n.a.	$Z_4(5)=0.99$	$Z_4(4)=1.24$
instruments		dCPINF, DUMMY345, DUMMY90, $(S/Y)_{t-1}$ $d(BQF_{t-1}/Y_t)$ $d(BQL_{t-1}/Y_t)$.	dCPINF, DUMMY345, DUMMY90, $(S/Y)_{t-1}$, $d(BQF_{t-1}/Y_t)$

Note : Z_4 is the specification chi-square test (footnote 8).

8. This is a test for the validity of the choice of instrumental variables as discussed by Sargan (1964). It is asymptotically distributed as chi-square (m) when the m overidentifying instruments are independent of the equation error.

There is no sign of parameter change due to simultaneity bias in the deficit policy model. Specification chi-square test indicates that instruments from (3) fit better than those from (2).

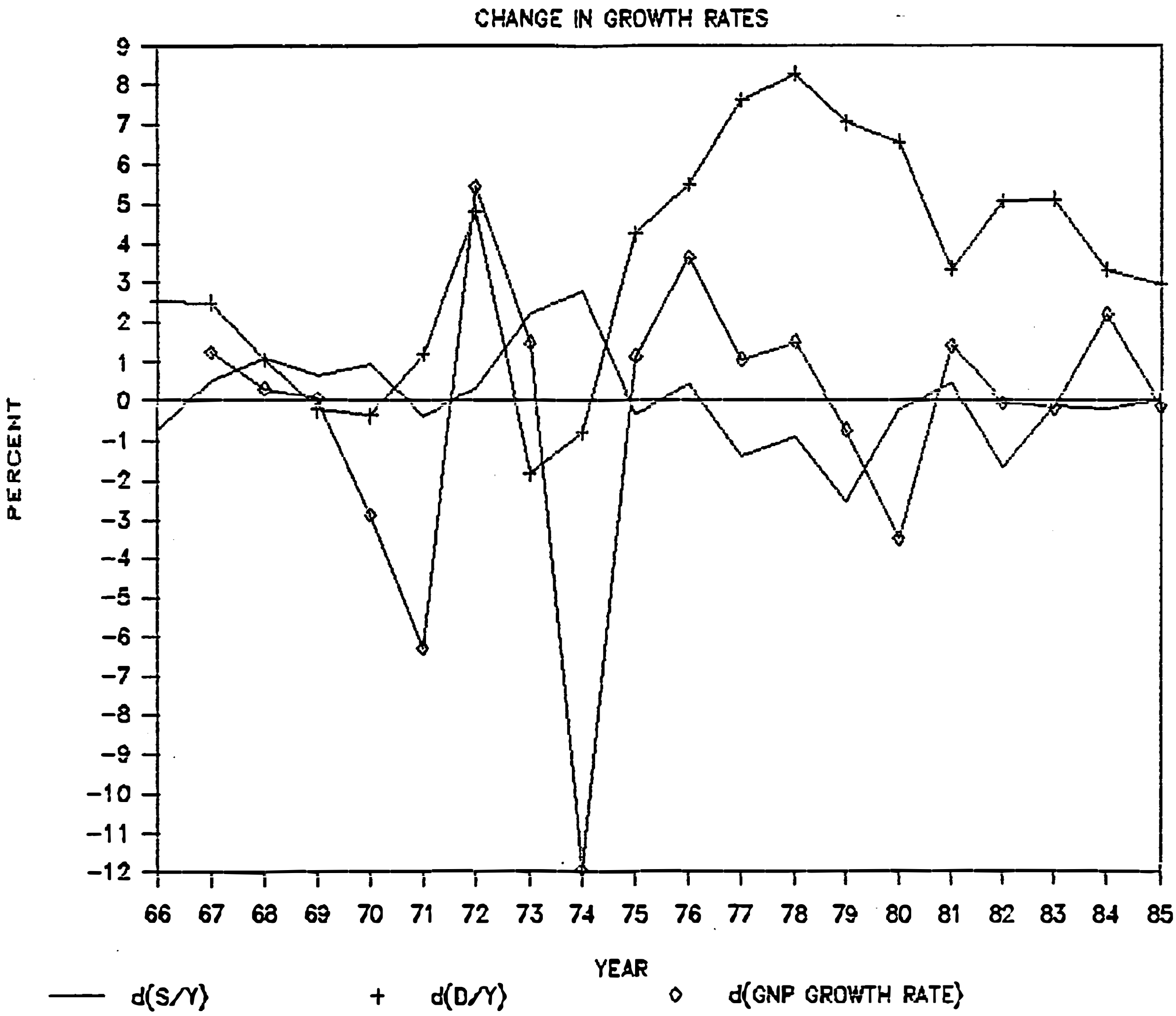
From the above results, we conclude that both the saving model and the deficit model can be estimated by the OLS method without serious simultaneity biases.

Let us formally define the error terms of (3) and (4) as u_S and u_D respectively, then they can be written as $\begin{bmatrix} u_S \\ u_D \end{bmatrix} \approx IN\ (0,\Sigma)$ and $\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{12} & \sigma_{22} \end{bmatrix}$. The above results imply that u_S and u_D are independent (i.e., $\sigma_{12} = 0$). This system is called a *recursive system* in which the OLS method leads to consistent and asymptotically efficient estimates.

In a recursive system, causality flows in one direction (i.e., from savings to deficits). This recursive system implies that the fiscal authority takes account of household savings while households determine their savings independently of fiscal policy. Important policy implications are that (1) deficit policy does not influence household savings at all (in the sense of neither Ricardo nor Keynes), that (2) deficit policy, on the other hand, is a reaction against household savings as a weakly exogenous variable and that (3) the deficit growth rate, as approximated by $d(D/Y)_t$, moves counter-cyclically against the change in household saving rate (i.e., a negative effect on the change in saving rate variable). Deficit policy, in particular after 1973, could be considered as a counter-cyclical policy against the business cycle in general [see Figure 6-1 for plots of $d(D/Y)_t$, $d(S/Y)_t$ and $d\{(GNP_t - GNP_{t-1})/(GNP_{t-1})*100(\%)\}$]. The household sector, on the contrary, has no mechanism/incentive to offset deficit policy in the sense of the rational expectations mechanism (i.e., the household sector does not have a reaction function against fiscal policy).

It should be noted that policy ineffectiveness on saving behaviour is not due to a rational expectations mechanism of feedback system but due to the independence of the household sector from the influences of fiscal policy. As the comparisons and encompassing tests of saving models show, the household saving rate can be estimated and forecast competently without involving any fiscal policy variables.

FIGURE 6–1 : SAVINGS AND DEFICITS



Source : Annual Report on National Accounts 1987.

IV. Conclusion

The main conclusion is that there is no active fiscal policy effect on household savings and bequests. Both direct econometric tests and model selection tests indicated that government expenditure (G), public debt (D), and deficits (δD) did not influence household saving and bequest behaviour at all. This result is quite a strong one but it could be expected from the results of chapter 5 in which Japanese household saving behaviour was shown to be insensitive to short-run fluctuations in the economy.

The Ricardian equivalence proposition was rejected by econometric tests. First, bequest transfers did not satisfy the direct tests (i.e., no causality and no co-integration with deficits). Secondly, savings satisfied the direct tests with respect to deficits. But a further model selection study revealed that the causality flowed from savings to deficits and not *vice versa*. So savings also did not finally satisfy the Ricardian equivalence condition.

Our conclusion implies that Japanese household saving and bequest behaviour cannot be described by the logic/theory of Ricardo or Keynes. Capital accumulation in Japanese households has been made quite independently of the influences of the government. According to our findings, deficit policy was not responsible for whether or not household capital (wealth) was overaccumulated. Judging from the very high saving rate, a natural interpretation seems to be that the household sector had felt their capital accumulation still insufficient.

Among fiscal policy activities, only taxation on households can influence saving and bequest behaviour because it directly changes a household's disposable income [note that gross income was co-integrated with social security (tax) adjusted income tax]. Historical records, however, showed that the effective tax rates remained stable and that the basic tax structure had not been revised during the sample period. So we could not infer the effects tax policy changes on saving and bequest behaviour. Note, however, that both property and bequest taxes on real estates seem to have distortionary effects on wealth holdings.

This stability of effective tax rates must have been maintained by some process of political economy. We will investigate the theoretical mechanism for this process alongside the Ricardian equivalence proposition in chapter 7.

APPENDIX. A THEORETICAL DERIVATION OF OPTIMAL DEFICIT POLICY

A theoretical framework is taken from chapter 7. For detailed discussion, see section III of chapter 7. A difference from chapter 7 is that this appendix is based on annual flow variables for empirical application.

The government is assumed to optimise the loss function with state-contingent constraints. The government loss function is defined as,

$$X_t = -(D_t - D_t^*)^2 - k(F_t/e_t - F_t^*/e_t)^2 \qquad \text{(A-1)}$$

where D_t = annual public deficits at t.
D_t^* = desired public deficits level at t.
F_t = annual increase in foreign assets at t.
F_t^* = desired increase in foreign assets at t.
k = government's policy weight imposed on foreign assets. $k > 0$.
e_t = terms of trade at t.

The IS- current account balance equation is given by,

$$F_t = e_t(S_t - I_t - D_t) \qquad \text{(A-2)}$$

where S_t = aggregate private savings.
I_t = private investment.

In this model, the interest income from public debt and foreign assets is ignored. This does not change any substance of the model derivation.
The optimisation problem is to maximise (A-1) subject to (A-2).

$$\text{Max } X_t = -(D_t - D_t^*)^2 - k(S_t - I_t - D_t - F_t^*/e_t)^2$$

The first order condition yields an optimal deficit policy such that,

$$dX_t/dD_t = 0 \Rightarrow D_t = (k/k+1)(S_t - I_t + D_t^*/k_t - F_t^*/e_t) \qquad \text{(A-3)}$$

Let us assume that desired public deficits and desired increase in foreign assets are adaptive functions of the actual levels, i.e.,

$$D_t^* = D_{t-1} + \alpha\, dD_t = D_{t-1} + \alpha\, (D_t - D_{t-1})$$
$$F_t^* = F_{t-1} + \beta\, dF_t = F_{t-1} + \beta\, (F_t - F_{t-1}) \qquad \text{(A-4)}$$

and also assume that investment is a linear function of disposable income (GDP) such that $I_t = \phi(Y_t - T_t)$. After some rearrangements of (A-3), the theory model is derived,

$$D_t = \alpha_1 D_{t-1} + \alpha_2 F_t + \alpha_3 F_{t-1} + \alpha_4 Y_t + \alpha_5 T_t + \alpha_6 S_t \qquad \text{(A-5)}$$

where T_t = total net tax revenue at t.

