GROWTH, DISTRIBUTION AND MACRO CLOSURES: A GENERAL EQUILIBRIUM ANALYSIS OF POST-WORLD WAR II JAPAN

by

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ABSTRACT

A computable general equilibrium model with eight productive sectors is built, and calibrated using data of 1960 Japan as the base. The sector division reflects the intraurban modern-traditional dichotomy. Intraurban unskilled wage differentials are assumed to be caused by the employers' labor cost minimization behavior when there exist sector-specific training costs and quit rates. These quit rates are function of all nominal wages and consumers' price levels.

Three different methods of closing the model are employed. The first is the neo-Keynesian type (FI) where unemployed resources exist and the investment in new capital stocks is determined only by investors' expectations on user costs of factors of production and on future demands. The second closure is of the neoclassical type (NC). In this closure all factors are fully employed and the investment is passively determined by the total savings available in the economy. The third closure (IX) is a hybrid of the former two closures: factors are fully employed as in NC, and the investment is determined by the "animal spirits" of the investors as in FI.

It is observed through ten-year simulations that the FI closure replicates the economic history of Japan during the 1960s fairly well. It also replicates the qualitative relationship between growth and distribution during the most of the 1960s, although toward the end of the 1960s, there are some signs that the IX closure may do better. The neoclassical closure behaves poorly throughout the simulation period. In all three closures, higher growth rates of the economy tend to benefit capital and skill owners more than unskilled labor classes, although who actually benefits by how much differs substantially by closures and by the kinds of sensitivity experiments performed. Especially there is a marked distinction between the distributional outcomes of export-led growth and simple investment spurts.

Some relevant policy implications for dualistic, rapidly growing and labor abundant economies and a summary of model behavior of different closures appear as conclusions. Warnings against use of the neoclassical closure without caution are emphasized.

Thesis Supervisor: Dr. Richard S. Eckaus

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CONTENTS

CHAPTER 1: INTRODUCTION

This study attempts to gain better insights into the process of economic growth and the accompanying changes of income distribution. Japan's recent history is the chosen site for this study with the assumption that the destruction of capital stocks during World War II and the repatriation of six million people back into Japan after the war created a situation akin to the problems faced by many contemporary developing countries today. These problems include scarce capital stocks and an excess in the supply of labor (as seen in the amount of un- and underemployed). It would, of course, be a mistake to conclude from this that the case of post-war Japan can be directly applied to tackling the problems facing contemporary developing countries, but with a certain abstraction it is hoped that some aspects of Japan's experiences of economic growth are relevant to the problems faced in the development process.

The tool chosen for this "abstraction" is a computable general equilibrium model, relying heavily on the existence of consistent national accounting data, and on the assumption that the market mechanism plays an important role*. Much of this kind of modeling has been developed since Johanson (1960) did his pioneering work on the Norwegian economy, and with the rapid development of computers numerous general equilibrium model exercises have been performed in the recent past. This would be an appropriate place for reviewing

*This model, with some behavioral assumptions, is also compatible with centrally planned economies whose planning is naturally based on the national accounting consistency. See Zalai (1982).

some of them*.

The most appropriate starting point for a review of this sort may be the Kelley and Williamson (1974) study of the economic history of Japan. They apply a two-sector, two-factor general equilibrium model to the early phase (1887-1915) of Japan's economic development. Their model is surprisingly neoclassical considering the inevitable market imperfections expected during such an early phase of economic development. What is even more amazing is that it works in the sense that it can replicate Japan's history fairly well. Their sector division is industry and agriculture, and they ignore services due to the lack of plausible data. Factors are completely mobile with full information, so that both wage rates and profit rates on capital are equal across sectors. No intermediate demands exist and there is no foreign trade. Investment is determined by the savings available in the economy and adds to the "pool" of putty-putty capital stock. Their model is, therefore, better suited for such a long-term analysis as the one they actually did.

Some of the results Kelley and Williamson derive from this modeling and counterfactual exercise are: they argue that the Japanese economic performance between 1887 and 1915, in particular long swings are supply oriented, i.e., the supply of savings varied in accordance with the extent of the country's military adventurism; they also argue that a demographic factor, i.e., low population growth, is <u>not</u> likely to have significantly accounted for Japan's growth; and they give more credit to the magnitudes and directions of technical progress in both industry and agricultural sectors. These results are sometimes counter to what other students of Japanese economic history have almost taken for granted, i.e., the exogenously determined investment

*This review, however, is biased towards those models intended towards studying economic history and issues of development.

spurts, and are quite stimulating, although one could naturally argue these results come directly from their assumptions in the model building.

Williamson (1974) also built a model and successfully examined the late 19th century American history with a similar framework as the Kelley-Williamson model above, but using two regions (Midwest and Northeast).

Karlström (1982) also studies mainly the 19th century history of Sweden. His model emphasizes Sweden's relationship with the rest of the world through emigration and trade. His is a five-sector, two factor model; the sector division is based on how export- or homemarket-oriented sector goods are. Capital and labor are completely mobile within the urban region. Interregional mobility of factors, however, is limited. He examines the effects of emigration and rural-urban migration on the economic development of Sweden between 1871 and 1890, and comes up with the conclusion that the effect of the absence of emigration opportunities would <u>not</u> have affected the Swedish economy so much, and that the rural-urban migration had much larger impacts on the pattern of economic growth. The first is akin to the conclusion of Kelley and Williamson with regard to the population experiment in Japan. The supply and demand effects almost cancel each other out under the assumption of full employment. The second conclusion shows the cost of having immobile factors of production.

We shall now turn to models emphasizing economic development and structural change in developing countries as opposed to historical counterfactual analyses. Many of these models have been built at or in association with the World Bank. In particular, I. Adelman, S. Robinson, K. Dervis, and J. de Melo have produced a number of models with some common features* and are usually interested in the issue of trade policies of developing countries. They

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*A summary of these works appears in Dervis et al. (1982).

set the aggregate price level as the numeraire, i.e., they assume appropriate monetary and fiscal policies for price stabilization—whether such a set of policies is available and feasible is, understandably, beyond their immediate interest. One exception to this is Adelman and Robinson (1978). In this large model they include money balance demand equations and the price level that equates the total money balance demand with the exogenous money supply becomes the price level used as the numeraire*.

Adelman and Robinson have also detailed financial markets that determine the nominal amount of investment for each size of firm in each sector. The rest of their model is more straightforward. Nonagricultural sectors (except for service sectors) have Cobb-Douglas specifications where different kinds of skills are also combined in Cobb-Douglas forms. Their major conclusions are that size-distribution of income is quite stable over different external shocks, and that price and wage adjustments are much more powerful than quantity adjustments. These might at least be partly attributed to the specific neoclassical structure of the model (e.g., many exogenous log-normal variances assumed in within-group income distribution), but as a pioneering work of large scale general equilibrium modeling, these lessons, together with the lesson that "larger is not necessarily better" (which the author's themselves admit), have given other modelers and students of economic development much deeper insights.

All other studies by Dervis, Melo and Robinson (either all together or as subsets of the three) ignore the money and financial aspects. Melo and Dervis (1977) use a stylized three-sector model to examine the effects of protection by tariff over 40 years. They use different closures and labor

*Although, as Sanderson (1980) points out, there is some puzzling independence between money holding and savings behavior.

market specifications. They argue that the higher the factor (labor) mobility, the less desirable the protection is. Thus, in such a case where the Harris-Todaro type of rural-urban migration is assumed (Harris and Todaro 1970), the protection can become quite effective and efficient for developing "infant industries". Melo and Robinson (1980a) examine which trade policy (from among free trade, protective tariff, export subsidy and general subsidy) would be most suitable for such a primary exporting country as Columbia, and conclude that a more open development strategy (i.e., export subsidy) can worsen the distribution of income. In essence, they argue that the structure of the economy with regard to trade determines which policy might be better in terms of income distribution*.

In Dervis, Melo and Robinson (1981) they now study the effects of measures for curing foreign exchange shortage, and conclude that although there is no easy way out of the exchange shortage problem, export-oriented consumer goods' industries benefit from devaluation whereas domestic capital goods and intermediate goods' industries benefit from rationing of foreign exchange. This conclusion naturally leads to yet another study by them (Melo and Robinson 1980b), where they examine three sterotyped archetype economies (closed, primary exporting and manufacture exporting), and study what kind of policy choice tends to emerge depending on which class is more economically and politically powerful. In the more recent works they have used the Armington assumption almost exclusively for trade specification, i.e., that domestic products are substitutes for the imported commodities of the same sector with finite elasticities of substitution (Armington 1969). They usually assume full employment of all factors, and a zero trade deficit.

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*They also use an export-supply function rather than demand. The implication of this choice is not discussed in their paper.

Lysy and Taylor (1980) use another general equilibrium model for examining growth and distribution in Brazil. Some major differences from the models described above are easily noticeable: their trade account is not closed; their numeraire is the income of self-employed proprietors; and their labor aggregates are formed by constant elasticities of substitution (CES) functions with rather high elasticities. The first of these means that the trade deficit is endogenous, and adds (or subtracts from in the case of trade surplus), to the savings pool. Imports are all noncompetitive and real exports are exogenous. The second fact means that some classes of society receive nominally fixed income. This clearly opens the way for forced savings*, which is exactly what they intended to show: that forced savings are quite important. The effect of the third specification above, is that it enables the model to simulate changing shares of income of different kinds of labor. (The Cobb-Douglas specification used in works by Dervis, Melo and Robinson has fixed shares of course.) Lysy and Taylor's conclusion is that their model, like many other general equilibrium models, is rather unresponsive to policy shifts in general, although when the model responses are compared in magnitude with the shocks imposed, they can be fairly large. In a simplified one-sector version of their model (Taylor and Lysy 1979) they also examine the cause of the model's stability. They argue that if the money wage changes can affect the prices, the changes in cost can be passed on to the price level, and the effects on output and distribution of such wage changes can be quite small. This effect does not occur when the price level is fixed (by world price or by macro policy). As the neoclassical theory predicts, factor substitution then becomes important.

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*Adelman and Robinson (1980) also have this mechanism built into their model. They call it "real balance effects".

Eckaus et al. (1979) and McCarthy and Taylor (1980) examine the policy impacts in Egypt and Pakistan respectively. Relatively speaking, these models have some similarities with the Lysy and Taylor model described above. Although these models do not have the explicit mechanism of dynamics and their analyses are limited to comparative statics, they are capable of showing how difficult it is to change the distribution of income and/or improve the lot of the poor by a single policy measure. Similar results are also shown in de Melo's model for Sri Lanka .(M. de Melo 1979 and 1982).

Another model, which uses a similar closure as the Lysy and Taylor model, has been built for Mexico using a dualistic framework (Heroles 1980). Heroles's traditional sectors are poverty-farming, with a price-inelastic supply curve, and traditional service sectors who are the pool of underemployed. Although no equation mentions emigration, it is quite visible in the model by the assumption of the existence of the minimum "acceptance" wage level. At this level the traditional workers reach a subjective indifference point between staying in the sector or leaving for the USA. The modern sectors are quite conventional except for the fact that they are constrained by legal minimum wage levels.

The models reviewed so far purport to examine the patterns of structural changes and the possible policy responses of developing countries. To the extent that there is an implicit belief that physical variables and their growth are more important for developing countries in the medium-run, general equilibrium models can prove to be quite useful. Many general equilibrium models such as reviewed above concentrate only on the real aspects of economies*.

*There are, of course, models that incorporate monetary and financial aspects (for a simple example, see Clements 1978). Adelman and Robinson (1978), however, only include money to determine the aggregate price level, and neither money nor financial aspects are really consistent with the core of their general equilibrium model.

There are also general equilibrium models concerned with (often theoretical) issues common to both developed and developing countries, with a slight tilt towards developed economies. Some are interested in trade, othersin tax incidence, and still others in energy policies. Bergman's Swedish model (Bergman 1981, Bergman and Pör 1980) is one example of an energy policy model. It studies the impact of nuclear power discontinuation in Sweden in the long run (until the year 2000). His long time span enables him, therefore, to use a neoclassical, resource-mobile, full employment model. For the tax incidence analysis, there are the classical models of Harberger (1962), and more recently, Whalley (1977), Shoven and Whalley (1972) and Pleskovic (1982). These models are quite simple in structure and the authors are interested in examining where hypothetical equilibria would occur under different assumptions of distortion or fiscal actions. There are also models emphasizing the issues of trade. In fact, many of the works by Dervis, Melo and Robinson actually come under this category, as well as under the developing-country model category. Evans (1972) is also primarily interested in protection effects in Australia.