Following a coherent procedure of model transformation in chapter 5, the theory model (A-5) is transformed into the baseline empirical model of dynamic deficit policy.

$$d(D/Y)_t = k_0 + k_1 d(D_{t-1}/Y_t) + k_2 d(F/Y)_t + k_3 d(F_{t-1}/Y_t) + k_4 d(T/Y)_t + k_5 d(S/Y)_t + v_t \qquad \text{(A-6)}$$

where macro aggregate variables in (A-5) are approximated by aggregate household data such that S_t = household savings, Y_t = disposable income, and v_t = a white noise.

CHAPTER 7

AN OPEN ECONOMY FISCAL POLICY GAME WITH OVERLAPPING GENERATIONS

I. Introduction

Empirical results in the earlier chapters demonstrated some important aspects of household saving behaviour in Japan. First, bequest wealth occupies a significant share of total household wealth (over 40-50 percent) (chapter 4). Secondly, aggregate saving behaviour is well explained by the bequest model of saving (chapter 5). Thirdly, bequest transfers are carried out independently of the fiscal policy of the government. The Ricardian equivalence proposition does not hold for Japanese data both for bequest transfers and for aggregate savings (chapter 6). Fourthly, the effective income tax rate remains fairly stable over the past twenty years (chapter 6).

This chapter extends the intergenerational game discussed in chapter 3 to incorporate fiscal policies and earlier empirical findings, in particular, the refutation of the Ricardian equivalence proposition through bequest transfer mechanisms.

There are several routes that lead to a rejection of the Ricardian equivalence proposition. These include (1) uncertainty in length of lifetime or economic/population growth [Blanchard (1985), Calvo and Obstfeld (1988) and Buiter (1988)], (2) uncertainty in income [Feldstein (1988)], (3) imperfect financial markets or liquidity constraints [Tobin (1980), Buiter and Tobin (1981), Yotsuzuka (1987)], (4) progressive or distortionary taxation [Abel (1986), Auerbach and Kotlikoff (1987)], and (5) permanent postponement of taxes [Feldstein (1976) and Bernheim and Bagwell (1988)].

In theoretical model building, it is not interesting to include *a priori* assumptions that are known to lead to a desired outcome. The model in this chapter avoids any assumptions that imply violations of Ricardian equivalence. That is to say, our assumptions include; (1) certainty in length of lifetime, (2) perfect foresight, (3) certainty of income, (4) perfect capital markets, (5) non-progressive taxation, (6) no a priori assumption of postponement of taxes, (7) fiscal policy neutrality [Modigliani-Miller theorem in public finance, see Stiglitz (1986) and Sargent (1987a)], and (8) tax burden neutrality (non-distortionary taxation).

In the model, the household sector and the government act strategically in a non-cooperative game. By introducing the government's objective function, a non-Ricardian equivalence outcome is *rationally* chosen by the household sector and the government. This is an important departure from results in the literature. The rejection of Ricardian equivalence as a rational outcome is a much stronger result than that obtained by making uncertainty-imperfection assumptions as listed above.

The model is based on the most important policy issue facing Japan in the 1980s, namely, reductions in the budget deficits and current account surplus. Using this set-up, we would like to explain why the government cannot cut budget deficits easily and why it is difficult to introduce a policy with higher taxation (i.e., tax reform).

The chapter is organised as follows. In section II, a simple model of the open economy is set out. The household sector, the government sector and the foreign sector are shown to depend on each other. Section III translates the open economy system into a non-cooperative game situation between the government and the household sector. The game is constructed as a one-shot game and then extended to a repeated game. Section IV evaluates the main results of this chapter.

II. An Open Economy

In this section, we set up a model of an open economy in which households, the government and foreign sectors interact with each other. In particular it is shown how households take account of the government's fiscal policy. This formulation will be transformed into a game theoretic framework in the next section. In our model, the firm sector is ignored and thus private capital investment is also ignored.

In general, time period is expressed by t (in a subscript) and generation is identified by i (in a superscript). A capital letter indicates aggregate value and a small letter implies per household value. All variables are in real terms.

II.1. The Household Sector

The household is a utility maximiser with an altruistic bequest motive. The household sector is characterised as follows:

(1) The representative household has a "joy-of-giving" utility function taking a log-linear form as discussed in chapter 3. The household gains utility from bequests themselves rather than from the utility of children (who

receive the bequests). Preference parameters are unity [i.e., consumption preference is indifferent between current and future goods or between domestic and foreign goods]. This assumption is made purely for analytical simplicity.

(2) The household lives for two periods (the working and the retired). The children start working when their parents retire. The parents die at the end of the retirement period, with certainty (the assumption of certainty).

(3) During the retirement period, there is no income source except savings and interest income from investment made during the working period.

(4) Income tax is imposed on wage income. Non-wage income tax, social security tax and other taxes are ignored for analytical simplicity.

(5) A planned bequest is announced at the beginning of the retirement period so that the next generation can take bequests into account in their budget constraints. At the beginning of the working period, the working generation has perfect information on relevant variables in both working and retired periods except for information on fiscal policy in the next period (the assumption of a perfect foresight).

(6) In this chapter, in contrast to earlier chapters, real estate holdings and real estate bequests are ignored.

Savings are held either in public bonds or in foreign assets.

The optimisation framework is essentially the same as in the basic model of chapter 3. Two extensions are made to deal with the open economy fiscal policy: (1) explicit inclusion of income taxation and (2) consumption of foreign goods.

Utility function :

The i+1-th generation's utility function is given by,

$$U^{i+1} = \ln c_t^{i+1} + \ln (c_t^{i+1*}/e_t) + \ln c_{t+1}^{i+1} + \ln (c_{t+1}^{i+1*}/e_{t+1}) + \beta^{i+1} \ln b_{t+1}^{i+1} \quad (1)$$

where c_t^{i+1} = household consumption of home goods of the i+1-th generation at t.
c_t^{i+1*} = household consumption of foreign goods of the i+1-th generation at t.
b_{t+1}^{i+1} = household bequests of the i+1-th generation.
β^{i+1} = an intergenerational weight of the i+1-th generation for the i+2-th generation (footnote 1). $\beta > 0$.
e_t = terms of trade at t (i.e., $e_t = p_t/p_t^*$ and p_t^* is foreign price).

A household of the i+1-th generation can shift the intergenerational weight according to the next generation's altruistic attitude and the government's fiscal policy. In

1. The optimal value of the intergenerational weight without the Ricardian transfer motive is calculated in the intergenerational game in section III of chapter 3.

this sense, the intergenerational weight is the only (strategic) choice variable in the optimisation strategy of the household. The Ricardian household is assumed to increase bequests to the next generation when the government follows a debt finance policy in the current period and is expected to increase tax rates in the next period. As discussed in chapter 3, without the Ricardian equivalence transfer motive, there is an optimal level of intergenerational weight ($^*\beta^{i+1}$). The problem is whether or not the i+1-th generation increases its intergenerational weight above the level of $^*\beta^{i+1}$, such that it equals $^*\beta^{i+1} + d\beta^{i+1}$. $d\beta^{i+1}$ is calculated such that it exactly compensates for the future tax increase in the next generation and leaves the two generations' after-tax aggregate budget unchanged.

Budget constraint :

The i+1-th generation's budget constraint in the t-th period is,

$$k_t y_t^{i+1} + \tau^i b_t^i = c_t^{i+1} + c_t^{i+1*}/e_t + s_t^{i+1} \qquad (2)$$

where k_t = $1-\phi_t$ and ϕ_t is income tax rate at t.
τ^i = adjustment for per household bequest receipt such that $\tau^i = h^i/h^{i+1}$
h^i = number of households in the i-th generation.
y_t^{i+1} = household gross wage income at t.
s_t^{i+1} = household saving at t.

Saving is made for consumption in the retired (t+1-th) period and for preparing bequests to be made to the i+2-th generation.

The i+1-th generation's budget constraint in the t+1-th period is,

$$(1+r_t)s_t^{i+1} = c_{t+1}^{i+1} + c_{t+1}^{i+1*}/e_{t+1} + b_{t+1}^{i+1} \qquad (3)$$

where r_t = real interest rate in world financial markets.

From (2) and (3), the i+1-th generation's lifetime budget constraint is obtained,

$$k_t y_t^{i+1} + \tau^i b_t^i = c_t^{i+1} + c_t^{i+1*}/e_t + (c_{t+1}^{i+1} + c_{t+1}^{i+1*}/e_{t+1} + b_{t+1}^{i+1})/(1+r_t) \qquad (4)$$

<u>Optimisation :</u>

The i+1-th generation optimises its lifetime utility [eq(1)] subject to its lifetime budget constraint [eq(4)]. The optimal solutions are given below. Asterisks on the left hand side (in superscript) imply optimal value.

$$\begin{aligned} {}^*c_t^{i+1} &= \{1/(4+\beta^{i+1})\}(k_t y_t^{i+1} + \tau^i b_t^i) \\ {}^*c_t^{i+1*} &= \{e_t/(4+\beta^{i+1})\}(k_t y_t^{i+1} + \tau^i b_t^i) \\ {}^*c_{t+1}^{i+1} &= \{(1+r_t)/(4+\beta^{i+1})\}(k_t y_t^{i+1} + \tau^i b_t^i) \qquad (5) \\ {}^*c_{t+1}^{i+1*} &= \{(1+r_t)e_{t+1}/(4+\beta^{i+1})\}(k_t y_t^{i+1} + \tau^i b_t^i) \\ {}^*b_{t+1}^{i+1} &= \{(1+r_t)\beta^{i+1}/(4+\beta^{i+1})\}(k_t y_t^{i+1} + \tau^i b_t^i) \ . \end{aligned}$$

By the same procedure, the i-th generation's optimal consumption and bequests are given by,

$$\begin{aligned}
{}^{*}c_{t-1}^{i} &= \{1/(4+\beta^{i})\}(k_{t-1}y_{t-1}^{i} + \tau^{i-1}b_{t-1}^{i-1}) \\
{}^{*}c_{t-1}^{i*} &= \{e_{t-1}/(4+\beta^{i})\}(k_{t-1}y_{t-1}^{i} + \tau^{i-1}b_{t-1}^{i-1}) \\
{}^{*}c_{t}^{i} &= \{(1+r_{t-1})/(4+\beta^{i})\}(k_{t-1}y_{t-1} + \tau^{i-1}b_{t-1}^{i-1}) \qquad (6) \\
{}^{*}c_{t}^{i*} &= \{(1+r_{t-1})e_{t}/(4+\beta^{i})\}(k_{t-1}y_{t-1} + \tau^{i-1}b_{t-1}^{i-1}) \\
{}^{*}b_{t}^{i} &= \{(1+r_{t-1})\beta^{i}/(4+\beta^{i})\}(k_{t-1}y_{t-1} + \tau^{i-1}b_{t-1}^{i-1}) \ .
\end{aligned}$$

Aggregate consumption of two (the i-th and i+1-th) generations at t is obtained by,

$$\begin{aligned}
{}^{*}C_{t} &= h^{i}({}^{*}c_{t}^{i} + {}^{*}c_{t}^{i*}/e_{t}) + h^{i+1}({}^{*}c_{t}^{i+1} + {}^{*}c_{t}^{i+1*}/e_{t}) \\
&= \{2(1+r_{t-1})/(4+\beta^{i})\}(k_{t-1}Y_{t-1}^{i} + BQ_{t-1}^{i-1}) \\
&\quad + \{(2/(4+\beta^{i+1})\}(k_{t}Y_{t}^{i+1} + BQ_{t}^{i}) \qquad (7)
\end{aligned}$$

where $Y_{t-1}^{i} = h^{i}y_{t-1}^{i}$

$BQ_{t-1}^{i-1} = h^{i}\tau^{i-1}b_{t-1}^{i-1} = h^{i-1}b_{t-1}^{i-1}$

Aggregate budget (Z_t) at t is the sum of the i-th generation's savings at t-1 inclusive of interest payment and the i+1-th generation's total disposable income at t such that,

$$\begin{aligned}
Z_{t} &= (1+r_{t-1})h^{i}s_{t-1}^{i} + k_{t}h^{i+1}y_{t}^{i+1} \\
&= (1+r_{t-1})S_{t-1}^{i} + k_{t}Y_{t}^{i+1} \qquad (8)
\end{aligned}$$

where $S_{t-1}^{i} = h^{i}s_{t-1}^{i}$

As discussed in chapter 3, aggregate saving at t is obtained by subtracting aggregate consumption from aggregate budget such that,

$$\begin{aligned}
S_{t} &= Z_{t} - {}^{*}C_{t} \\
&= (1+r_{t-1})S_{t-1}^{i} + k_{t}Y_{t}^{i+1} - {}^{*}C_{t} \ . \qquad (9)
\end{aligned}$$

II.2. The Government Sector

The role of government fiscal policy can be considered either in terms of policy objectives or in terms of government expenditure. In both cases, the government budget constraint at t is given by,

$$G_t = T_t + dD_t - r_t D_t \qquad (10)$$

where G_t = government expenditure.
$T_t = \phi_t h^{i+1} y^{i+1}$ = total income tax revenue.
D_t = public bonds (public debt outstandings).
dD_t = budget deficits.

Budget finance is obtained either *via* income taxation or by debt finance or by a combination of the two. The government is assumed to consume home goods only, to hold no foreign reserves and to have no saving. The government expenditure at each period is treated as given.

In the household sector (section II.1), we indicated that the intergenerational weight could be altered according to changes in fiscal policy if a generation held strong altruistic feelings towards the next generation.

Let us explore the household's reaction further. Suppose that, at period t-1, the government issues public bonds (debt) and keeps the tax rate constant such that,

$\phi_{t-1} = \phi_{t-2}$ = the initial tax rate
$D_{t-1} = dD_{t-1} + D_{t-2}$.

Neither the i-th generation household, nor the government at t-1 knows what policy is going to be followed at t. The household's decision depends its expectation of government policy in the period and the next generation's reaction to that policy.

Let us consider, the i-th generation with the Ricardian equivalence transfer motive. The latter takes account of the following policy alternatives at t.

(1) Tax-rate increase :

$$\phi_{t-1} + d\phi_t = \phi_t \quad \text{and } dD_t = 0$$

The i-th generation wants to compensate for the expected increase in tax-rate borne by the i+1-th generation by increasing bequests (say, $\beta^{i\prime} > \beta^i$). Suppose that, with perfect foresight the household knows exactly by how much the tax rate will increase (i.e., $d\phi_t$), then it can calculate the optimal value of $\beta^{i\prime}$ to cover the next generation's increased tax-burden (see appendix of this chapter for actual calculations). Note, however, that this tax increase does not necessarily reduce outstanding public debt by the equivalent amount of the last period's bond issue dD_{t-1}. The tax increase may be the result of an expansion in government expenditure. It is simply assumed that the i-th generation has altruistic feelings towards the i+1-th generation regardless of the motive underlying the tax increase.

(2) Debt-finance case :

$$D_t = dD_t + D_{t-1} \quad \text{and } \phi_t = \phi_{t-1}$$

In this case, the i-th generation does not increase its bequest. β^i remains at the initial value (i.e., $\beta^{i\prime} = \beta^i$).

Although a higher tax rate must be imposed on some future generation, the i-th generation is concerned only with its immediate descendants. As long as the i+1-th generation is not expected to experience a tax increase, the i-th generation consumes and bequeathes as initially planned.

II.3. The Foreign Sector

This chapter is based on a small country open economy model. The foreign sector is large enough to absorb net domestic saving surplus. Perfect capital mobility is assumed. The real interest rate is given in world capital markets, there is no real interest rate difference between public bonds and foreign assets at a given time t. A current account balance is shown below with a terms of trade adjustment.

$$dF_t = e_t \{Y_t - T_t + r_t D_t + (r_t/e_t)F_t - C_t - (1/e_t)C_t^*\} - e_t dD_t$$

$$= e_t\ dS_t - e_t\ dD_t \qquad (11)$$

where Y_t = total gross wage income at t.
= gross domestic product minus government expenditure (G).
dF_t = an increase in foreign assets
= current account surplus.
C_t^* = aggregate private consumption of foreign goods.
C_t = aggregate private consumption of home goods.
dS_t = an increase in net saving
= $(1+r_t)S_t - (1+r_{t-1})S_{t-1}$.

(11) is a simple IS-current account identity without private investment. (11) can be rewritten in terms of stocks, such that,

$$S_t = D_t + (1/e_t)F_t \tag{12}$$

This identity implies that savings at t are either absorbed by public bonds or by foreign assets.

The preparatory work for a fiscal policy game has now been completed. We would like to move to the main model.

III. A Model of a Fiscal Policy Game

An argument against the effectiveness of economic policy is that private agents may take account of government policy and act in such a way as to offset the government's objective. Policy implications of rational expectations models are based on this kind of logic. Recently many authors have attempted to capture this type of strategic behaviour with a game-theoretic approach. We would like to apply the game-theoretic approach to fiscal policy analysis in order to draw some policy implications

In section II, we outlined the basic framework of an open economy system in which economic interdependence was taken into account. However, the model was not formulated as a game. In this section, the open economy system will be reworked in the form of a non-cooperative game. A one-shot game is first considered [model (I)] and then it is extended to a repeated game [model (II)].

III.1. The Model (I) : A One-shot Game

<u>The Rule :</u>

(1) The i-th generation at period t-1 has an exact knowledge of government policy at t-1. This generation optimises its lifetime utility at the beginning of period t. The generation has complete information about the extensive form of the game (the assumption of complete information). However government policy of the next period t is not known. The household may or may not make adjustments to the intergenerational weight ($\beta^{i} \rightarrow \beta^{i\prime}$) according to differing expectations of government policy in period t.

(2) The government of period t announces its policy after it knows the action of the i-th generation at t.

(3) The i+1-th generation at t optimises its life-time utility over periods t and t+1, with knowledge of the announced government policy at t. For the sake of a one-shot game, the i+1-th generation's intergenerational weight (β^{i+1}) is treated as optimally given.

(4) Given both the i-th and the i+1-th generations' actions [i.e., (β^i or $\beta^{i}{}'$) and β^{i+1}] and feasible policy alternatives, the government of period t finally chooses the actual policy which optimises its objective function.

<u>Additional Assumptions :</u>

(1) At period t-1, the government takes a debt finance policy.

(2) Each generation is concerned only with the generation that immediately follows it, It does not take account of distant future generations nor of future government policies. The generation may or may not be guided by the Ricardian equivalence transfer motive (i.e., compensate for a tax-increase in the next period), depending on its expectations of the reaction of the government.

(3) The household sector's payoff remains the same irrespective of which generation bears the tax-burden (the assumption of tax-burden neutrality).

(4) The government can raise its revenue as much as it needs (the assumption of fiscal policy freedom) and the method of finance does not matter (the assumption of fiscal policy neutrality).

<u>The Payoff Function :</u>

The government payoff (loss) function is defined as follows,

$$X_t = -(D_t - D_t^*)^2 - k_t (F_t/e_t - F_t^*/e_t)^2 \qquad (13)$$

where D_t^* = desired public debt outstanding at t.
F_t^* = desired stock of foreign assets at t.
k_t = government's policy weight imposed on foreign asset stock at t. $k > 0$ (footnote 2).

As is clear from the payoff function, the government tries to reduce (or raise) either stock of foreign assets or outstanding public debt. The government faces two constraints, namely its budget constraint and a stock version of the IS-current account balance identity such that,

$$G_t = T_t + dD_t - r_t D_t \qquad (14)$$

$$F_t = e_t S_t - e_t D_t \qquad (15)$$

where $T_t = \phi_t Y_t$, ϕ_t is income tax rate.