One example of a large scale, multi-purpose, multi-region model is the ORANI model for Australia (Dixon et al. 1981)*. The authors, however, use across the board tariff increases to test how the model works. Another example of a large scale model used to test trade issues is Whalley (1977 1980). He studies trade distorting and liberalizing policies, and their impacts with a 4-trading region model. These regions are the USA, Japan, the EEC and the rest of the world. The basic structure of the model within any region is essentially the same as in more conventional one-nation models.

*A notable feature of the ORANI model is that multi-product transformation possibility functions that are empirically estimated are introduced. Their method for solving the model (a modified Johanson method) is also of particular interest.

Whalley, however, further imposes the conditions that all commodities clear in the interregional market, that all factors clear in their respective intraregional markets, and that the total external balance in all trading regions be zero. The model is so large and demanding in computer time and data, however, that the author himself admits that the findings are still at a preliminary stage and a lot depends on future work.

As we have mentioned one multi-region model* that is more interested in developed economies, we should add one more set of models to this brief review. Chichilnisky (1981a, 1981b, 1981c) uses two-region models in these three works. Her two regions are usually North and South or the developed and developing world. While she uses extremely simple and highly abstrat models: linear Leontief production functions, two commodities, two (or three when energy is an issue) production factors, and no government, she draws some powerful conclusions. For example, she concludes that with the South exporting basic consumption goods and the North investment/luxury goods, the export-led growth strategy can, under certain conditions, worsen the South's terms of trade, reducing its domestic employment and consumption, and increasing the inequality of factor prices across regions**. Even to casual observers these conditions are actually fairly common in contemporary developing economies; namely that the South has dualistic technology with abundant labor so that the labor supply is quite elastic. This result is essentially derived due to the relatively large income effects on the part of the South. Similar results are shown in Chickilnisky (1981c) where the South is the monopolistic oil exporter. In Chickilnisky (1981b) she further shows that the oil importing region would have oscillating profit rates and overall

*There are, of course, more multi-country models, e.g., Deardorff and Stern (1978), Ginsburg and Waelbroeck (1978).

**Similar conclusions have been derived by many so-called structural economists (e.g., Bacha (1978), Diaz-Alejandro (1965) and Taylor (1974).

output, so that the real revenues of oil exporters also oscillate as oil prices increase.

We now turn to the present study and ask what is the point of adding yet another general equilibrium model to this body of existing models. For one thing, it is always worthwhile to do an empirical historical study of a developed country with new perspectives. Kelley and Williamson (1974) started this, and the present study can be viewed as an extension to their efforts. The extensions are manifold in size, complicatedness and issues of interest. Unfortunately, limitations in data and time delineate this study to focus only on the post-World War II period. But the spirit is still the same. We can still see why Kelley and Williamson came to certain conclusions on specific questions and perhaps, even more, because of the richness of our specification.

One other feature of this study is the comparison made between the outcomes of different ways to close the same model. Comparing different macro closures has been done but only sporadically (Melo and Dervis 1977) or more theoretically by Taylor and Lysy (1979) and Bell (1979), but nobody has done this on a consistent basis with an empirical general equilibrium model. The differences in model responses with the same external shocks but under different closure rules are shown to be often quite substantial. Most of the results seem to favor the views taken by structuralists rather than neoclassicists, although naturally it is not possible to say that this conclusion applies to all developing countries at any time. (It does, after all, depend on the "structure" of the economy.)

Thirdly, there are more micro features used in this model specification than have been used in any general equilibrium models before. The assumptions that skilled workers compliment equipment and machinery to form one nest of the production function, and that unskilled workers are substitutes of composite capital (of skilled workers, equipment and buildings), for example, have a profound influence on the welfare of the labor force in general. The wage determination mechanism held in the model also merits attention. The whole urban wage structure is determined by the employer's labor cost minimization behavior with hypothetical (or employer's perceived) quit functions and hiring costs. This makes any urban sector's unskilled wage a function of average agricultural income and consumer price indices of both urban and rural areas. Investment is determined by the investor's expectations on factor and commodity prices and the commodity demand rather than on the exogenously desired growth rates of the sectoral capital stocks. The strengths and weaknesses of each specification will be shown as we proceed.

The next chapter briefly reviews the relevant aspects of Japan's economic history. It is brief because a huge literature already exits on this subject and there is no need to repeat it here. Chapter 3 describes the model, the data base and the way the parameters were estimated. Chapter 4 describes the "base" solutions from the different closures used and examines how well each "fits" to the actual history of post-War War II Japan. Chapter 5 goes on with a lengthy description of the different dynamic comparative analyses (or counterfactuals) under different closure rules. Finally, concluding remarks appear in Chapter 6.

CHAPTER 2: JAPAN'S ECONOMIC DEVELOPMENT

This chapter attempts to review the history of Japan's modern economic development. However, because there have already been many excellent works on this subject (e.g., Ohkawa 1972, Ohkawa and Rosovsky 1973, T. Nakamura 1971, and Patrick and Rosovsky, eds., 1976, to mention just a few), I will keep this one simple and brief.

In the past there have been many controversial issues in interpreting the Japanese economic experience; one only has to remember the debates on agricultural growth rates, factor pricing, factor intensities, timing of "turning points", savings rates, total factor productivity growth, and wage differentials*. I shall not, however, go into great detail regarding these arguments, I intend only to review those aspects that are relevent to the present study, namely:

1. The overall long term growth performance and distribution of income.

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*For agricultural growth rate issues, see J. Nakamura (1965, 1966, 1968), Ohkawa and Rosovsky (1960, 1961, 1965), and Rosovsky (1968). For factor pricing, see Fei and Ranis (1964a), Ranis and Fei (1961), Jorgenson (1966), Dixit (1970), Kelley and Williamson (1974). For factor intensities, see Ranis (1957), Fei and Ranis (1964a, 1964b, 1971, 1981), Choo (1971), Blumenthal (1980, 1981). For the turning point, see Fei and Ranis (1964a), and Minami (1973). For savings rates, see Shinohara (1959, 1970), Williamson and de Bever (1978), Yoshihara (1972), Shiba (1979), and Odaka (1944). For total factor productivity growth, see Denison and Chung (1976), Nishimizu and Hulten (1978), and Watanabe and Egaitsu (1968). For wage differentials, see Ohkawa (1972), Ohkawa and Rosovsky (1973), Yasuba (1976), and T. Nakamura (1971). This list is, of course, incomplete.

2. A description of wage dualism and the hypothesis with regard to the cause of its origin and continued existence.

3. A brief review of the post-World War II pattern of urbanization.

2.1. OVERVIEW OF JAPANESE AGGREGATE GROWTH PERFORMANCE

Between 1901 and 1969 real GNP in Japan grew at an average annual rate of 4.68 percent. The population grew at 1.24 percent per annum*. The post-World War II performance is even more amazing. The Japanese economy (real GNP) grew at an average annual rate of 10 percent between 1953 and 1969. The population grew at 1.08 percent during the same period. These, called by some, "spectacular" growth rates were not achieved easily; there were repeated long swings, each cycle averaging approximately 20 years. There is, at present, general agreement that Japan first grew at a fairly moderate pace, the growth rate secularly accelerating later**. Both the long swings and the secular trend of growth acceleration (trend acceleration) are shown in Table 2.1. During the upswing periods, the average annual growth rate of GNE was 3.21 percent (1887-1897), 3.30 percent (1904-1919), 4.88 percent (1930-1938 and 9.56 percent (1953-1969). During the same time periods private fixed capital formation also experienced trend acceleration: 6.03 percent, 7.03 percent, 10.95 percent, and 15.06 percent, respectively.

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*Labor force grew at 2.19 percent per annum between 1901 and 1969, and by 1.54 percent between 1953 and 1969.

**As already mentioned, this is the result of a famous debate between Prof. Ohkawa, his associates, and Prof. Nakamura regarding the speed of early agricultural growth in Japan.

Table 2.1. Long-term pattern of aggregate growth rates, with a constant price series: average annual growth rates (in percent), (U) = upswing, (D) = downswing.

Period (length in years)	GNE	Total Population	Per Capita GNE
Long-swing phases			
(U) 1887-1897 (10)	3.21	0.96	2.25
(D) 1897-1904 (7)	1.83	1.16	0.67
(U) 1904-1919 (15)	3.30	1.19	2.11
(D) 1919-1930 (11)	2.40	1.51	0.89
(U) 1930-1938 (8)	4.88	1.28	3.60
(D) 1938-1953 (15)	0.58	1.36	-0.78
(U) 1953-1969 (16)	9.56	1.03	8.53

Source: Ohkawa and Shinohara (1979), page 10.

In accordance with these long swings, fixed capital formation shows much more obvious cyclical movement than does GNE, and its trend acceleration is also more pronounced during the upswing periods. If we look at the relative share of investment (inclusive of military and residential investment) in total growth as calibrated by Ohkawa, it increases during each successive upswing period; 19.9 percent (1887-1897), 30.7 percent (1904-1919), 41.5 percent (1930-1938), and 46.4 percent (1953-1969). Other components of GNE do not show such conformity with the GNE growth pattern, revealing the increasing importance of fixed capital formation in determining Japan's economic growth pattern, especially in the 20th century. The major driving force behind this growth pattern was non-residential and non-primary private investment that increased in the 1934-1936 prices 28.4 times between 1901 and 1940, whereas primary sector (agriculture, forestry, and fisheries) investment increased by a mere 1.9 times during the same period.

There have been several investment spurts characterized by private non-primary investment in this century, and, as a matter of course, they coincide with the long swings. Apart from a minor set-back between 1909 and 1912, the first major spurt appeared during 1903 and 1917 (see Figure 2.1). The second spurt occurred in the late 1930s and the third and most recent immediately after World War II. These investment spurts accelerated and made more explicit the structural changes of the Japanese economy, including urbanization and industrialization. Figure 2.2 shows the share of the non-primary labor force from the total labor force, and the share of non-primary products from total GDP. These changes naturally occurred most rapidly during the three investment spurts and this period, from around 1900 until the 1960s, is also well-known because of one other strong feature of Japan's economic experience, namely, the dualistic nature of Japan's development. The next section examines some of the features of this development pattern.

2.2. DUALISTIC DEVELOPMENT

In the development literature the term "dualism" describes a variety of characteristics observed in economically developing societies. In general, it means a situation where heterogeneous factors co-exist in one society simultaneously. For simplicity, these factors are often

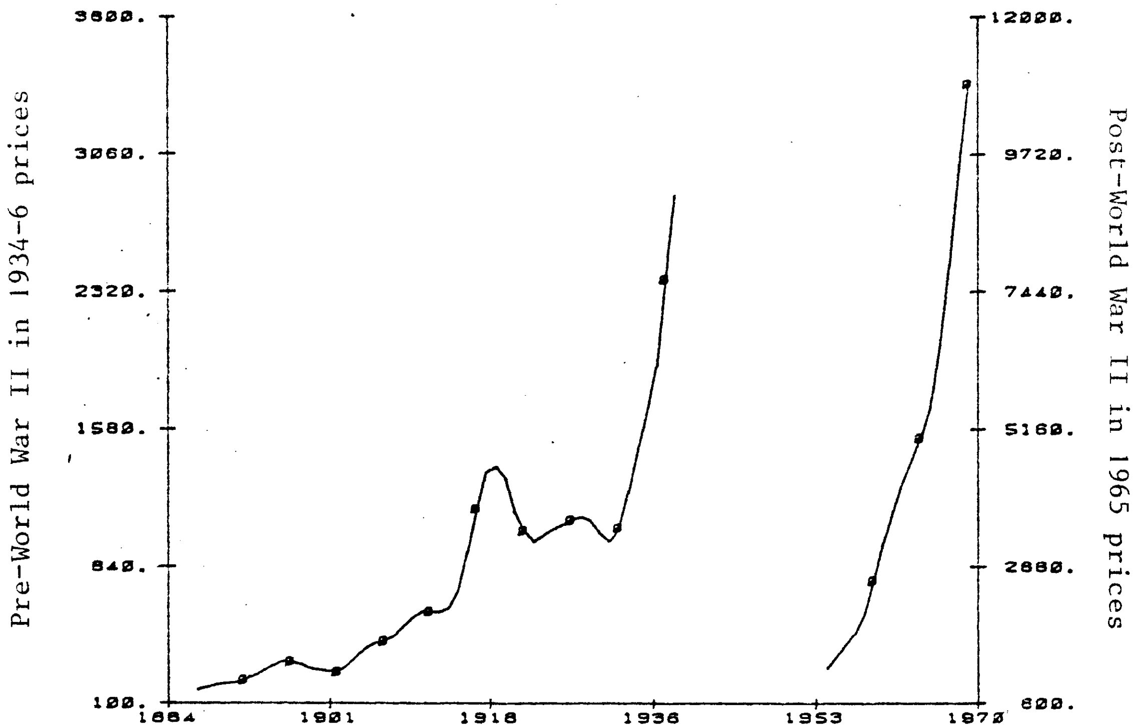

Figure 2.1. Real investment in constant prices; five-year moving average. Source: Ohkawa and Shinohara (1979).