The government's problem is to optimise X_t subject to (14) and (15). The policy instruments are changes in debt finance (i.e., dD_t) and an increase in tax rate (i.e., $d\phi_t$). The policy domain is defined within a range between a full debt-

2. The government may not consider two policy objectives equally. For example, in the early 1980s, the Japanese government seemed to have put a higher weight on reducing public debt outstanding. As a result, current account surplus increased dramatically. It should be noted that the government can reduce foreign assets stock indirectly by increasing deficits (bond issue) or by raising a tax rate whereas public debt can be cut directly by an increase in tax rate, given the government expenditure.

finance policy (i.e., $d\phi_t=0$) and a full tax-finance policy (i.e., $dD_t=0$). However, by the assumptions of fiscal policy freedom and neutrality, the government's optimisation is, in fact, constrained only by (15). A key point is that even if the government is able to use its fiscal instruments to optimise X_t, X_t also depends on household savings which appears in (15). To see this point clearly, (15) is substituted into (13).

$$X_t = -(D_t - D_t^*)^2 - k_t(S_t - D_t - F_t^*/e_t)^2 \qquad (16)$$

The government optimises (16). The first order condition yields the optimal level of outstanding debt such that,

$$dX_t/dD_t=0 \Rightarrow D_t = \{k_t/(1+k_t)\}(S_t + D_t^*/k_t - F_t^*/e_t) \qquad (17)$$

Substituting (17) back into (16), the government's payoff function maps the optimal payoff schedule (i.e., the optimal reaction function) such that,

$$^*X_t = - \{k_t/(1+k_t)\}(S_t - D_t^* - F_t^*/e_t)^2 \qquad (18)$$

As expected, the government's payoff depends on action by households with respect to savings. All other variables are optimally chosen. Barro's model [Barro(1974)] can be interpreted in this context as implying that Ricardian household savings offset the payoff value of the government such that $^*X_t < 0$. In our model, this is only half the story. The rest depends on the household sector's payoff function.

The household sector's payoff function is defined as aggregate consumption of two generations at t such that,

$$C_t = h^i(c_t{}^i + c_t{}^{i*}/e_t) + h^{i+1}(c_t{}^{i+1} + c_t{}^{i+1*}/e_t) \quad (19)$$

The i-th and the i+1-th generations obtain their optimal consumption levels through their utility optimisation exercises subject to their respective lifetime budget constraints as discussed in section II. The household sector's strategic variable is an intergenerational weight of the i-th generation (β^i). By assumption, β^{i+1} is fixed in this one-shot game. The i-th generation decides the amount of bequests (BQ^i) in accordance with its expectations of government reactions. We consider two polar cases:

(1) The Ricardian equivalence transfer case. The intergenerational weight is determined in such a way as to fully compensate a tax-increase at period t :

$$\{ \beta^{i\,\prime} = \beta^i + d\beta^i \text{ to satisfy } dBQ_t{}^i = dT_t \}.$$

This strategy is called ($\beta^{i\,\prime}$)-strategy.

(2) Non-Ricardian equivalence transfer case. The intergenerational weight is determined purely by the degree of intergenerational reciprocal altruism without any policy consideration (as discussed in chapter 3). This strategy is called (β^i)-strategy.

Given a possible strategy, the optimal payoff function is given by [the same as (7)],

$$\begin{aligned} {}^*C_t &= h^i({}^*c_t^{\,i} + {}^*c_t^{\,i*}/e_t) + h^{i+1}({}^*c_t^{\,i+1} + {}^*c_t^{\,i+1*}/e_t) \\ &= \{2(1+r_{t-1})/(4+\beta^i)\}(k_{t-1}Y_{t-1}^{\,i} + BQ_{t-1}^{\,i-1}) \\ &\quad + \{2/(4+\beta^{i+1})\}(k_t Y_t^{\,i+1} + BQ_t^{\,i}). \end{aligned} \tag{20}$$

This payoff depends on the government's fiscal policy ($k_t = 1-\phi_t$) and the i-th generation's intergenerational weight (β^i). However by the assumption of tax-burden neutrality of the household sector, the payoff ultimately depends only on the government's policy action.

The interactions of the government and the household can be translated into a game.

<u>The Game :</u>

Given a set of strategic variables $\{(d\phi_t, dD_t), (\beta^i, \beta^{i\prime})\}$ and the payoff function (X_t, C_t), we have a one-shot non-cooperative game $G = G\{(d\phi_t, dD_t), (\beta^i, \beta^{i\prime}), (X_t, C_t), N = 2\}$, where N is the number of players.

The rules of the game are defined so that the household moves first and the government moves second. There are no other moves in this game. Such sequential moves can be captured by the reaction function of the government to the household's first move.

By (9), the household's optimal payoff function can be rewritten as,

$$^{*}C_t = Z_t - S_t = (1+r_{t-1})S_{t-1} + k_t Y_t^{i+1} - S_t \tag{21}$$

where Z_t = aggregate budget at t.

The government's optimal payoff function can include the household's optimal payoff function [by using (21)] such that,

$$\begin{aligned} ^{*}X_t &= -\{k_t/(1+k_t)\}(Z_t - {}^{*}C_t - D_t^{*} - F_t^{*}/e_t)^2 \\ &= -\Theta(k_t)(Z_t - {}^{*}C_t - D_t^{*} - F_t^{*}/e_t)^2 \\ &= f(^{*}C_t) \end{aligned} \tag{22}$$

where $\Theta(k_t) = \{k_t/(1+k_t)\}$, $0 < \Theta < 1$.

$^{*}X_t = f(^{*}C_t)$ is the government's reaction function against the action of household. This function shifts according to the i-th generation's strategy (β^i, $\beta^{i'}$).

Case I : (β^i)-strategy or case of non-Ricardian equivalence transfer. The i-th generation chooses (β^i)-strategy no matter what fiscal policy is actually pursued at t. Let us define the following equation such that,

$$w(\phi_t) = Z_t - D_t^{*} - F_t^{*}/e_t > 0 \tag{23}$$

This is the aggregate budget minus desired levels of public debt outstanding and foreign asset holdings. (22) can be simplified as follows,

$$^{*}X_t = -\Theta(k_t)\{w(\phi_t) - {}^{*}C_t\}^2 . \tag{24}$$

Taking partial derivatives of $^{*}X_t$ with respect to ϕ_t,

$$\delta^* X_t / \delta \phi_t = -2\Theta(k_t)\{w(\phi_t) - {}^*C_t\}\{\delta w(\phi_t)/\delta\phi_t - \delta^* C_t/\delta\phi_t\}$$

where $\delta w(\phi_t)/\delta\phi_t = - Y_t^{i+1} < 0$.
$\delta^* C_t/\delta\phi_t = - \{2/(4+\beta^{i+1})\}Y_t^{i+1} < 0.$
thus $\delta w(\phi_t)/\delta\phi_t - \delta^* C_t/\delta\phi_t < 0$.

Therefore,

$$\delta^* X_t/\delta\phi_t \begin{matrix}<\\=\\>\end{matrix} 0 \quad \Longleftrightarrow \quad w(\phi_t) \begin{matrix}<\\=\\>\end{matrix} {}^*C_t \tag{25}$$

The household sector's payoff is maximised when a full debt-finance policy (i.e.,$d\phi_t=0$) is fulfilled with the (β^i)-strategy because $\delta^* C_t/\delta\phi_t < 0$. This is a perfect foresight equilibrium point, ${}^*C_t(d\phi_t=0)$. We assume ${}^*C_t(d\phi_t=0) = w(\phi_t)$ (footnote 3). From (24), ${}^*X_t = 0$ (since ${}^*C_t = w(\phi_t)$).

The government's payoff schedule under (β^i)-strategy is given by,

$${}^*X_t = f_1({}^*C_t) = -\Theta(k_t)\{w(\phi_t) - {}^*C_t\}^2 \quad \text{(Case I schedule)} \tag{26}$$

For analytical simplicity, let us further assume that at ${}^*C_t = w(\phi_t) - 1$, a full tax-finance policy (i.e.,$dD_t=0$) is followed. When the i-th generation's expectation turns out to be completely wrong, the payoff becomes ${}^*C_t = w(\phi_t)-1$ and the government payoff is ${}^*X_t = -\Theta$. We do not consider beyond the range of full debt-finance and full tax-finance policies. The domain of ${}^*C_t$ is defined as ${}^*C_t \in [w(\phi_t)-1 , w(\phi_t)]$.

3. The government can make adjustments to achieve ${}^*C_t = w(\phi_t)$ by equalizing; $S_t = D_t^* + F_t^*/e_t$.

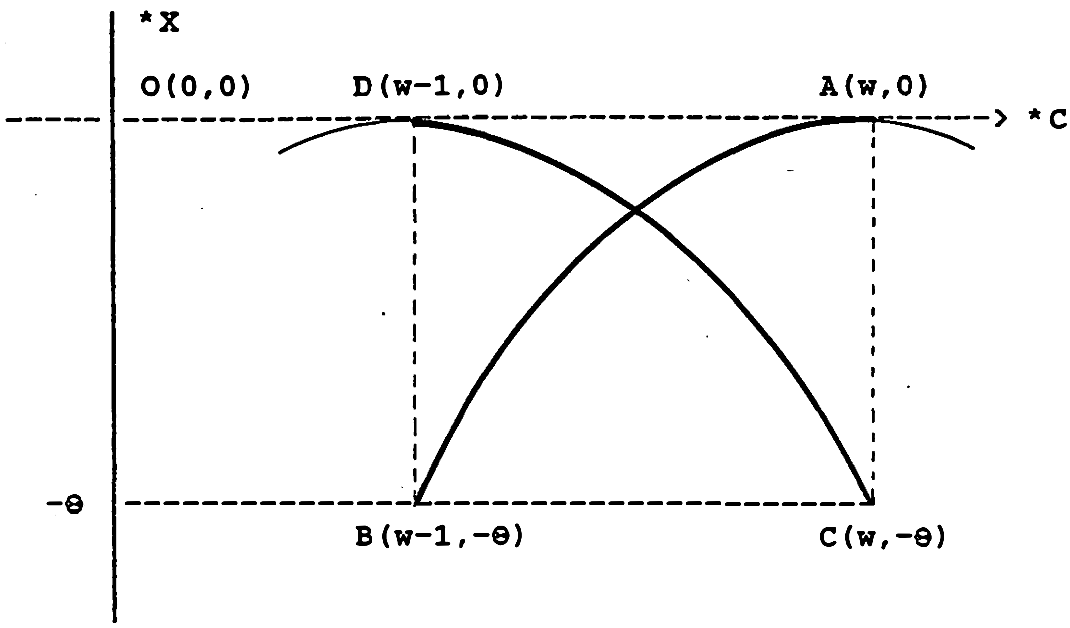
Case II : (β^{1} ')-strategy or the case of Ricardian equivalence transfer. The i-th generation chooses (β^{1} ')-strategy regardless of actual fiscal policy at t. From this it follows that a full tax-finance policy is chosen at $^{*}C_t(dD_t=0) = w(\phi_t)-1$ which is another perfect-foresight equilibrium point. In this case the i-th generation transfers bequests which exactly compensate for a tax-increase at t. The optimal government payoff is achieved at $^{*}C_t(dD_t=0) = w(\phi_t)-1$ such that,

$$^{*}X_t = f_2(^{*}C_t) = -\theta(k_t)\{w(\phi_t)-1-^{*}C_t\}^2 \quad \text{(Case II schedule)} \qquad (27)$$

$^{*}X_t = 0$ when $^{*}C_t(dD_t=0) = w(\phi_t)-1$. (27) is the government payoff function schedule under (β^{1} ')-strategy in the domain $^{*}C_t \varepsilon [w(\phi_t)-1,\ w(\phi_t)]$.

Both Case I and II schedules are shown in Figure 7-1.

FIGURE 7-1 THE PAYOFF SCHEDULE FOR THE ONE-SHOT GAME



Notes : The heavy lines represent feasible payoff schedules. f_2(*C) is decreasing on [w-1,w] while f_1(*C) is increasing on the same domain. Both points A and D represent perfect foresight equilibrium and both B and C imply completely unexpected points from the perspective of the i-th generation.

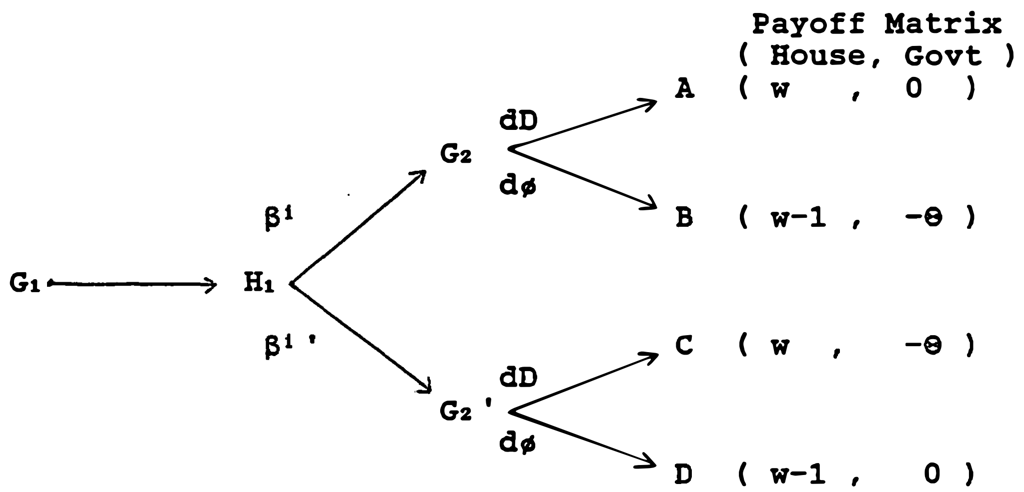
III.2. A Game Tree Analysis

A set of the payoff values (*C, *X) is a Nash equilibrium. Among many possible equilibria, let us consider four extreme points {(w,0),(w,-Θ),(w-1,0),(w-1,-Θ)} as our payoff values in a game tree analysis (in extensive form).

As is clear from section III.1. and Figure 7-1, these extreme points represent a combination of {(β^1)-strategy,

(β^1')-strategy } and { a full tax-finance policy, a full debt-finance policy }. The following game tree emerges.

FIGURE 7-2 : A GAME TREE



For the household sector, either A or C is a desirable point. But by the rule of the game, once the household moves to G_2 or G_2', the government is free to choose either (A or B) or (C or D) in the next move, and the household cannot do anything to influence the government's choice at that stage.

For the government, as far as its payoff value is concerned, the choice between A and D or between B and C does not make much difference because of the assumption of fiscal policy neutrality. Depending on whether the household chooses G_2 or G_2', the government will choose A or D accordingly.

If the household sector is to prevent D from being chosen, it must not choose G_2' in the first move. As a result, the household chooses G_2 and the government chooses A which is a perfect equilibrium and Pareto optimal as well.

There are several implications of this result.

First, the household sector's action creates a credible threat to the government. The government's best policy is to react in the way in which the household sector wishes it to. If the household takes the ($\beta i'$)-strategy, then the government is better off with a tax-finance policy because the household is prepared for the tax policy. The same thing can be said for the (β^i)-strategy. In this sense, the government's best strategy is to follow a kind of tit-for-tat procedure. A policy of "surprising" households does not benefit the government while a tit-for-tat policy maximises government payoff in this fiscal policy game.

Secondly, the household's payoff value is bounded by government policy (i.e., by w). If the government adopts a "higher tax (tight fiscal) policy", then the household's payoff is lower than under conditions of an "higher debt (easy fiscal) policy". However this follows not from results of the game but from the *a priori* assumption of unequal treatment given to debt and tax policies (an increase in taxation reduces the payoff of the household with or without Ricardian equivalence transfers). A related and important result is that a fiscal policy game tends to make the government behave in a "Keynesian" manner.

Thirdly, Barro's conjecture (1974) is quite likely to be rejected. Even with fiscal policy neutrality and the Ricardian equivalence condition, the household does not seem to choose ($\beta^{i}{}'$)-strategy if the alternative strategy (β^{i}) is available. A perfect Nash equilibrium does not give any incentive to deviate from (β^{i})-strategy.

Fourthly, our result supports the fact that most democratic governments tend to run a debt finance policy and avoid a tax increase policy even when fiscal policy neutrality holds. This is not only because of the unpopularity of tax policy among households but also because choosing the point B is Pareto inferior for society in general. If the government's social goal is wider than maximising its own payoff value, it would avoid choosing a Pareto inferior point.

The results of the one-shot game, however, have some limitations. For example, it is assumed that the intergenerational weight of the i+1-th generation (β^{i+1}) is given, but in fact, the i+1-th generation's strategy must affect the household sector's payoff value. To set the game in a more realistic situation, it is necessary to extend it to a repeated game. In fact, many social situations, including overlapping generations, are not comprehensible in a one-shot situation but need to be repeated several times.

III.3. The Model (II) : A Repeated Game

<u>The Rules :</u>

(1) We consider a two-shot complete information game without discounting and this two-shot game is repeated infinitely (the assumption of infinite economy). Basically each game repeats the one-shot game of model (I).

(2) Each generation (player) is concerned only with its parents and its children. Each player appears twice in the games. The player's role switches in the two games (i.e., children in the first game are parents in the second game).

(3) The household sector's strategy is determined endogenously, depending on the previous generation's action and the expectation of the future generation's action. A closed loop strategy for each generation is allowed.

(4) The government changes each period. There is no source of coordination between the present government and the next government. The strategy (i.e., the policy) is, therefore, determined independently of previous and future policies.

<u>Additional Assumptions :</u>

(1) In the first period, the government takes a debt finance policy.

(2) It is assumed that there are tax-burden neutrality, fiscal policy neutrality and fiscal policy freedom.

(3) The distance (or the norm) between full tax-finance and full debt-finance is set to be one in the domain of $^*C$. i.e., $\| {}^*C(d\phi=0) - {}^*C(dD=0) \| = 1$. With this assumption, the domain of the government's payoff value, $^*X$ is $[-\theta, 0]$.

To understand the repeated game situation intuitively, we illustrate the strategy in Figure 7-3.

FIGURE 7-3 : THE OVERLAPPING GENERATIONS

Period t-2 t-1 t t+1 t+2 t+3

The Government
G_{t-2} G_{t-1}(dD) G_t G_{t+1} G_{t+2} G_{t+3}

i-1 [-------I-------]
β^{i-1}
i [-------I-------]
β^{i} or $\beta^{i'}$
i+1 [-------I-------]
β^{i+1} or $\beta^{i+1'}$
i+2 [-------I-------]
β^{i+2} or $\beta^{i+2'}$
i+3 [-------I-------]
generation β^{i+3} or $\beta^{i+3'}$

Given the i-1-th generation's intergenerational weight (β^{i-1}) and debt-finance policy at period t-1, the i-th generation decides its intergenerational weight (β^i or $\beta^{i\prime}$)-strategy by taking account of the i+1-th generation's strategy. The i+1-th generation, in turn, takes account of the i+2-th generation's strategy, and so on. Since we assume that the government changes every period, it is sufficient for our analysis to consider the i+1-th generation's first and second games at period t and t+1 respectively with the respective governments.

The main difference between the repeated game and the one-shot game is allowing for variation in the next generation's strategy. The household sector's payoff value depends on strategies of both the i-th and the i+1-th generations. From this point of view, a sense of cooperation creeps into the game.

The Payoff Function :

Since the government changes each period, its payoff function changes each time. However the basic structure remains the same. The payoff function of the government at t is given in (13). At the period t+1, the payoff function is defined such that,

$$X_{t+1} = -(D_{t+1} - D_{t+1}^*)^2 - k_{t+1}(F_{t+1}/e_{t+1} - F_{t+1}^*/e_{t+1})^2 \quad (28)$$

where D_{t+1}^*, F_{t+1}^* and k_{t+1} are the government's choice variables. Definitions are analogous to (13).

The household sector's payoff function ($^*CC$) is defined simply as the sum of the payoff functions at t and t+1 without discounting.

$$^*CC_{t,t+1} = {}^*C_t + {}^*C_{t+1} \quad (29)$$

where $^*C_t$ is defined in (20) and $^*C_{t+1}$ is calculated analogously.

The i+2-th generation is assumed to follow the optimal strategy (i.e., (β^{i+2})-strategy, footnote 4). In the game at t, the key decision maker is the i-th generation with the strategic variable β^i while in the game at t+1, the i+1-th generation decides the strategy on β^{i+1}.

The Game :

A two-shot repeated game at t and t+1 is defined as,

$$\Gamma = \Gamma[\{(d\phi_t, dD_t), (\beta^i, \beta^{i\prime})\}_t, \{(d\phi_{t+1}, dD_{t+1}), (\beta^{i+1}, \beta^{i+1\prime})\}_{t+1}, ({}^*X_t, {}^*C_t), ({}^*X_{t+1}, {}^*C_{t+1}), N = 2]$$

where N is the number of players in each game.

As is usual with a repeated game, the game is solved backwards. Let us first consider the game at t+1. The payoff function for the household sector is given,

4. A "last" (youngest) generation in each two-shot game is supposed to follow the optimal strategy (non-additional bequest transfer) by the assumption of an infinite economy.

$$ {}^{*}C_{t+1} = {}^{*}C_{t+1}{}^{i+1} + {}^{*}C_{t+1}{}^{i+2} \quad (30) $$

where ${}^{*}C_{t+1}{}^{i+1}$ = total consumption of the i+1-th generation at t+1.