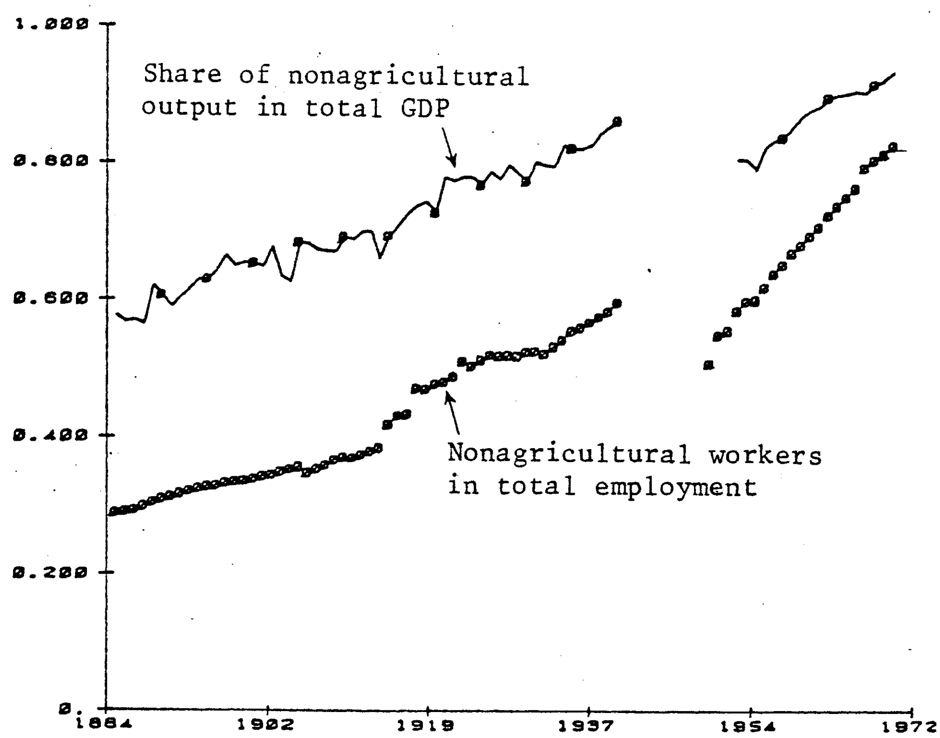

Figure 2.2. Shares of nonagricultural output and workers in total GDP and employment. Source: Ohkawa and Shinohara (1979).

grouped into two dichotomous sets and described in a variety of ways: modern and traditional, formal and informal, center and periphery, or foreign and indigenous. It has been argued that these dichotomies exist in social systems (Boeke 1953) or in various aspects of political and economic situations. Production dualism is emphasized by Eckaus (1955) and by many subequent students of development. The celebrated works of Lewis (1954), Ranis and Fei (1961), and Fei and Ranis (1964a) characterize the dualism between a traditional subsistent sector with a virtually unlimited supply of labor, and a small but growing modern sector. In this surplus labor model, dualism disappears when the supply of surplus labor from the subsistence sector is exhausted and it consequently becomes "commercialized". They argue that until this commercialization turning point the labor force in the subsistence sector has a wage rate that equals the (institutionally determined) subsistence minimum, and that, therefore, no marginal return argument holds for this sector.

This classical model, however celebrated, has not gone unchallenged*. Neoclassical economists argue that the marginal principle still works even in the very early stages of industrialization (Kelley and Williamson 1974), This paper essentially avoids the problem, and if anything, stands closer to Fei and Ranis and other classicists by using average (rather than marginal) products of labor in agriculture as a measure of the welfare of the people in this sector. The whole debate, however, seems to be left open with no definite conclusions, and I feel that the truth lies somewhere in between these two.

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*Jorgenson's (1966) challenge did not prove very successful. See Dixit (1970).

As Ohkawa and Rosovaky (1973) point out, certain farmers were paid for their marginal products, some more and others less. Especially with family farming and share cropping known to distort this picture of perfect competition and static profit maximization, it is not surprising that the debate is inconclusive.

Other, mainly Japanese, scholars use the term "dualism" a little more vaguely. Here it is often meant to express the wide range of average labor productivity in different sectors or the wage differentials between modern and traditional activities. Modern-traditional dichotomies are often replaced here with arguments in accordance with the differences in the size of the operation, due partly to the fact that in Japan the size distribution of firms coincides with modern-traditional divisions. A great deal of scholarly effort, therefore, has been made in order to shed more light on the reasons for wage differentials among establishments of differing scales (in terms of number of workers) within some sectors in Japan. Indeed, even after adjusting for differences in age or schooling mixes, the relative wages differ substantially even in 1960 (see Table 2.2).

Table 2.2. Adjusted nominal relative wages by firm size (males).

	Size		
	Less than 100 workers	100-999 workers	1000 workers
All male	68.3	81.7	100
Production workers	68.4	81.7	100
Managers	67.7	81.7	100

Source: Mizuno (1973).

Yasuba (1976) made an intensive study of the evolution of intra-sector, inter-firm wage differentials between 1909 and 1951. He found that wage dualism appears in those sectors that borrowed foreign technologies and/or where rapid technical progress was being made. Less dualistic phenomena were observed in those "homogenous" sectors where only traditional technologies were used (e.g., sake, soy sauce), those where only modern technologies were used (e.g., beer, cars, electrical applicances), and those where modern elements were completely diffused.

These findings are in corroboration with the findings of Tan (1980) who tests a hypothesis that firm size and inter-industry wage differentials reflect quasi-rents from the possession of technology-specific skills, and that the quasi-rents depend on the rate of technical progress. Tan finds strong empirical support for this hypothesis in the Japanese data of post-World War II. His findings include *inter alia* that discounted specific training wages* are positively and significantly correlated with the rate of technical change, and that for production workers "...employment in large firms or firms in high technology industries is associated with significant increases in specific training wage profiles" (Tan 1980, p.153).

Another important aspect of Tan's study is that he finds no support for institutional explanations of wage differentials. What Tan essentially points out is that there is a bilateral monopoly relationship between the owner of new technologies and the owner of skill specific to these technologies (Becker 1964).

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*This is roughly the size of coefficients of length of internal experience with a firm in wage equations.

These technology-specific skills are not limited to Japan. They can be observed all over the world. What makes the Japanese experience conspicuous and attract so much scholarly effort, however, is the extent of the observed wage differentials and how long they have lasted. This, I believe, is the fate of the industrial late-starter who has grown so fast. When Japan started its modernization efforts, it had to depend on foreign technologies, especially in those sectors which faced tough foreign competition. As the economy grew, it required even more new technologies, obtained either by importing them or by innovative activity (most likely both). As long as the acquisition of new technologies proceeded faster than the diffusion of yesterday's new technologies, somebody kept getting the quasi-rents for the new technology-specific skills.

This dualism on wage differentials among sectors or among scales of operation emerged in Japan sometime during the early 1900s. Although the exact timing differs in different studies, the essential fact is that following the first investment spurt around 1905, the modern sector surged ahead leaving the traditional elements lagging behind (Ohkawa and Rosovsky 1965). During the recession after World War I (i.e., after the first investment spurt), wage differentials were firmly established. The recession also hit the agricultural sector the hardest. Employment opportunities in modern sectors were limited because of their high capital-labor ratio and decreased turn-over rates. These sectors used borrowed technologies with substantial technology-specific skill requirements and limited factor substitutabilities. Even during this period of general contraction, therefore, employers would try to retain those workers who already had the required skills and thus, wage rates in modern sectors did not decrease during the recession. At the same time, however, the agricultural sector was suffering from a long term structural stagnation, caused by a combination of the world-wide agricultural crises, a shift in government policy*, and the temporary exhaustion of scale-neutral technical progress**. Agriculture could not absorb the growing labor force and the "push" pressure of rural areas therefore increased. On the other hand, the "pull" factor in the modern sectors was limited as stated above. The surplus labor force naturally flowed into various urban traditional sectors forcing the wage levels down. Hence the birth of urban wage dualism, which lasted until well after World War II. That it lasted this long means, according to the technology-specific skill hypothesis, that new technoglogies continued to be imported and/or innovative efforts continued to exist through this period. However, Japan was still experiencing high economic growth when wage dualism started to disappear in the 1960s, and it is hardly plausible that innovative activities *per se* then ceased. What was exhausted in the 1960s was the surplus labor in the traditional sectors.

In the early 1960s, the wage rate for young high school graduates started to pick up relatively in traditional sectors, although overall wage differentials still remained. It appears that it was not the case that large modern firms were no longer innovative, but that firms in traditional sectors started to use newer equipment with higher capital-labor ratios because a shortage of labor was expected to emerge in the near future. In

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*After the rice riot in 1918, the government decided to appease the urban workers rather than protect the farmers by importing cheap rice from the colonies.

**Napier (1979) claims that this was not the case. He attributes the low productivity to unusually bad weather.

the 1950s, smaller firms mainly used second-hand equipment transferred from larger firms. In the 1960s, however, the smaller firms themselves started to import new technologies from the West and there was thus a drastic shift in the direction of biased technical progress. Using cross-section data, Sato (1973b) argues that the annual rate of labor-augmenting technical progress jumped from 1.25 percent between 1953 (the year when pre-war peak production was passed) and 1958 to 17.94 percent during 1959 and 1969. During the same period the similar rate for capital stock however, was 5.39 percent and 0.14 percent, respectively. The capital augmenting rate actually contracted after 1964, while the labor-augmenting rate showed an accelerated increase.

There is also an argument that the smaller maufacturing firms (except for the very smallest with less than 10 workers), showed the same efficiency rates as the larger firms in terms of total factor productivity (Sato 1973c)*. This implies that they all had a similar production function although facing different wage-rental ratios. That smaller firms (and in the literature they are almost synonymous to traditional sector firms) were as efficient as the modern and /or larger firms does not say anything about equity or welfare.

The size income distribution is one good measure for examining the aspects of equity and welfare in economic development, and there is an abundance of relative size distribution data in Japan for the post-World War II period. Mizoguchi (1975) and Mizoguchi et al (1980) find that Kuznet's U exists for post-World War II Japan, with the turning point in the early 1960s. For the pre-World War II period, however, the data base is, to say

*His studies are for 1957, 1962, 1967, 1969, and briefly for 1932.

the least, limited. However, given this limitation, Otsuki and Takamatsu (1978) have shown that there was an increasing inequality trend throughout the pre-war period, and that the deterioration was most severe during the two investment spurts of 1910-1915 and the 1930s. This also coincides with the findings of Minami and Ono (1981) with regard to the functional distribution of income. They show that the non-primary wage share had a decreasing trend throughout the pre-war period covered in their study, starting at 68.2 percent (1896-1912), and ending at 48.7 percent (1934-1940). The two periods mentioned above (1910-1915 and the 1930s) are also shown to be hard times for wage earners in the Minami and Ono study. Although the post-war fluctuation is less conspicuous one can still observe that the turning point of the U-curve was in 1962. This also corresponds with the results of Mizoguchi et al. Similar results are obtained in Ono and Watanabe (1976).