The government's optimal reaction function is,

$$ {}^{*}X_{t+1} = -\Theta(k_{t+1})\{w(\phi_{t+1}) - {}^{*}C_{t+1}\}^{2} \quad (31) $$

where $\Theta(k_{t+1}) = \{k_{t+1}/(1+k_{t+1})\}$
$w(\phi_{t+1}) = Z_{t+1} - D_{t+1}^{*} - F_{t+1}^{*}/e_{t+1}$.

The government reaction function $f_3(.)$ is defined according to the strategy of the i+1-th generation.

$$ {}^{*}X_{t+1} = \begin{cases} -\Theta\{w(\phi_{t+1}) - {}^{*}C_{t+1}\}^{2} & \text{under } (\beta^{i+1})\text{-strategy} \\ -\Theta\{w(\phi_{t+1})-1-{}^{*}C_{t+1}\}^{2} & \text{under } (\beta^{i+1\prime})\text{-strategy} \end{cases} \quad (32) $$

By the same logic as of model (I), this game reaches a perfect Nash equilibrium $\{{}^{*}X_{t+1}, {}^{*}C_{t+1}(d\phi=0)\} = \{0, w(\phi_{t+1})\}$ with the strategy set (dD_{t+1}, β^{i+1}).

For the game at t, given the i+1-th generation's optimal strategy, we can simply apply the results of model (I). A sequence of optimal payoff values with optimal strategies is obtained such that $[({}^{*}X_{T}, {}^{*}C_{T}) = \{0, w(\phi_{T})\}, (dD_{T}, \beta^{I})$, I=i and i+1, T = t and t+1].

As long as the i+2-th generation chooses the optimal strategy, the i-th and the i+1-th generations select their optimal strategies which give them the highest payoff values. The government reacts to these strategies such that it achieve an optimal payoff (i.e., *X = 0) by pursuing a full debt-finance policy.

By further induction through overlapping generations in the infinite economy (i.e., an infinite linkage of clusters of generations), we obtain a sequence of perfect Nash equilibrium with the optimal strategy, $\{(^*X_T, ^*C_T) = \{0, w(\phi_T)\}, (dD_T, \beta^I), I\varepsilon[0,\infty], T\varepsilon[0,\infty]\}$ as long as the game structure remains the same.

<u>The Folk Theorem :</u>

This result can be seen as a simple application of the Folk Theorem which states that " every feasible and individually rational payoff (Nash equilibrium) of the one-shot game is achievable as an equilibrium of the repeated game and *vice versa* "(see Aumann (1985) and Mertens (1986)).

An important aspect of the Folk theorem is that outcomes usually associated with cooperation can be supported by non-cooperative equilibrium strategies. Aumann (1985) argues,

> " In game-theoretic terms, an outcome is co-operative if it requires an outside enforcement mechanism to make it "stick". Equilibrium points are self-enforcing: once an equilibrium point is agreed upon, it is not worthwhile for any player to deviate from it. Thus it does not require any outside enforcement mechanism, and so represents non-cooperative behaviour. On the other hand, the general feasible outcome does require an enforcement mechanism, and so represents the co-operative approach. In a sense, the repetition itself, with its possibilities for retaliation, becomes the enforcement mechanism "(op.cit., p.211.).

Aumann's argument can be applied to our game. As far as we are concerned, in the one-shot game, some extreme altruist (self-sacrificing) generation (say, k) may choose (β^{k}')-strategy for the benefit of the next generation in the game at period k+1. Once the k-th generation is involved in the repetition of this game, it becomes immediately recognisable that choosing the apparently extreme altruistic behaviour, i.e., (β^{k}')-strategy, reduces the household sector's payoff value in the game at k, no matter what strategy is taken by the k-1-th generation. As a result, the rational generation k would not deviate from the optimal strategy.

Formally the household sector's payoff function in a two-shot game at k and k+1 is defined as,

$$*CC_{k,k+1} = *C_k + *C_{k+1}. \quad (33)$$

Each payoff is a function of the household sector's strategic variables, given the government's optimal reaction. Now suppose the k-1-th and the k+1-th generations' strategies are optimally given, the household sector's payoff values, then, depend on the k-th generation's strategy.

$$\begin{aligned} *C_k &= *C_k\{ (\beta^{k-1}), (\beta^{k} \text{ or } \beta^{k}{}') \} \\ *C_{k+1} &= *C_{k+1}\{ (\beta^{k} \text{ or } \beta^{k}{}'), (\beta^{k+1}) \} \end{aligned} \quad (34)$$

By definition of the household payoff function, eq (34) can be ordered as follows; omitting the k-1-th and the k+1-th generation's strategies,

$$
\begin{aligned}
{}^*C_k(\beta^k) &> {}^*C_k(\beta^{k\prime}) \\
{}^*C_{k+1}(\beta^k) &> {}^*C_{k+1}(\beta^{k\prime}). \qquad (35)
\end{aligned}
$$

The k-th generation's decision to choose $(\beta^{k\prime})$-strategy makes the payoff value of both games at k and k+1 lower than in the case of (β^k)-strategy. The household sector's payoff value in this two-shot game is substantially lower {i.e., ${}^*CC_{k,k+1}(\beta^{k\prime}) \ll {}^*CC_{k,k+1}(\beta^k)$}.

When altruism is defined as a voluntary act of one generation which strictly benefits other generations and strictly harms its own generation, the Ricardian equivalence transfer strategy (i.e.,$(\beta^{k\prime})$-strategy) can be seen as one of *excess altruism*. Certainly in a repeated game, no rational generation chooses $(\beta^{k\prime})$-strategy which increases the benefits of the k+1-th generation a little while it causes great harm to its own generation (footnote 5).

---

5. Schelling (1969) discussed a similar point when he argued that, " if each player tries to maximize his partner's payoff, he has a dominant strategy that leaves them both worse off than if they had minded their own business and played selfishly for personal score. While it is indeed socially inefficient for people to make small personal gains at large expense to others, it can be equally inefficient socially to make large personal sacrifices for the slight benefit of others" (pp. 50-51).

IV. Conclusion

The main result of the fiscal policy game outlined in this chapter is that the household sector chooses a non-Ricardian equivalence transfer strategy and forces the government to choose a debt finance policy. This result is obtained without introducing uncertainty of income [e.g., Feldstein (1988)] or distortionary taxation [e.g., Abel (1986)] or uncertainty of length of lifetime [e.g., Blanchard (1985)]. The rejection of the Ricardian equivalence transfers in this game is based on the following features:

(1) As long as the government can choose a debt finance policy in subsequent periods, the household does not feel it necessary to compensate for future tax designed to pay off public debt. Feldstein (1976) indicated the possibility of this mechanism; when the growth rate of the economy exceeds the interest rate, the government can roll over deficits indefinitely. If the permanent postponement of taxes is feasible, then the household faces no incentive for the Ricardian equivalence transfers. The result of the repeated game depends on the feasibility of the permanent deferral of a tax-increase policy.

(2) The policy objectives of the government are multiple and these objectives are often in trade-off situations [in this game, the trade-off between budget deficits and current account surplus. This trade-off occurs because of the stability of household savings in Japan](footnote 6). The household sector can manipulate this trade-off and make the government choose a less harmful policy for the household sector. This is the political economy aspect of the game. As Buchanan and Wagner (1977) have argued, a democratic society has a tendency to run deficits. The idea of the Ricardian equivalence proposition is based on the assumption that the household sector takes account of the government budget as a part of its own budget. In this proposition, the household takes the government policy as given. But if the household can manipulate government policy, it might not be necessary to behave in the way assumed by the Ricardian equivalence proposition.

(3) The intergenerational coordination of the household sector prevents *excess altruism.* As shown in chapter 3, if the household sector has already held an optimal degree of reciprocal altruism, then there is no incentive to increase bequests. In particular as shown in chapters 4 and 6, per

6. In a monetary policy game [e.g., Barro and Gordon (1983), Backus and Driffill (1985) and Vickers (1986)], the trade-off between inflation and unemployment is often used.

household bequest transfers exceed, by far, per household public debt burdens. The incentive for Ricardian equivalence transfers must be extremely weak if it exists at all.

These aspects of the game seem to capture some of the essence of the real world economy. Non-existence of Ricardian equivalence transfers in Japan can be explained by these factors. However, it is also true that permanent deferral of taxes may not be feasible in the real world. The government does not necessarily accept the household's strategy. It is also not always true that the household benefits by choosing a debt finance policy which may cause inflation, high interest rates or crowding out of private investment. A further limitation of this model is that the foreign sector is treated only as the absorber of domestic net saving surplus. No positive role is attached to the foreign sector. The model can be extended to analyse fiscal policy transmission mechanisms on the lines suggested by Hamada (1986) and Frenkel and Razin (1986, 1987a,b).

APPENDIX. DERIVATION OF THE RICARDIAN INTERGENERATIONAL WEIGHT

The Ricardian intergenerational weight ($\beta^{i\prime} = \beta^i + d\beta^i$) can be calculated by equating the bequest increase of the i-th generation and the tax-burden increase of the i+1-th generation, as we assume that the i-th generation wants to compensate for all the tax-burden increase of the i+1-th generation.

First, let us consider bequest increase, we have the bequest without tax-compensation,

$$BQ_t^{\,i} \doteq \{(1+r_{t-1})\beta^i/(4+\beta^i)\}(k_{t-1}Y_{t-1}^{\,i} + BQ_{t-1}^{\,i-1}) \qquad \text{(A-1)}$$

and the bequest with tax-compensation,

$$BQ_t^{\,i\prime} = \{(1+r_{t-1})\beta^{i\prime}/(4+\beta^{i\prime})\}(k_{t-1}Y_{t-1}^{\,i} + BQ_{t-1}^{\,i-1}) \qquad \text{(A-2)}$$

Bequest increase is given by (A-2) minus (A-1)

$$BQ_t^{\,i\prime} - BQ_t^{\,i} = [4(\beta^{i\prime}-\beta^i)/\{(4+\beta^i)(4+\beta^{i\prime})\}] \times (1+r_{t-1})(k_{t-1}Y_{t-1}^{\,i} + BQ_{t-1}^{\,i+1}) \qquad \text{(A-3)}$$

Next consider the tax burden increase. We have taxation without tax-rate increase,

$$T_t = \phi_t Y_t^{\,i+1} \qquad \text{(A-4)}$$

and tax revenue with tax-rate increase,

$$T_t{}' = (\phi_t + d\phi_t)\, Y_t^{\,i+1} \qquad \text{(A-5)}$$

Thus the total tax burden increase is given,

$$dT_t = T_t{}' - T_t = d\phi_t Y_t^{\,i+1} \qquad \text{(A-6)}$$

By our assumption, (A-3) must be equal to (A-6), solving for $\beta^{i\prime}$,

$$\beta^{i\prime} = [\{16(dT/B)+4(dT/B+1)\beta^i\}/\{4-(dT/B)(4+\beta^i)\}] \qquad \text{(A-7)}$$

where $dT = d\phi_t Y_t^{\,i+1}$
$B = (1+r_{t-1})(k_{t-1}Y_{t-1}^{\,i} + BQ_{t-1}^{\,i-1})$.