2.3. URBANIZATION TRENDS

Table 2.3 shows the urbanization trend measured by the ratio of population living in cities to total population. These data have only been available since 1920 but another index (the population share of the six prefectures containing the six largest cities) shows that rural-urban migration became conspicuous around 1905, which coincides with the start of the first investment spurt. The increase of the urbanization, however, actually starts to accelerate around 1915, and then jumps very rapidly from 1930 onwards (the period of the second investment spurt and rapid growth). War related incidents such as the evacuation of urban population, destruction of urban capital stocks, and the repatriation of six million people from foreign colonies and battlefields lowered the urbanization rate in in 1945 to the, say, 1933 level. After 1945 the phenomenal recovery started, and rural-urban migration accelerated accordingly until in 1955 the pre-war trend (extended linearly) was surpassed.

Table 2.3. Urbanization rates (ratio of population living in cities to total population).

Year	Percent
1920	18.1
1925	21.7
1930	24.1
1935	22.9
1940	37.9
(1945	27.8)
1950	37.5
1955	56.3
1960	63.5
1965	68.1
1970	72.2

Source: Bureau of Statistics, Office of the Prime Minister, 1970 Population Census of Japan (1971).

The definition used here for "cities" is in fact political jurisdiction*, and does not exactly conform to the meaning of urbanization. The trend, however, is clear. A polarization trend to major metropolitan areas was also seen until 1970. During the catch-up phase with pre-war trends (until 1955), only four metropolitan areas (Tokyo, Nagoya, Osaka, and Fukuoka regions) and Hokkaido had a net population inflow; all other areas lost their

*Political city boundaries were substantially enlarged in 1950 to 1955.

population. This trend became more pronounced during the five years from 1955 to 1960 when only the three largest metropolitan areas (Tokyo, Osaka, and Nagoya) gained population by migration. This trend more or less continued in the 1960s, but was more concentrated in the suburban area surrounding the three centers. Polarization reversal (see Richardson 1977) began in the 1970s when the metropolitan centers started to show net outflows of population.

This urban population increase occurred in a country where the total area is less than that of California, where only 14 percent of the land is flat and arable and whose population is more than 100 million people, 75 percent of which live in urban areas. Between 1952 and 1973 some land prices soared 58 times and coupled with the insufficient supply of urban housing has been the main problem issue for the country since the mid-1960s.

Despite these problems, housing conditions have slowly improved in Japan. Floor space, in terms of "tatami's"* per dwelling increased by 2.5 percent per annum between 1948 and 1969 and the share of dwellings not needing repairs increased from 68.9 percent in 1953 to 82.6 percent in 1969 in all cities. As is shown in Table 2.4, this is due mainly to the growing amount of resources being invested in housing. Housing costs, however, are also increasing. The data show an average increase of 13 percent between 1958 and 1968 in the contract rent per "tatami", with land values increasing by 17 percent per annum and construction costs by 8 percent per annum.

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*"Tatami" is a straw mat of usually 1.65m^2 in size.

Table 2.4. Housing investment as a percentage of gross capital formation and GNP.

Year	Gross Capital Formation	GNP
1950	8.8	1.5
1960	12.4	4.3
1964	16.1	5.7
1968	17.7	6.7
1971	19.2	7.0
1972	20.8	7.6

Source: Annual Report on National Income Statistics (ARNIS) (1972).

CHAPTER 3: DESCRIPTION OF THE MODEL

In this chapter, section 1 describes the model used and section 2 discusses the specifications in general and the parameter values used. The Appendices describe the social accounting data, some of the econometric results of migration, an extended version of the model, and the method for solving the model.

3.1. THE MODEL

3.1.1. Sector Divisions

The base model is an eight-sector model, and sector divisions are shown in Table 3.1. The manufacturing sector is divided into three subsectors; the first subsector includes what can be called the modern sectors, i.e., chemistry, non-ferrous metals, iron and steel, etc.; the second subsector includes machinery and metal processing sections; and the third subsector includes the consumption goods producing activities, e.g., processed foods, textiles, clothes, leather, etc. The second subsector activities are peculiar in the sense that together with the construction sector they contribute mostly to the fixed capital formation, although the technology used is not as capital intensive as in the first manufacturing subsector. This sector division differs slightly from that suggested by Motai and Ohkawa (1978), who stress the distribution of technologies used by firms with different scales within a sector.

Table 3.1. Sector divisions of the model.

1.	Modern manufacturing	Chemistry, nonferrous, iron and steel, pulp and paper, coal and petroleum products, etc.
2.	Machinery manufacturing	Metal products. General machinery, electric machinery, transport machinery, precision machinery.
3.	Traditional manufacturing	Processed foods, tobacco, textiles and clothes, wood, furniture, leather goods, rubber, ceramics, other manufacturing.
4.	Mining	
5.	Construction	
6.	Modern services	Gas, electricity, telecommunications, transportation, banking and finance, real estate.
7.	Traditional services	Retail and wholesale, all other services.
8.	Agriculture	Agriculture, forestry and fishery

In Japan, economic historians have typically associated the scale of firms with the degree of moderness of the technology employed (see, IDCJ 1977), and discussions on Japanese economic dualism have inevitably been related to the differences between labor productivities or wages by firm size. We may do well by employing sector divisions based on such criterion. Experience shows, however, that in such a model we could have somewhat ambiguous and, from time to time, misleading results by aggregating mainly consumption and investment goods into a one-sector commodity. A policy that increases investment in equipment and machinery could have an unjustifiably large "direct" impact on consumption.

The fourth sector in this model is mining. This particular industry has been singled out not only because of its potential importance to the economy as the supplier of raw materials and energy sources, but also because of its fundamentally different character compared with the other sectors, i.e., its dependence on exhaustible natural resources.

The fifth sector is construction, which is the supplier of almost half of all new fixed capital. This sector should be separated because of the non-tradeability of its output and also because it employs a sizeable amount of unskilled labor.

The next two sectors are service sectors: the sixth including modern services, transport, communication, utilities, and banking and finance; and the seventh all other services. Despite the fact that the latter includes such services as medicine and education, it is called the "traditional service" sector for convenience's sake. This was made necessary due to the fact that there is no detailed data base available in which the amounts of capital stock in these disaggregated activities are easily accessible.

Finally, the eighth sector is conveniently called the "agriculture" sector, and includes agriculture, fisheries, and forestry.

3.1.2. Production Technologies

In this model we assume away joint production. Each sector produces only one commodity that employs the services of equipment and machinery (em), constructed structures (cs), and unskilled labor (ul). In most urban sectors, skilled labor (sl) is also used. Amounts of em, cs, and sl in each sector are fixed for each period. In the agriculture and mining sectors land and natural resources (mineral deposits) are also included in their respective production functions. We also assume constant returns to scale, although this may be an incorrect assumption viewed from the qualitative observation point of view (see opinions expressed by Ohkawa and Rosovsky

1973). Empirical quantification, however, seems to lag behind and, especially at the level of aggregation employed here, the problem seems to be little in favor of complying with the received theoretical framework. The justification for our assumption is again, therefore, the insufficient development of alternative specifications. Constant elasticities of substitution (CES) functions are mainly used, and for sectors 1, 2, 3, 5, 6, and 7 take the form*

$$Q_i = (CK_i^{\sigma_i^3} + \gamma_i \, ul_i^{\sigma_i^3})^{1/\sigma_i^3}$$

where

$$CK_i = (KS_i^{\sigma_i^2} + \beta_i \, cs_i^{\sigma_i^2})^{1/\sigma_i^2}$$

and

$$KS_i = (\alpha_i^1 \, em_i^{\sigma_i^1} + \alpha_i^2 \, sl_i^{\sigma_i^1})^{1/\sigma_i^1}$$

Q_i = supply of sector i goods

CK_i = composite capital stock of sector i

KS_i = composite of equipment and skilled labor

$\alpha_i^1, \alpha_i^2, \beta_i, \gamma_i$ = distribution parameters in sector i

$\sigma_i^1, \sigma_i^2, \sigma_i^3$ = substitution parameters that relate to the elasticity of factor substitution by $\sigma_i^j = 1 - 1/s_i^j$ where s_i^j is the jth elasticity of substitution in sector i.

We have also assumed here the following substitutabilities among the four factors:

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*To allow for readability of expressions we ignore the factor augmenting technical progress here, although in the real model they are fully taken account of.

1. em and sl are complements with very limited substitutability, i.e., the more machines there are, the more skilled labor one needs to operate them or to manage their operation.

2. The composite of em and sl, KS are also complements of cs but less in degree than between em and sl.

3. ul is more or less a substitute of the composite of capital stock (em, sl, and cs).

We also assume that the degree of substitutability is higher in the more traditional sectors, and while this assumption may be debatable, it is, we believe, a fairly well-accepted one. If the substitutability of an aggregate production technology actually measures the diversity of the micro processes available for producing the commodities in that sector, then even if each micro process can be characterized by a Leontief production function, the assumption that the traditional sectors have a wider spectrum of processes to choose from (the assumption we employ here), may not be easy to refute. It should suffice to mention the limited number of "processes" that produce internationally competitive chemical products with the number of processes that can produce clothing.

The fourth sector, mining, has an exhaustible resource in its production function, i.e.,

$$S_4 = A_4(\text{resource})^{\alpha_4}\left[\left(\beta_4^1\ em_4^{\sigma_4^1} + \beta_4^2\ cs_4^{\sigma_4^1}\right)^{\sigma_4^2/\sigma_4^1} + \gamma_4\ ul^{\sigma_4^2}\right]^{1-\alpha_4/\sigma_4^2}$$

We exclude skilled labor here because of its small number in this sector.

Resource is defined as

$$RES_{1960} \cdot \exp\ (d \cdot t)$$

where

RES_{1960} = the mineral deposits of coal of standard quality or higher in 1960 in Japan

t = the time

d = the rate of depletion of resources.

The rate of depletion takes account not only of the actual decrease of minerable coal (which did not decrease very rapidly), but also of the fact that imported oil was increasingly a substitute for domestic coal during this period. The use of coal deposits for this purpose is based on the fact that coal has a substantial share in the domestic mining sector products of Japan.

The use of a Cobb-Douglas specification for the resource and the rest of the factors is based on a simple theoretical argument put forward by Dasgupta and Heal (1979). They argue that CES with less than unitary elasticity of substitution has bounded-from-above average product per resource in use, whereas CES with more than unitary elasticity could give corner solutions. The former allows for the possibility of output to go to zero, while the latter means the possibility of positive products with zero resources. Both, according to Dasgupta and Heal, are "uninteresting". Whether or not they really are "uninteresting" in an empirical analysis with a finite time horizon is another question. To answer it, however, would require more thorough scutiny than the scope of this paper.

The agricultural sector also has a Cobb-Douglas function:

$$S_8 = A_8 \, K_8^{\beta_8^1} \, L_8^{\beta_8^2} \, T_8^{\beta_8^3}$$

where

$$\beta_8^1 + \beta_8^2 + \beta_8^3 = 1$$

and

$$K_8 = \left(\alpha_8^1\ em_8^{\sigma_8} + \alpha_8^2\ cs_8^{\sigma_8} + \alpha_8^3\ ap^{\sigma_8}\right)^{1/\sigma_8}$$

ap = animal and plant stock

$L_8 = ul_8$

T_8 = agricultural land

The CD specification is defended on the basis of a series of empirical work completed by Hayami and associates (see Hayami 1975, and Hayami and Ruttan 1971), that failed to reject the hypothesis of unitary elasticity.

3.1.3. Urban Wage Determination

We assume that the cost of unskilled labor for sector i (lc_i) is

$$lc_i = w_i + T_i\ q_i$$

and

$$q_i = q_i(w_i, \ldots, w_7, ya;\ pci_u,\ pci_R)$$

where

w_i = the nominal unskilled labor wage in sector i

T_i = the labor training and hiring cost perceived by the employer of sector i

q_i = the quit rate that depends on all urban wage and rural income, deflated by urban consumers' price index (pci_u) and rural consumers' price index (pci_R), respectively

ya = the average income in the agricultural sector.

This formulation is also used by Stiglitz (1973) in his study of internal labor migration. Employers then try to minimize their labor costs. The first order condition is:

$$\frac{\partial lc_i}{\partial w_i} = 1 + T_i \frac{\partial q_i}{\partial w_i} = 0 \qquad\qquad i = 1,\ldots,n$$

It is assumed that the quit rates take a generalized Cobb-Douglas form, i.e.,

$$q_i = TC_i \left(\frac{ya}{pci_R}\right)^{\beta_R} \prod_{j=1}^{n} \left(\frac{w_j}{pci_u}\right)^{\beta_j}$$

where n is the number of urban sectors and TC_i is a sector specific constant.

Such equations are extremely difficult to estimate rigorously. Guesses are made therefore on β coefficients utilizing the results of such works as Shorey (1980) and Tan (1980).

We should emphasize one aspect of this specification: it is based on the assumption that average agricultural income determines the urban wage structure to a large extent. In the base version of the model, agricultural factor endowments are fixed period by period, i.e., the supply is fixed. The demand for the commodity, therefore, determines the price and thus, the agricultural income. Agricultural income, via the first order condition equations above, determine the relative wage structure in the urban sectors. This is not an unreasonable assumption, given Japanese economic historians' claim that for a long time Japanese traditional sector wage rates were determined at a level the same or slightly higher than agricultural income (Nakamura 1971, Ono 1973). Table 3.2 shows the comparison of nominal wages of female workers in manufacturing and agriculture. Female workers' wage rates are used here because the comparison is easier due to the relative homogeneity in quality of female labor across different sectors. If we can safely assume that women were the marginal labor force in both agriculture and manufacturing during the period concerned, then the close tie between agricultural labor and the traditional sector labor, which tends to be marginal, in the labor market is hard to deny.

Table 3.2. Female nominal wage rates in manufacturing and agriculture (in yen per day).

Year	Manufacturing	Agriculture
1952	278	243
1953	305	270
1954	328	298
1955	337	305
1956	348	314
1957	363	328
1958	357	340
1959	387	358
1960	429	387
1961	496	464
1962	577	563
1963	649	661
1964	720	744
1965	809	812
1966	908	851
1967	1004	956
1968	1185	1163
1969	1248	1286
1970	1669	1422

Source: Ohkawa and Shinohara (1979).

The use of average total agricultural income in urban quit rate functions actually sweeps some delicate issues under the rug. As already mentioned in the previous chapter, one of these issues is factor pricing in agriculture. Fei and Ranis (1964) and many other Japanese scholars (e.g., Minami 1973), believe that agricultural real wage was determined at the subsistance level and that the marginal productivity did not matter until "the turning point" although, determination of the timing of this turning point differs substantially between Fei and Ranis, and Minami, as is well documented. Proponents of neoclassical economics (e.g., Kelley and Williamson 1974), claim that marginal productivity factor pricing applied even during the early phase of the modern economic growth of Japan. The approach taken here denies neither of these theories because the issue becomes less decisive when we look at post-World War II Japan. The land reform took place under the occupation, giving Japanese farming communities a fundamental institutional transformation and making landlords and landless tenants almost negligible parts of the farming population*. The reform promoted a more equal distribution of costs and income, making the behavior of the farming population more homogenous. The use of average income here reflects this institutional change where family farming or owner-occupied land is very predominant.

One final point that should be made is that this wage determination mechanism fixes the urban wage structure. We have another fixed price in the model, the foreign exchange rate, and in those instances where either the foreign exchange market or the unskilled labor market does clear, we endogenize the urban wage level in the following way:

$$w_i = \omega_i W \qquad i = 1,\ldots,n$$

where

w_i = the wage rate

ω_i = a discrepancy parameter of urban wages. We use the solution of the first order conditions of the wage determination mechanisms above as ω_is.

W = the endogenous urban wage level that clears the urban labor market.

3.1.4. Urban Labor Demand

Here we take faith with the marginal principle and assume that unskilled labor demand is in accordance with the following:

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*The ratio of farmland under tenancy declined from 45 percent in 1945 to 9 percent in 1955 (Hayami 1975).

$$\frac{w_i}{pv_i} = \frac{\partial Q_i}{\partial ul_i} \qquad \text{for} \quad i = 1,2,3,5,6, \text{ and } 7$$

For the mining sector (i = 4), however, some elements of arbitrariness appear for distributing the rent of the natural resources. With no other alternative being more plausible we, therefore, assume that rent is distributed among the management and unskilled labor in accordance with their real share of the value added. That is, the demand for the unskilled labor in the mining sector is derived from

$$\frac{(1 - \alpha_4)\ w_4}{pv_4} = \frac{\partial Q_4}{\partial ul_4}$$

3.1.5. Tradeable Commodities

The manufacturing, mining and agricultural sectors are tradeable commodity producing sectors. We assume that all imports are competitive* and that domestically produced goods and imported goods in the same sector are substitutes with finite elasticities following the tradition of Armington (1969). People, therefore, consume hypothetical aggregate commodities of imports and domestically produced goods. This aggregate is formed by CES functions ψ_i's:

$$\psi_i = \gamma_i \left(\varepsilon_i\ M_i^{\eta_i} + (1 - \varepsilon_i)\ TD_i^{\eta_i} \right)^{1/\eta_i}$$

where

TD_i = the amount of goods produced and consumed domestically in sector i

M_i = the imports of the sector i goods

*Even crude oil at that time has a domestic production share of 1 percent. The noncompetitiveness is, however, built into the model by declining depositable resources in the production function for the mining sector.

$\gamma_i, \varepsilon_i, \eta_i$ = parameters

η_i is related to the substitution elasticity in sector i (θ_i) by

$\theta_i = 1/(1 - \eta_i)$

The purchaser's price (pp_i) of this aggregate is the cost function of ψ_i, i.e.,

$$pp_i = \frac{1}{\gamma_i}\left(\varepsilon_i^{\theta_i}\left[(1 + tr_i)\, e\, pm_i\right]^{1-\theta_i} + (1 - \varepsilon_i)^{\theta_i}\, p_i^{1-\theta_i}\right)^{1/1-\theta_i}$$

where new notations are

tr_i = *ad valorem* tariff rate of sector i imports

pm_i = foreign currency price of imported goods of sector i

e = exchange rate (= yen/dollar)

p_i = producers' price of sector i goods

The amount of imports of sector i is simply

$$M_i = \left(\frac{\varepsilon_i}{1 - \varepsilon_i}\right)^{\theta_i}\left(\frac{p_i}{(1 + tr_i)\, e\, pm_i}\right)^{\theta_i} TD_i$$

and the domestic production ratio (TD_i/ψ_i) is

$$\gamma_i^{\theta_i - 1}\ (1 - \varepsilon_i)^{\theta_i}\ \frac{pp_i}{p_i}^{\theta_i}$$

Exports are similarly specified as

$$X_i = \alpha_i\ WT_i^{\zeta_i}\left(\frac{p_i}{e\ pw_i}\right)^{\xi_i}$$

where

X_i = the export demand for sector i goods

WT_i = the index of the quantity of the world trade of sector i goods

pw_i = the world market price of sector i goods

α_i, ζ_i, ξ_i are parameters.

If Armington's assumption is applied to the rest of the world vis-a-vis Japan, then ζ_i's should be unitary. But various econometric results show that they are significantly higher than 1 for Japan (e.g., Matsukawa 1979; see also the high world income elasticity of Japan's export estimated by Goldstein and Kahn 1978). Zalai (1982) criticizes the careless use of export demand functions as opposed to supply functions in almost all models of this kind. In this particular case, however, we may do well to interpret our export specification as demand functions because as Krause and Sekiguch (1976) state, Japan is

> ...heavily dependent on imported raw materials, economic growth could not proceed without increases in imports, and exports are needed to pay for them... export competitiveness became a goal of government policy and private investment behavior (p. 348).

In such a situation it is more reasonable to assume that the export supply is very elastic*, and that demand played a major role.

3.1.6. Nontradeable Commodities in Current Account

Services and construction sectors do not have trade, but both modern and traditional services receive "handling charges" for externally traded commodities (storage, transportation, and insurance etc.), that are included in the balance of current account payments.

3.1.7. Prices

There are five different prices defined in the model: domestic

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*Goldstein and Khan (1978) also found that the Japanese supply elasticity of exports is infinite.

producers' prices (p_i), purchasers' prices (pp_i), consumers' prices (pc_i), value-added prices (pv_i), import prices (pm_i), and world market prices (pw_i). The last two are exogenous and assumed to coincide unless otherwise stated. Producers' prices (p_i's) are the prices that clear the domestic market, i.e.,

$$TD_i + X_i = S_i \qquad \text{for all i's}$$

or

$$r_i \, \psi_i + X_i = S_i$$

where

$$r_i = \frac{TD_i}{\psi_i}$$

Purchasers' prices (pp_i's) are already defined above as cost functions of ψ-aggregation functions. For nontradeable commodities p_i and pp_i naturally coincide. Value-added prices (pv_i's) are defined as follows:

$$pv_i = (1 - ti_i) \, p_i - \sum_j a_{ji} \, pp_j$$

where ti_i is the rate of indirect tax. pc_{ij}'s are the purchasers' prices (pp_i) marked-up by the sector and by the area of consumption. This mark-up creates additional demand for the traditional service goods, i.e., retail and wholesale services. Thus the consumer price of goods of sector i in region j (= urban, rural), pc_{ij} is

$$pc_{ij} = pp_i + mu_{ij} \, p_7$$

where

mu_{ij} = the mark-up rates of sector i in region j

p_7 = the price for traditional services.

3.1.7. Consumption Demand

Household consumption demands are expressed in a linear expenditure system:

$$cd_{h\cdot i} = \frac{\beta_{h\cdot i}}{pc_{h\cdot i}} (E_h - TCE_h) + \gamma_{h\cdot i} \qquad \begin{array}{l} h = 1,2,\ldots,5 \\ i = \text{sectors} \end{array}$$

where

$cd_{h\ i}$ = per capita consumption demand of sector i goods in class h

$\beta_{h\cdot i}$ = marginal propensity to consume sector i goods in class h

E_h = total per capita expenditure in class h

$\gamma_{h\cdot i}$ = per capita committed consumption (minimum subsistence demand) of sector i goods in class h

TCE_h = total committed expenditure per capita in class h $(= \sum_i pc_{h\cdot i}\, \gamma_{h\cdot i})$

Government consumption demands are treated as exogenous and business consumption demands are treated as intermediate input demands.

3.1.8. Fixed Capital Formation

Investors instigate investment through expectations on future prices and demands. Expectation of all relevant values are formed in the following manner:

$$X^e_{t+1} = \nu_x(X_t - X^e_t) + X_t$$

where

X^e_{t+1} = the expected value of the variable X for period t+1

X^e_t = the expected value of the variable X for period t, the expectation was formed in period t+1

X_t = the actual value of X

ν_t = the adjustment parameter

Investors are also assumed to know the production parameters, and the amount of investment desired by them is:

$$I_i = \left(\frac{K}{Q}\right)_i^{ef} DD_i = \frac{\partial C_i(w_i^e, r_i^e)}{\partial r_i^e} DD_i$$

where

$\left(\frac{K}{Q}\right)_i^{ef}$ = the efficient capital output ratio

$C_i(w_i^e, r_i^e)$ = the cost function underlying the technology. The arguments are expected user cost of labor (w_i^e) and capital (r_i^e). The user cost of capital is assumed to be the interest rate on bank loans plus the rate of depreciation of capital stock multiplied by capital prices. The capital price is the weighted average of purchasers' prices of commodities that consist capital stock.

DD_i = the difference between the expected demand and present supply capacity less the expected loss of capacity through depreciation.

The equality between $(K/Q)_i^{ef}$ and $C_i(w_i^e, r_i^e)/\partial r_i^e$ comes from Shephard's Lemma (Shephard 1953, Diewart 1974).

Depending on the assumptions of how the aggregate excess demand is driven to zero (or, equivalently, how savings equal investment), these desired investments may be the actual investments next year or they may be scaled up or down by the amount of savings available in the economy. See the section on Macro closure below.

3.1.9. Skill Investment

The skill owned by skilled labor is assumed to be completely specific, i.e., the employers bear all the costs of skilled investment. We also assume that skill is a quasi-fixed factor, so that employers assume that once a laborer is trained he will stay with the firm (or sector in this case), until his time of retirement. This is once again the assumption of bilateral monopoly between owners of skill and technology (Becker and Tan as cited above).