Given the assumption of perfect foresight of $d\phi_t$ and $Y_t^{\,i+1}$, the i-th generation can calculate $\beta^{i\prime}$ by (A-7).

GENERAL CONCLUSION

In the general introduction, the following six questions were raised:

(1) What are the most important motivations for savings in Japan ?

(2) What theoretical foundations can we give to Japanese saving and bequest behaviour ?

(3) Does bequest wealth account for a high proportion of total wealth holdings ?

(4) What sort of aggregate saving model is appropriate for explaining actual savings ?

(5) How will the saving rate change in the future ?

(6) Does government policy influence household savings and bequests ?

For each question, this thesis provided a clear answer and we believe that our investigation deepened understanding of Japanese saving and bequest behaviour.

The first question was approached through an examination of relevant parts of the saving literature (chapter 1) and a broad survey of empirical facts in Japanese savings (chapter 2). We suggested that the bequest motive gave a possible explanation for the high saving rate of older households and also for aggregate savings in general.

Together with the life-cycle motive of savings, a theoretical model with bequest motive was formulated by using the overlapping generations (OLG) model. This model established the theoretical foundations in answer to the second question. We further analysed intergenerational interactions and bequest transfer mechanisms by translating the OLG model into an intergenerational game. This game demonstrated how optimal bequests were determined and established the stability of optimal bequest transfer strategies over many generations.

The third and fourth questions were concerned with the empirical validity of the models of saving and bequest behaviour based on the theoretical foundations established in chapter 3. The third question was discussed in connection with the Kotlikoff-Summers-Modigliani controversy. We presented a new method of estimating bequest wealth and obtained empirical results from Japanese data in chapter 4. According to our estimates, bequest wealth accounted for 40-50 percent of total wealth. In addition, the bequest ratio to total wealth was increasing over time. With the aid of a complementary survey, it was shown that bequest factors would be significant and have important implications for the Japanese economy in the future.

The fourth question was answered in chapter 5. The bequest model of savings satisfied diagnostic tests and was selected as a dynamic saving model. In conjunction with the Kotlikoff-Summers-Modigliani controversy, we showed that a reasonable life-cycle model was encompassed by the selected bequest model.

Since the results of chapter 4 indicated the importance of bequest factors in the future, chapter 5 assumed that the bequest model would continue to be empirically valid in the future. A projection of saving rates was conducted incorporating the assumption of increasing importance of bequests. From 1986 to 1995, the forecast saving rate rose a little despite increases in bequests. This was due to the growth gap between income and bequests. After 1996, the bequest-income ratio reached a steady-state value and the saving rate declined gradually. However, as the saving rate was constantly high over the period (i.e., a high mean value with low variance), the rate did not decline as much as implied by other studies (it remained at 16 percent in 2010).

The sixth question was examined both empirically (chapter 6) and theoretically (chapter 7). Both chapters refuted the Ricardian equivalence proposition. Chapter 6 concluded that fiscal policy variables had no effect on saving and bequest behaviour. Chapter 7 showed that with multiple policy objectives of the government and the fiscal policy neutrality condition, the household sector would avoid a tax-increase policy by choosing a non-Ricardian equivalence strategy. Policy ineffectiveness, however, did not imply that the household sector was completely indifferent to the government. On the contrary, the household sector applied pressure which ensured a no-tax-increase policy and this could have real effects on household saving and bequest behaviour.

The answers to the six questions posed by this thesis have contributed to our understanding of Japanese household saving and bequest behaviour in various respects. In addition to our results, the empirical and theoretical approaches used here have differed substantially from previous studies in the literature so that the study has added to the research methodology for measuring bequests and evaluating policy effects and to the theoretical literature on altruistic household behaviour and Ricardian equivalence in overlapping generations models.

DATA APPENDIX

This appendix presents the original (raw) data used in this thesis. Most macro data and consumer price deflator come from The Annual Report on National Accounts (annual issues) and Report on Revised National Accounts on The Basis of 1980 (Economic Planning Agency). The data on inheritance and property tax revenues and deficits (on the basis of general accounts) come from Economic Statistics Annual 1988 (The Bank of Japan). Bequest data come from Tax Bureau Annual Report 1965-1985 (Ministry of Finance). The land price deflator (used for real estate bequests and total real estate holdings) is taken from the land price index of all urban districts (The Japan Real Estate Institute). Since the national accounts stock data only start from 1969, financial assets stock from 1965 to 1968 are taken from The Flow of Funds (Application Table)(The Bank of Japan) and real estate holdings from 1965 to 1968 are calculated by subtracting annual net increase (flow) in real estate holdings from the benchmark stock level in 1969. Demographic (population) data are taken from Japan Statistical Yearbook 1987 (Statistical Bureau). Bonus and wage data come from Yearbook of Labour Statistics 1985 (Ministry of Labour). Bonus and wage are average monthly special and contractual cash earnings for regular employees, covering establishments employing five or more people in all industries.

(1) The data set for chapter 2

The sample period = 1953-1985 (calendar year, current value = billions of yen unless otherwise stated). The saving rates and household disposable income during 1953-1964 are taken from <u>The Annual Report on National Accounts</u> (the old series).

Definitions of (raw data) variables are as follows:

S/Y = household saving rate (percent).
Y = household disposable income.
POP65 = percentage of population above the age of 65 years.
LP = land price index (deflator). The base year = 1980.
CP = consumer price index (deflator). The base year is 1980.
INHETAX = inheritance tax payments.
BONUSPAY= average monthly special earnings (thousands of yen).
WAGE = average monthly contractual cash earnings (thousands of yen).

The variables used in chapter 2 (Tables 2-1 and 2-2) are transformed from the above raw data. These are defined as follows:

S/Y = the same as the raw data.
dY/Y = disposable income growth rate.
= $[\{(Y_t/CP_t)-(Y_{t-1}/CP_{t-1})\}/(Y_{t-1}/CP_{t-1})]*100$ (percent).
POP65 = the same as the raw data.
CPI = consumer price inflation rate.
= $\{(CP_t - CP_{t-1})/CP_{t-1}\}*100$ (percent).

Land = land price inflation rate.
= $\{(LP_t - LP_{t-1})/LP_{t-1}\}*100$ (percent).
Inherit = inheritance tax payments per unit of disposable income.
= (INHETAX/Y)*100 (percent).
Bonus = bonus payments in terms of months of base wage rate.
= (12 BONUSPAY)/WAGE.

TABLE DA-1 : THE RAW DATA FOR CHAPTER 2

YEAR	S/Y	Y	POP65	LP	CP	INHETAX	BONUSPAY	WAGE
1953	7.8	5058.7	5.1	n.a.	21.3	3.3	n.a.	n.a.
1954	9.6	5710.6	5.2	2.3	22.6	4.2	n.a.	n.a.
1955	13.4	6381.7	5.3	2.5	22.4	5.5	n.a.	n.a.
1956	13.7	6963.5	5.4	2.9	22.5	7.0	n.a.	n.a.
1957	15.6	7815.4	5.5	3.6	23.2	8.2	n.a.	n.a.
1958	15.0	8304.6	5.5	4.5	23.1	8.3	2.895	15.733
1959	16.7	9268.8	5.6	5.5	23.3	9.9	3.301	16.676
1960	17.4	10686.4	5.7	6.8	24.2	12.2	3.929	17.818
1961	19.2	12507.5	5.8	9.3	25.5	16.1	4.712	19.487
1962	18.6	14437.4	5.9	11.8	27.2	21.1	5.235	21.896
1963	18.0	16790.9	6.1	13.6	29.3	28.8	6.030	24.231
1964	16.4	19146.9	6.2	15.5	30.4	33.8	6.624	26.801
1965	15.8	22257.7	6.3	17.8	33.8	44.0	7.294	29.485
1966	15.1	25426.9	6.5	18.9	35.4	55.8	8.288	32.424
1967	15.6	29414.8	6.6	20.8	37.0	64.8	9.465	35.778
1968	16.7	34101.9	6.8	24.2	39.0	77.6	11.090	40.439
1969	17.3	39640.0	6.9	29.0	40.8	103.0	13.586	46.078
1970	18.2	46261.6	7.1	35.5	43.9	139.0	16.150	53.228
1971	17.9	52054.2	7.2	41.8	46.8	210.2	19.353	61.165
1972	18.2	60245.4	7.4	47.8	49.4	318.5	22.644	70.456
1973	20.4	74924.8	7.5	61.6	54.6	309.8	29.701	83.674
1974	23.2	93833.2	7.7	77.8	66.2	301.3	38.478	104.311
1975	22.8	108712.8	7.9	74.6	73.7	310.3	40.463	122.766
1976	23.2	123540.9	8.1	75.7	80.4	317.4	44.666	137.180
1977	21.8	135318.4	8.4	78.7	86.2	351.7	48.197	150.921
1978	20.8	147244.2	8.6	82.5	90.1	422.6	50.041	162.078
1979	18.2	157071.1	8.9	88.7	93.4	424.5	53.341	170.416
1980	17.9	169932.7	9.1	100.0	100.0	440.5	57.073	181.102
1981	18.3	180367.9	9.3	112.2	104.4	552.1	60.015	190.832
1982	16.5	188815.0	9.6	122.4	107.1	664.5	61.231	198.736
1983	16.3	197912.4	9.8	129.5	109.1	786.1	61.702	205.610
1984	16.0	206742.2	9.9	134.1	111.3	877.3	n.a.	n.a.
1985	16.0	216558.8	10.3	137.7	113.7	1061.3	n.a.	n.a.