The marginal return of "skill" to employers or capitalists is $\partial\pi/\partial S$, where π is the total return to capitalists, i.e.,

$$\pi = r_e \, em + r_c \, cs$$

where r_e and r_c are

$$pv \frac{\partial Q}{\partial em}$$

and

$$pv \frac{\partial Q}{\partial cs}$$

respectively (sector subscripts are suppressed). This return of skill to capitalists, with elasticities of substitution less than 1 behave as shown in Figure 3.1. It can be seen exactly by using a 2-factor CES function*. We also assume that skill investment takes the form of on-the-job training and the cost of training is, therefore, a decreased product of the sector where "skill" is employed. It may be in the form of time taken away from

*If $Q = (K^\rho + S^\rho)^{1/\rho}$, where $\rho = 1 - 1/\rho$, then

$$rs = \frac{\partial\pi}{\partial S} = (1 - \rho)(K^\rho + S^\rho)^{1-2\rho/\rho} \, K^\rho \cdot S^{\rho-1}$$

$$\frac{\partial rs}{\partial S} = \frac{\partial^2\pi}{\partial S^2} = (1-\rho)(K^\rho + S^\rho)^{1-2\rho/\rho} \, S^{\rho-2} \cdot K^\rho \quad \frac{1 - 2\rho}{1 + (\frac{K}{S})^\rho} + \rho - 1$$

$$\frac{\partial rs}{\partial S} \gtreqless 0 \quad \text{as} \quad (\frac{K}{S})^\rho \lesseqgtr (1 - \varepsilon)$$

This means that

$$\frac{\partial rs}{\partial S} < 0 \quad \forall S \geqq 0 \quad \text{if } \varepsilon \geqq 1 \ ,$$

and if $\varepsilon < 1$, rs behaves as in Figure 3.1.

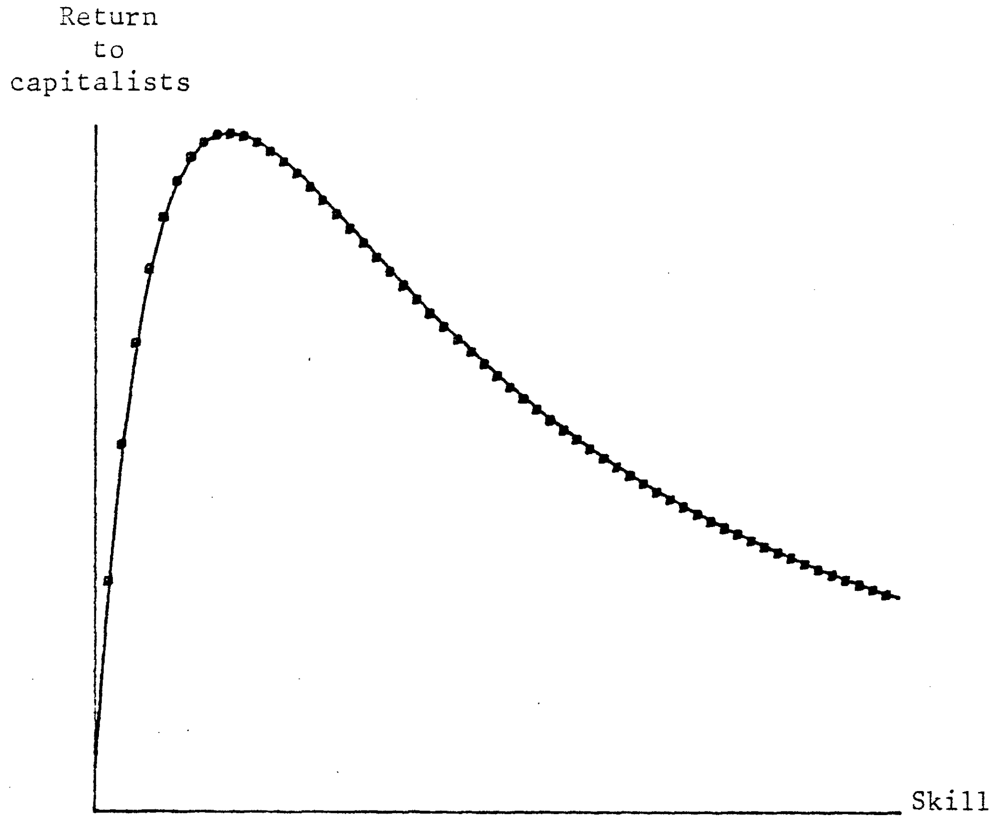

Figure 3.1. Return to skill to capitalists with elasticity substitution (ε) less than 1.

the normal productive activities of supervisors or seniors while training unskilled workers, or simply as those lower quality products produced by the people being trained that cannot be sold on the market. Skill investment appears in the national accounting, therefore, as an element of final demand of own-sector goods.

We also assume that the training costs increase as skill investment increases, i.e., that the cost increases the more one would like to train because there will be fewer potential skilled labor of good quality. The cost, therefore, of skill investment is:

$$p\ CT\ \alpha\ (\frac{siv}{sl})$$

where

α = a monotone increasing function of the argument*

siv/sl = the ratio of skill investment to existing skilled labor force

CT = the base cost of training.

This is shown graphically in Figure 3.2. Skill investment takes place so that the cost is equalized with the capitalized value of the marginal rate of return of skill to capitalists, i.e.,

$$\frac{\frac{\partial \pi}{\partial s}}{i} = \text{cost of training}$$

where i is the assumed discount rate of interest on loans.

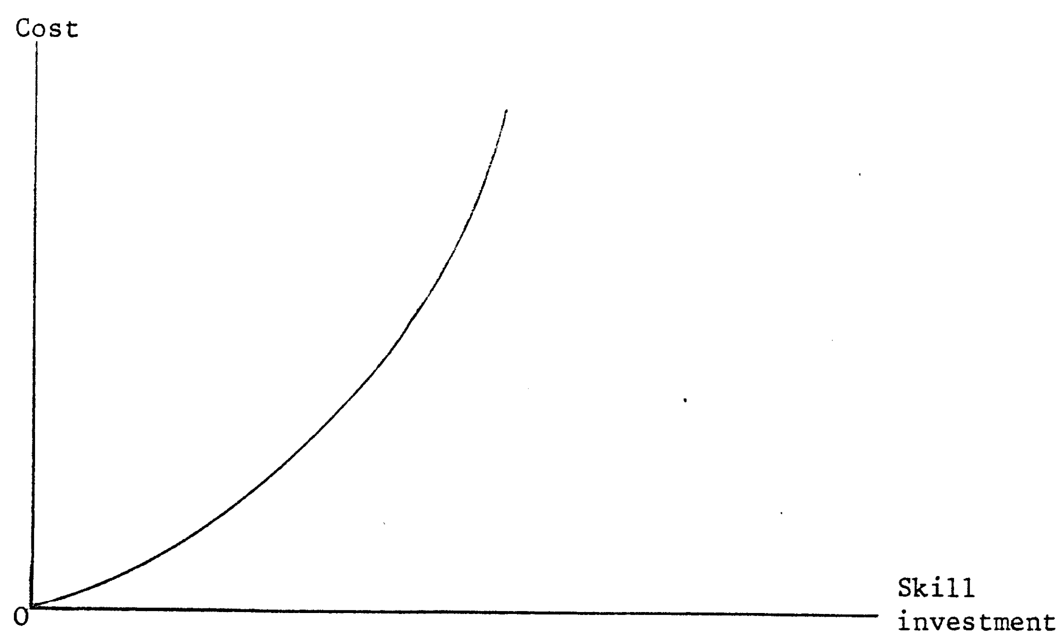

Figure 3.2. Cost of skill investment.

*An exponential function is used for α:

$$\alpha = \exp\ (C \cdot \frac{siv}{sl})$$

where C is a constant.

3.1.10. Rural-to-Urban Migration

Migration here means the shift of the working population (with their families) from primary to non-primary sectors. It does not necessarily mean the spatial shift of the population. A two-step analysis is therefore introduced here. The first step is to analyze how many workers decide to shift from primary to non-primary sectors, and the second step to show how many of those who do shift actually move to cities as opposed to commuting from rural households.

The first step, i.e., to determine the share of people who shift from primary to non-primary activities among the total primary employment is specified in two ways. One specification considers this share as a function of expected income ratios in non-primary and primary employment. In this case the expected non-primary income is a weighted average of non-primary sector wages, the weights are shares of job openings potentially available to migrants through new investments and quits. The other specification assumes that the share is a function of only the number of new jobs available through investment in the non-primary sectors and quits, i.e.,

$$\text{shift} = \alpha_{\text{shift}} \left(\sum I_i \frac{L_i}{K_i} + q_i \cdot L_i \right) .$$

where

shift = the number of workers who shift from primary to non-primary employment

α_{shift} = parameter that shows the degree of responsiveness of rural workers to new opportunities in non-primary activities

$\frac{L_i}{K_i}$ = the average observed labor-capital ratios of sector i

L_i = the unskilled labor employment of sector i

q_i = quit rate of sector i.

From a preliminary regression analysis (see Appendix 2), the latter specification seems to be appropriate for the post-World War II period, whereas the former seems to apply to the period before the War.

The second step is to determine the share of actual movers from among the shifters. For this, we assume a logit type of specification. Given that a person has already decided to obtain a non-agricultural job, the probability that he moves or does not move depends on the utility differences of the two choices, which in turn, depend on the differences of present value of expected income for movers and non-movers. For simplicity, however, we assume that utility levels of movers and non-movers have the following specifications:

$$U_M = \beta_1 \frac{W_M^e}{p_C} + \beta_2 \frac{ya}{p_R} + \beta_3$$

$$U_{NM} = \beta_4 \frac{W_{NM}^e}{p_R} + \beta_5 \frac{ya}{p_R} + \beta_6$$

where

U_M, U_{NM} = the utility levels of movers and non-movers, respectively

W_M^e, W_{NM}^e = the expected wage levels of movers and non-movers, respectively

ya = the average value product of labor in the agricultural sector

p_C, p_R = the consumer price indices in cities and rural areas, respectively

β_i = i = 1,...,6 are parameters

Here we assume β_1 and $\beta_4 > 0$ and $\beta_2 < \beta_5 < 0$. The second inequality comes from the fact that movers lose agricultural income completely, whereas non-movers can still contribute to agricultural production. We also assume that W_M^e is the weighted average of all urban wages, the weights being the

the employment share in each sector, whereas W^e_{NM} is the weighted average of construction and traditional non-primary wages, the weights again being the actual employment share of those two sectors in each period.

Thus, the conditional probability that a person stays in a rural area, given that he has decided to change from an agricultural to a non-agricultural job, is

$$\frac{1}{1 + \exp\left[\beta_1 \frac{W^e_M}{p_C} - \beta_4 \frac{W^e_{NM}}{p_R} + (\beta_2 - \beta_5) \frac{ya}{p_R} + (\beta_3 - \beta_6)\right]}$$

Non-movers are assumed to retain their previous consumption and fertility behavior in the rural area. The employment sectors for non-moving shifts (i.e., those who shift to non-primary employment but do not actually move to cities), are determined by taking the historical share of non-moving shifts employed in each sector as an exogenous parameter.

3.1.11. Government

Government expenditures are largely exogenous. Government consumption, investment and labor employment are given exogenously in real terms. Government workers' wages are given exogenously in nominal terms. All are taken as the historical values. Government revenue, on the other hand, is more endogenous:

$$GR = \sum_{i=1}^{5} t_i Y_i + \sum_{j=1}^{8} pm_j tr_j \cdot e\ im_j + \sum_{j=1}^{8} p_j \cdot ti_j Q_j$$

where

GR = government revenue

t_i = direct tax rate for income class i

Y_i = nominal income of income class i

pm_j = import price of sector j goods

tr_j = tariff rate of sector j imports

e = exchange rate

im_j = imports of sector j goods

P_j = producers' price of sector j goods

ti_j = indirect tax on sector j goods

Q_j = output of sector j goods

Government expenditure is simply:

$$GE = Wg \cdot Lg + \sum_{j=1}^{8} pp_j \ \ gcd_j$$

where

Wg = wage level for government employees

Lg = labor employed by the government

gcd_j = government consumption demand from sector j

pp_j = purchasers' price of sector j goods

All, except pp_j, are given exogenously.

3.1.12. Macro Closures

Three different closures of the model are employed. The first assumes investment to be endogenous, while the sizes of the total urban and rural labor forces are exogenous. The wage level, therefore, becomes endogenous. This specification determins investment by the amount of savings available in the economy (or in the model). This is the ordinary neoclassical way of closure and is referred to as the NC model in this paper.

The second way of closing the model is to assume the physical value of investments as predetermined by the expectations of investors in the previous period. However, we still retain the neoclassical full-employment assumption.

This is referred to as the IX model. The third closure is to assume, in addition to the predetermined investment, that the urban unskilled labor has infinitely elastic supply, i.e., a large pool of unemployed or underemployed exists. The demand, therefore, becomes important *à la* Keynes. Because we assume that the unskilled labor market does not clear, the wage level becomes exogenous, or rather the agricultural income and consumers' price levels in urban and rural areas determine, for the solution, the absolute urban wage structure. This closure is referred to as the FI model. These three closures are summarized in Table 3.3.

Table 3.3. A summary of the differences between the three closures.

1.	NC	— Fixed total labor and capital available in each of the urban and rural areas.
		— Total amount of investment determined by total available savings.
		— W is endogenous.
2.	IX	— Fixed total labor and capital available in each of the urban and rural areas.
		— Physical amounts of investment are determined by investors' expectations during the previous period.
		— W is endogenous.
3.	FI	— Aggregate demand determines the level of urban labor employment, i.e., unemployed labor exists.
		— Physical amounts of investment are determined by investors' expectations during the previous period.
		— W is exogenous (= 1).

3.1.13. Savings

Savings consist of private savings, government savings, and foreign savings. Private savings are derived by assuming exogenous saving propensities for each income class (described below). The constancy of saving propensities is, however, a rigid assumption, despite the fact that it is widely used. In the modification of the base model, therefore, saving propensities are assumed to be of the Metzler type (see Appendix 3).

Government savings are its revenues (direct, indirect taxes and tariff revenue) less expenditure (government consumption plus wage payment to government workers).

Foreign savings are changes in foreigner's claims in Japan. It is the total value of imports minus the total value of exports. In a model version where trade deficit is constrained to be zero, foreign savings are naturally zero.

3.1.14. Income and Consumption Classes

The model described so far is able to generate the functional income distribution. The total income is classified into five different income groups. Roughly, they are as follows:

1. Unskilled urban labor of sectors 1, 2, and 6 (the modern sectors).
2. Unskilled urban labor in the rest of the sectors and the self-employed.
3. Urban skilled labor.
4. Capital income receipients.
5. Rural workers (agricultural workers and non-agricultural workers living with farming families).

Table 3.16 summarizes this classification.

3.2. ESTIMATION, GUESSTIMATION, AND CALIBRATION

3.2.1. General Remarks

The model and its extensions exposited above is not a large general equilibrium model in terms of size, number of sectors or factors of production (see, for example, Adelman and Robinson 1978, or Lysy and Taylor 1980 for examples of large models). It is, however, complicated enough in terms of structure, and estimation of all the parameter values in the framework of a system of simultaneous equations is impossible. We have to therefore depend largely on *a priori* knowledge from both theories and past empirical works, together with a consistent set of social accounting data for a base-year.

This section briefly describes how we proceeded with this rather time-consuming yet still crude work. There are five different methods to determine parameter values:

1. Parameters whose values have actually been econometrically estimated.
2. Parameters whose values have been taken from other studies.
3. Parameters whose values have been calibrated from combinations of theories, social accounting data and (1) and (2).
4. Parameters whose values have been calibrated only from social accounting data of the base year.
5. Parameters whose values have been guessed.

The first set of parameters include those in migration functions and savings functions. The second set includes various elasticities of factor substitutions, some elasticities in labor-quit functions, export and import elasticities, marginal propensities to consume, rates of technical progress, and rates of depreciation.

The third set includes such important parameters as all production parameters except for substitution elasticities, subsistence minimum requirements in consumption, and parameters in physical investment equations. The fourth set includes saving propensities, various tax, subsidy, and tariff rates, and shares of nonagricultural employment in the rural population, mark-up rates in consumers' prices, origin vector of investment, and, of course, input-output coefficients.

Finally, the fifth set includes parameters in expectation-formation functions, the remaining quit function parameters, housing and land market parameters, and parameters in skill investment. These parameters can be claimed to be of dubious reliability because they are simply guessed. But even then, they are educated guesses with some theories or empirical works in the background determining at least rough upper and lower bounds on each parameter value. Also, these guesses are made so that they can be consistent with the base-year data set, and to the extent that the model simulates the overall economy history of Japan during the period concerned, we are satisfied. Of course, the system is under-identified in the sense that there are more parameters than number of values that can be tracked throughout the simulation period. This method of "estimation by simulation", therefore, does not give a unique solution. Improvements on this issue, however, are left for future detailed works and are no longer discussed in this paper.

3.2.2. Base Data and Parameter Values

3.2.2.1. Base year data and parameter values for static solutions

For the major base year solution, the data base from 1960 in Japan has been employed. This includes social accounting matrix (SAM) (reproduced in Appendix 1), destination sectors of investment (origin sectors of investment are given in SAM), existing capital stocks, rural and urban populations, and sectoral employment levels.

Table 3.4 shows base year sectoral outputs, unskilled employment, skilled employment, and two different kinds of physical capital stocks. The sources are as follows. Outputs are taken directly from the social accounting matrix in the Appendix. Unskilled and skilled labor employments are taken mostly from the *Japan Statistical Yearbooks* (produced by the Office of the Prime Minister) supplemented by Kayo (1977). Capital stocks come from a combination of *Capital Stocks and Economic Growth* and *Gross Capital Stock of Private Enterprises* produced by the Economic Planning Agency and the author's judgement. Skilled labor is defined as that part of the labor force with any kind of college education, including junior college. This is a debateable definition,

Table 3.4. 1960 Japanese data on output and factor employment by sector.

Sector	Output (billion yen)[a]	Unskilled labor (thousand persons)	Skilled labor (thousand persons)	Equipment & machinery (billion yen)[a]	Buildings & structures (billion yen)[a]
1	5961.6	1198.2	151.2	1262.3	832.5
2	4947.0	2430.5	244.7	610.9	371.1
3	8474.5	4388.2	(747.2)[b]	898.0	691.1
4	371.0	520.0	0	124.4	132.7
5	3147.5	2068.6	(485.4)[b]	153.0	52.3
6	4222.8	2704.4	327.3	1799.5	2947.2
7	5378.8	10827.6	266.9	788.1	1250.6
8[c]	3043.9	14247.2	0	452.8	487.1

[a]The value terms are all in 1960 constant prices.

[b]This includes self-employed proprietors.

[c]This sector also has "animals and plants" as capital stock, whose value is 582.9, and land whose value is 5701.7 (thousand ha.).

Source: SAM, *Japanese Statistical Yearbooks.*

because "skill" in Japan really depends very much on on-the-job training. It might be argued that a better definition is one which uses the ages and years of employment in addition to education levels. Computational disadvantages, however, would be quite high, especially in dynamic analyses, if we have to keep track of different ages and experience levels as well as educational backgrounds with technical substitutabilities among them. For computational purposes, and analytical tractability, the simple definition of skilled labor is used here. It may not be so unrealistic if we consider that in most Japanese business establishements a higher education is used as a means of preselection for future skilled employees. In other words, a completed higher education is often taken as evidence that someone is more suitable for receiving special "skill" training.

Wage levels for skilled labor are taken from the *Japan Statistical Yearbook*. Unskilled labor wage rates are the total sectoral labor income (from SAM), less the skill wages divided by sectoral unskilled employment. These levels differ somewhat from other wage data, but to keep consistency we need to solve the model we use these wage rates (Table 3.5).

Table 3.5. 1960 Japanese wage levels (million yen/(worker year)).

Sector	Skilled labor	Unskilled labor
1	0.509	0.313
2	0.489	0.286
3	0.329	0.170
4	n.a.	0.318
5	0.376	0.209
6	0.510	0.348
7	0.268	0.151
8	n.a.	0.052[a]

[a]This is the value marginal products of labor in agriculture. In the model, average income is actually used as a criterion of rural welfare.

Source: See text.

Capital income is a residual here and includes depreciation allowances besides the ordinary definition of capital income (profits) in SAM. Capitalists take this sum as their total income from which they consume, save, and invest in the skill accumulation after income tax is netted out. Tax rates are taken from different quotes of effective tax rates, and information available in SAM. The direct income tax rates are as shown in Table 3.6. As is obvious from Table 3.6, the capitalists tax rate is calibrated after all other tax rates are determined so that the model tax revenue equals the actual 1960 tax revenue. Consumption propensities are determined similarly (Table 3.7).

Table 3.6. Rates of direct income tax.

Income class	Income tax rates %
1	5.0
2	3.5
3	6.0
4	15.9814
5	2.5

Source: SAM (see the text).

Table 3.7. Consumption propensities.

Income class	Consumption propensities
1	0.84
2	0.87
3	0.85
4	0.34518
5	0.864

Source: SAM (see the text).

Rates of indirect taxes and *ad valorem* tariffs are derived directly from SAM (Table 3.8).

Table 3.8. Rates of indirect taxes and *ad valorem* tariffs.

Sector	Indirect tax %	Tariff %
1	2.975	5.514
2	1.856	8.887
3	5.992	36.473
4	0.644	1.807
5	0.235	n.a.
6	5.168	n.a.
7	1,679	n.a.
8	1.238	1.049

Production parameters are derived from the values stated above: outputs, factors employed and factor returns. Because we assume constant elasticities of substitution production function in most sectors, however, we still have extra degrees of freedom that can be eliminated by choosing or estimating values of the substitution elasticities. Unfortunately, the literature shows only a confusion as to the reasonable values of these elasticities and appropriate methods for estimating them empirically. Ever since the publication of the pathbreaking article by Arrow, Chenery, Minhas and Salow (ACMS)(1961), the conventional wisdom has been that elasticities of capital-labor substitution are by and large less than unitary. A review by Caddy (1976), however, shows that the empirical estimates are varied and not quite in agreement with conventional knowledge. Indeed, Sato (1977) shows that the ACMS contention of less than unitary substitutions elasticity is logically half true. The other half of the logic, says Sato, shows that it is possible to have higher than unitary elasticities, and that this would conform better to reality than lower elasticities. Thursby (1980), however, contends that estimations of the elasticities of factor substitutions may not exist or, even if they do, can be very unreliable due to extremely large variance. Also the famous impossibility exists of estimating the elasticity of substitution from time series data when there is biased technical progress (Diamond and McFadden 1965).

All these findings make it very difficult to obtain a plausible set of values for these elasticities, either from the past literature or from direct efforts to estimate them. Because recent estimates (Fishelson 1979, Paraskevopoulos 1979, for example) show that less than unitary elasticities are still hard to refute in general, and because we are more interested in the way the model behaves, we have chosen to use a set of elasticity parameters that seem more or less to be a lower bound of such values. We will see whether these values replicate history with a comfortable degree of precision. Sensitivity analyses will be employed for further testing of their plausibility. The values chosen are shown in Table 3.9.

Table 3.9. Elasticity of factor substitutions assumed.

	Elasticities between		
Sector	Equipment and skilled labor	and buildings	and unskilled labor
1	0.3	0.4	0.55
2	0.35	0.45	0.6
3	0.4	0.55	0.85
4	n.a.	0.46	1.15
5	0.42	0.6	0.95
6	0.3	0.4	0.55
7	0.48	0.7	0.95

As we have already discussed, it is assumed that modern sectors have less substitutable technologies than do traditional sectors. This relates to the higher number of production processes available in traditional sectors. Even if each process has a Leontief type of technology, the aggregation of different factor-proportion processes into one sector makes our assumption more plausible.

Now we are ready to calibrate all the production parameters. Sectors 1, 2, 3, 5, 6, and 7 have the following production functions

$$\left(\left[(\alpha_1\ em^{\rho_1} + \alpha_2\ sl^{\rho_1})^{\rho_2/\rho_1} + \beta\ cs^{\rho_2}\right]^{\rho_3/\rho_2} + \gamma\ ul^{\rho_3}\right)^{\rho_1/\rho_3}$$

All that needs to be calibrated now is α_1, α_2, β and γ given the first order conditions. These are shown in Table 3.10.