(2) The data set for chapters 4-6

The sample period = 1965-1985 (calendar year, current value = billions of yen unless otherwise stated).

LC, CP, Y and S/Y are given in Table DA-1. Definitions of (raw data) variables are as follows:

BQF = inheritance and gift (bequests) in financial assets.
BQL = inheritance and gift (bequests) in real estate (land and housing). BQ = BQF + BQL.
BQO = inheritance and gift in other assets (e.g., durables).
BQLIB = inheritance and gift (bequests) in liabilities.
BQTAX = taxation on inheritance and gift (bequests).
L = total real estate holdings.
F = total financial assets holdings.
S = household savings.
C = household consumption.
WINC = household wage income.
CAPINC = household capital income.
INCTAX = income tax revenue to the government.
SSTAX = social security tax.
SSBEN = social security benefits.
PROPTAX = property tax revenue.
GC = government consumption.
GINTPAY = government interest payments.
GS = government savings and investment.
GO = other government expenditure.
GTE = total government expenditure.
= GC + GINTPAY + GS + GO. Active government expenditure (G) is defined as GC + GS .
GPRPINC = government property income.
INDTAX = indirect tax revenue.
DIRTAX = direct tax revenue.
OTGINC = other government income.
GTR = total government tax revenue ≡ GTE .
GNP = gross national products.
D = outstanding public debt.
δD = fiscal budget deficit.
FOASS = stock on foreign assets in current yen.
FOLIB = foreign liabilities in current yen. Net foreign assets is defined as FOASS - FOLIB.

In the thesis, the raw data are first deflated either by consumer price index (CP) or by land price index (LP) and then transformed as required in each chapter.

TABLE DA-2 : THE RAW DATA FOR CHAPTERS 4-6 (1)

YEAR	BQF	BQL	BQO	BQLIB	BQTAX	L	F
1965	65.2	189.2	33.7	23.2	49.6	60378.6	31263.4
1966	80.5	199.0	35.5	24.8	47.0	67942.9	36862.2
1967	109.4	258.3	39.9	32.4	63.8	85903.6	42752.4
1968	116.0	344.7	54.6	38.5	79.2	106503.6	51118.1
1969	148.4	484.1	65.7	48.1	116.8	131457.3	62738.6
1970	203.3	640.1	84.5	68.0	164.6	135226.3	72022.9
1971	221.6	897.5	99.1	74.1	249.9	163461.2	85030.2
1972	302.0	1170.7	98.7	92.3	326.7	231997.9	114133.3
1973	364.5	1509.7	134.2	116.5	459.4	300795.9	136725.6
1974	375.6	1657.6	172.4	133.3	486.2	312465.4	151315.6
1975	351.1	1358.5	128.7	91.2	285.8	336591.8	174638.6
1976	415.0	1513.3	161.4	111.0	323.7	369601.4	207113.0
1977	461.4	1717.2	200.1	126.5	369.7	401471.0	234189.7
1978	529.5	1953.3	248.1	150.1	421.5	457020.1	274665.9
1979	603.4	2194.2	303.4	187.9	483.7	547796.0	308883.8
1980	731.7	2682.2	360.5	214.0	624.5	636774.2	339593.1
1981	848.5	3424.2	455.1	265.0	789.6	715919.4	379284.3
1982	912.2	3985.0	510.9	311.2	923.6	760279.0	413443.9
1983	1071.5	4329.0	586.6	341.3	1030.7	784995.9	458801.7
1984	1270.6	4693.8	680.7	430.5	1107.8	823894.3	507533.2
1985	1574.9	5230.8	755.8	474.8	1285.2	872883.5	555688.1

(continue)

TABLE DA-2 : THE RAW DATA FOR CHAPTERS 4-6 (2)

YEAR	S	C	WINC	CAPINC	INCTAX	SSTAX
1965	3509.7	18747.9	14261.9	2055.2	1202.6	1258.9
1966	3827.0	21599.8	16312.7	2350.3	1319.1	1539.2
1967	4585.1	24829.8	18763.1	2747.6	1518.1	1846.4
1968	5688.7	28413.2	22117.8	3017.6	1849.6	2157.4
1969	6862.6	32777.4	25639.8	3898.8	2225.2	2523.9
1970	8433.8	37827.8	31272.2	4602.3	2760.6	3165.3
1971	9257.5	42686.8	37146.9	5362.7	3467.9	3718.4
1972	10943.4	49302.0	44069.3	6574.2	4118.3	4300.3
1973	15273.9	59650.8	55235.8	8090.8	5543.3	5212.3
1974	21724.8	72108.4	70087.7	11258.9	6971.3	6910.2
1975	24792.8	83920.0	81678.2	13377.0	6967.1	9502.7
1976	28695.3	94845.6	92120.9	14894.5	7890.2	10684.2
1977	29448.6	105869.9	102896.8	15898.3	8793.7	12653.6
1978	30601.2	116643.0	111163.6	15929.8	9098.4	13880.2
1979	28512.7	128558.4	120120.3	17577.0	11671.1	16049.1
1980	30426.4	139506.3	130368.0	23919.6	14024.5	17513.4
1981	32996.3	147371.7	141047.1	26357.0	15997.1	20072.2
1982	31191.6	157623.4	149013.7	27022.7	17095.9	21645.5
1983	32285.9	165626.5	156804.3	29038.4	18465.7	22895.6
1984	33127.8	173614.4	165217.7	30124.6	19221.7	24269.7
1985	34733.6	181825.2	172926.5	31466.6	20386.7	26108.3

(continue)

TABLE DA-2 : THE RAW DATA FOR CHAPTERS 4-6 (3)

YEAR	SSBEN	PROPTAX	GC	GINTPAY	GS	GO
1965	1072.1	296.3	2690.0	132.3	1758.5	746.4
1966	1251.8	329.8	3054.3	172.3	1860.4	912.8
1967	1400.9	369.4	3410.2	248.6	2420.6	1079.4
1968	1687.9	423.8	3934.2	326.5	2997.5	1365.5
1969	1992.3	491.8	4558.4	385.1	3647.6	1535.5
1970	2464.8	576.7	5455.3	457.9	4875.6	1889.2
1971	2827.8	694.8	6421.4	540.1	5459.9	2166.4
1972	3474.0	827.5	7536.8	727.1	5547.6	2620.2
1973	4150.9	1056.3	9336.4	992.0	7651.2	3143.8
1974	6149.8	1269.6	12240.3	1288.0	8447.5	4697.9
1975	8788.3	1547.4	14890.2	1795.2	4697.6	5475.6
1976	10834.3	1795.1	16417.2	2555.9	3298.5	6141.6
1977	12719.7	2053.9	18243.2	3546.9	4224.2	7034.5
1978	14844.9	2256.8	19752.5	4578.7	2889.8	7998.9
1979	16931.9	2522.6	21486.2	5824.4	5304.9	8762.0
1980	18919.3	2784.0	23567.7	7569.0	6214.5	9943.3
1981	21452.9	2982.0	25584.8	9224.5	7872.7	10659.7
1982	23627.4	3320.3	26796.3	10385.2	7575.7	11070.2
1983	25883.2	3668.0	27996.1	11943.8	6516.1	11165.6
1984	27596.2	3941.7	29448.8	13337.1	9689.6	10635.8
1985	28918.7	4315.2	30748.3	14315.4	13553.5	11135.8

(continue)

TABLE DA-2 : THE RAW DATA FOR CHAPTERS 4-6 (4)

YEAR	GTE	GPRPINC	INDTAX	DIRTAX	OTGINC	GNP
1965	6399.3	218.5	2399.8	2467.0	55.1	32656.5
1966	7251.6	266.5	2712.8	2671.3	61.8	37931.9
1967	8559.7	327.3	3159.7	3159.6	66.7	44462.8
1968	10311.6	409.7	3758.9	3914.8	70.8	52702.7
1969	12118.9	483.5	4252.7	4782.4	76.4	62018.4
1970	15142.8	633.1	5201.8	6015.9	126.7	73128.2
1971	17415.6	793.3	5711.5	7043.8	148.6	80522.3
1972	19905.7	1010.5	6491.4	7925.9	177.6	92400.8
1973	25274.3	1294.0	7889.5	10664.3	214.2	112519.5
1974	32823.5	1668.8	9254.3	14727.7	262.5	133996.8
1975	35646.9	2020.7	9735.9	14091.7	295.9	148169.8
1976	39247.5	2305.5	10870.3	15032.6	354.9	166416.9
1977	45768.5	2710.3	12889.8	17113.6	401.2	185530.1
1978	50064.8	3158.1	13911.6	18688.2	426.7	204474.5
1979	58309.4	3739.2	16188.2	21885.4	447.5	221824.5
1980	66213.8	4625.7	17687.8	25875.8	511.1	240098.4
1981	74794.6	5664.7	19455.1	29029.1	573.5	256816.8
1982	79454.8	6213.1	20285.2	30679.9	631.1	269697.1
1983	83504.8	6685.9	20631.4	32605.1	686.8	280567.6
1984	90707.5	7463.8	22943.3	35291.4	739.3	298452.7
1985	98671.7	8368.0	24899.7	38484.9	810.8	317251.8

(continue)

TABLE DA-2 : THE RAW DATA FOR CHAPTERS 4-6 (5)

YEAR	D	δD	FOASS	FOLIB
1965	1766.5	197.2	3635.2	4541.5
1966	2662.2	665.5	3877.5	4332.3
1967	3818.4	709.3	4167.7	4690.9
1968	4785.8	462.0	4881.2	5027.1
1969	5479.3	412.6	5641.9	5024.9
1970	6226.3	347.1	7277.8	5595.1
1971	7605.6	1187.1	10087.9	7077.8
1972	11704.2	1949.9	13427.3	9156.2
1973	13154.4	1766.2	14645.7	10636.8
1974	15709.4	2159.9	17230.1	14475.7
1975	22795.2	5280.5	17966.9	15805.3
1976	32677.9	7198.1	20940.9	17992.1
1977	46097.8	9561.2	24658.5	17888.6
1978	62339.8	10673.9	27781.7	19307.6
1979	77553.9	13471.9	27885.2	21957.1
1980	95011.8	14170.2	38618.4	35827.2
1981	106832.0	12899.8	43944.0	41651.2
1982	121339.0	14044.7	53051.3	47323.1
1983	137244.0	13486.3	64453.8	55623.2
1984	150139.5	12781.3	78819.0	61645.1
1985	163571.2	12307.9	111176.0	78201.5

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