Sectors 4 and 8 have the following production functions:

$$Q_4 = (\text{minerable resources})^{0.4} \left((4475 \cdot em_4^{\rho_2} + 4457 \cdot cs_4^{\rho_2})^{\rho_3/\rho_2} + 0.6534 \cdot ul_4^{\rho_3}\right)^{0.6/\rho_3}$$

where

$$\rho_2 = 1.1739 \qquad \text{and} \qquad \rho_3 =.0.1304$$

and

$$Q_8 = 0.96\ (0.46\ em_8^{-1} + 0.32\ cs_8^{-1} + 0.12\ ap^{-1})^{-0.375}\ ul^{0.375}\ land^{0.25}$$

This latter function means the capital stock in agriculture is assumed to be the aggregation of equipment and machinery (em), constructed structures and buildings (cs) and animals and plants (ap) with elasticity of substitution of 0.5. The coefficients of the Cobb-Douglas form are taken from Hayami (1975) assuming that fertilizer is an intermediate input.

Table 3.10. Production parameters.

Sector	α_1	α_2	β	γ
1	0.5014 e-2	0.4957 e-5	0.7994 e-2	0.7989 e-1
2	0.1842 e-2	0.8381 e-4	0.3761 e-2	0.2850
3	0.1074 e-3	0.4202 e-4	0.2771 e-2	0.3828
5	0.2134 e-8	0.6198 e-8	0.5489 e-5	0.4272
6	0.1125 e-1	0.4760 e-4	0.1443	0.2310
7	0.5839 e-8	0.2133 e-9	0.1007 e-2	0.5275

Consumption demand functions take the ordinary linear expenditure system

$$cd_{hi} = \frac{\beta_{hi}}{pc_{hi}} (E_j - TCE_h) + \gamma_{hi}$$

An extensive search of the literature was made for the marginal propensities to consume. Estimates with enough disaggregation to make the calibration of consumption functions with the present sector division possible were very few. Actually the only works available covering Japan during the period concerned with substantial sectoral disaggregation are Sasaki (1982) and Sasaki and Fukagawa (1982). Even these works, however, do not include rural residents, and do not quite conform to the sector divisions of this model. The discretion of the author was therefore applied substantially, utilizing the results of the two works cited above and Yoshihara (1977) and Lluch, Powell and Williams (1977). The author also got some ideas as to the values of the supernumerary income ratios (ϕ_i) or the inverse of the Frisch parameter from these econometric analyses. Thus, γ_{hi} can be calibrated as*

$$\gamma_{hi} = \frac{E_{hi}}{pc_{hi}} (\omega_{hi} - \beta_{hi}\ \phi_h) \qquad \text{for all } h,i$$

*See Taylor (1979) for a good exposition.

where ω_{hi} is the expenditure share of good i by consumers of type h. The parameters that result from these exercises are shown in Table 3.11.

Investment is carried out by investors' expectations on future factor prices and demand. It is a multiple of the most efficient capital-output ratio times the expected increase in demand, i.e.,

$$I = \frac{\partial c}{\partial r} DD$$

where

c = the cost function with expected user costs of factors

r = the user cost of concerned capital stock

DD = the expected increase in demand.

Calculating this value for each sector in the base year, however, does not give values close to the actual investment next year. As a matter of fact, there is a tendency that capital goods producing sectors invest more heavily than this investment equation suggests, and among the similar sectors, modern

Table 3.11. Consumption parameters.

	Urban		Rural	
Sector	β	γ	β	γ
1	0.040	0.4490 e-3	0.040	0.3441 e-3
2	0.090	0.1518 e-2	0.080	0.1485 e-2
3	0.400	0.3204 e-1	0.380	0.1986 e-1
4	0.001	0.6198 e-4	0.002	0.4848 e-4
5	n.a.	n.a.	n.a.	n.a.
6	0.259	0.9659 e-2	0.220	0.8601 e-2
7	0.200	0.6588 e-2	0.248	0.6507 e-2
8	0.010	0.5894 e-2	0.030	0.4594 e-2

sectors invest more than traditional sectors. The differences may be attributed to economic forces that our model is unable to capture, or other political/institutional factors, or simply the "animal spirits" of the investors. We calculate the ratio of actual values of investment in 1961 and what the model produces, as the desirable investment for the next year in 1960 and call it "animal spirit" parameter (AS). That is,

$$I_{actual} = AS \frac{\partial c}{\partial r} DD$$

These animal spirit parameters appear in Table 3.12.

Origin sectors of investment in equipments and machineries are calibrated from SAM, i.e., sectoral compositions of equipment and machinery are shown in Table 3.13.

Constructed buildings and structures naturally originate only from sector 5, i.e., the construction sector. We also assume that the investment in animal and plants all originates from sector 8 the agricultural sector.

Table 3.12. Animal spirit parameters.

Sector	Equipment & machinery	Building & structures
1	2.008	1.423
2	2.337	2.214
3	1.452	1.031
4	0.001007	0.000701
5	1.747	1.978
6	1.120	1.626
7	0.853	0.801
8[a]	0.324	0.604

[a]For animals and plants of this sector, the same value is 0.0701.

Table 3.13. Origin sectors of equipment and machinery[a] in non-agricultural sectors[b].

Sector	Composite
1	0.0
2	0.886
3	0.16
4	0.0
5	0.0
6	0.008
7	0.089
8	0.0

[a]This table shows the origin sectors of capital stock (em), e.g., one unit of em includes 0.886 units of sector 2 goods.
[b]For simplicity it is assumed that all agricultural equipment and machinery comes from sector 2, and all animals and plants from sector 8.

International trade is specified as follows:

$$\text{import:} \quad M = \left(\frac{\varepsilon}{1-\varepsilon}\right)^{\theta} \left(\frac{p}{(1+t_r)\ e\ pm}\right)^{\theta} \ TD$$

$$\text{export:} \quad X = \alpha\ WT^{\zeta} \left(\frac{p}{e \cdot pw}\right)^{\xi}$$

where (sector subscripts are suppressed)

θ, ξ = elasticities of import and export, respectively, with respect to terms of trade

ζ = the elasticity of export with respect to world demand

TD = the total demand for domestically produced commodities net of export

WT = the quantum index of the world trade of the concerned sector goods

e = the exchange rate (= 1.0)

pm,pw = import and export prices

$\alpha, \varepsilon, \zeta$ = parameters to be estimated

tr = the tariff rate.

Here, pm, pw, and WT are given exogenously from the history (see Tables 3.20 and 3.21), ζ, θ and ξ are taken from Matsukawa (1979) because of the similar time periods and issues in both his work and this. WT's are indices whose value is 1 for all sectors in the base year, and p/e•pw also equals 1 in the base year, α is given as the base year value of the export in each year. TD is given (well almost) in SAM, and γ can also be calibrated from the import equation because we assume all domestic prices are 1 in the base year*. All these values are given in Table 3.14.

Table 3.14. Trade related parameters.

Sector	θ	ε	ζ	ξ	γ
1	3.1	0.309	1.401	0.616	1.669
2	0.8	0.16	1.6	1.700	1.127
3	0.5496	0.001	1.9053	2.869	1.059
4	3.0	0.509	1.0	0.500	2.018
8	0.201	0.201	1.0	0.500	1.608

*γ in the aggregation function of domestic and imported goods, i.e.,

$$\psi = \gamma[\varepsilon M^{\eta} + (1 - \varepsilon) TD^{\eta}]^{1/\eta}$$

can be calibrated assuming

$$pp \ (= \frac{1}{\gamma} \{[\varepsilon^{\theta}(1 + tr) \ e \cdot pm]^{1-\theta} + (1 - \varepsilon)^{\theta} \ p^{1-\theta}\}^{1/1-\theta})$$

is 1 as well.

Service sectors are also expected to explicitly benefit from trade. There are such foreign exchange earning activities as storage, insurance, and transportation of traded commodities. From the base year data we assume that a portion of the total exports in the base year prices (= 1), becomes these handling charges. This portion is 0.126 for sector 6 (modern services) and 0.029 for sector 7 (traditional services).

The last set of parameters that relates to the static solutions is the parameters in nominal wage determination. This is an important set of parameters but it has been impossible to estimate them in any sense. We do not have any good estimates of hiring and training costs of unskilled labor in each sector, and we only have the wage elasticity of quits in very aggregated sectors (e.g., Shorey). Discrete judgement, therefore, has been used to choose the matrix of β's in

$$q_j = AT_j \prod_{i=1}^{7} \left(\frac{w_i}{pci_u}\right)^{\beta_{ij}} \left(\frac{ya}{pci_R}\right)^{\beta_{8j}} \qquad \text{for } i = 1,\ldots,7$$

where

q_j = quit rate of sector j

AT_j = sector specific constants which reflect both training and hiring costs and some measure of propensity of unskilled laborers in the sector to stick to the job

w_i = nominal wage of sector i

pci_u, pci_R = consumers' price indices of urban and rural areas, respectively.

The sector specific constants reflecting both training and hiring costs (AT_j) are calculated from the first order conditions of labor cost minimization for the base year. That is,

$$0 = 1 + \beta_{jj} AT_j \left(\frac{w_1}{pci_u}\right)^{\beta_{1j}} \left(\frac{w_2}{pci_R}\right)^{\beta_{2j}} \cdots \left(\frac{w_j}{pci_u}\right)^{\beta_{jj}-1} \cdots$$

$$\left(\frac{w_7}{pci_u}\right)^{\beta_{7j}} \left(\frac{ya}{pci_R}\right)^{\beta_{8j}}$$

Table 3.15 contains all the values of the β_{ij}'s and AT_j's used for model simulation. The high values of own sector β's (β_{ii}) reflects the results of Shorey (1980). This could mean, among other things, that people have illusions about their own wages due to the lack of information about the wages of other sectors. Before we move to the variables and parameters for dynamic runs, we need to calrify how the population is divided into five income groups. Table 3.16 contains this information. The numbers for proprietors and capital owners in Table 3.16 are the historical values as given in the *Japan Statistical Yearbook*. r_3, r_5, and r_7 are given the values of 0.18, 0.20, and 0.20 respectively, and represent the share of capital income that would actually go to poorer classes, i.e., capital income that accrues to family firms, for example. The values are given as the ratio of unincorporated capital income to corporate capital income with some discrete judgement.

Table 3.15. Wage determination parameters.

	β_{ij}								
Sector	1	2	3	4	5	6	7	8	AT_j
1	-4.0	0.2	0.2	0	0	0.6	0.2	0.6	0.012
2	0.5	-3.2	0.4	0.2	0.1	0.2	0.6	0.65	0.118
3	0.2	0.3	-2.0	0.2	0.4	0.3	0.8	1.0	0.470
4	0.1	0.2	0.3	-3.0	0.3	0.1	0.6	0.85	0.423
5	0.2	0.2	0.6	0.4	-2.5	0.1	0.6	1.0	0.338
6	0.3	0.2	0.1	0	0.2	-3.0	0.1	0.45	0.037
7	0.2	0.4	0.8	0.2	0.1	.0.3	-2.0	1.2	0.317

Table 3.16. Division of the population into five income groups.

Sector	Representative name of income group: Urban modern unskilled workers	Urban traditional workers	Skilled workers	Capital workers	Rural workers
1	ul		sl	co	
2	ul		sl	co	
3		ul-rl prop $r_3$co	sl	$(1-r_3)$co	rl
4		ul		co	
5		ul-rl prop $r_5$co	sl	$(1-r_5)$co	rl
6	ul		sl		
7		ul-rl $r_7$co sl		$(1-r_7)$co	rl
8					ul
Government	government workers				

Note: ul = total unskilled workers

rl = unskilled workers living in rural areas and commuting to non-agricultural jobs

sl = skilled workers

prop = self-employed proprietors

co = capital owners

r_3, r_5, r_7 = shares of capital income going to self-employed or other workers in sectors 3, 5, and 7.

rl is explained in Section 3.1.10.

3.2.2.2. Values of parameters and exogenous variables for dynamic runs

In order to solve the model year by year, we need more information on parameter values and exogenous variables. These include rates of depreciation, rates of factor augmenting technical progress, parameters in expectation functions, population and labor force growth rates, world prices, world trade quantum indices, government consumption, government investment, government employment, and housing investment. These values are mostly historical values except for the rates of technical progress and expectation formation parameters. The latter set of parameters is simply guessed, taking into consideration the assumption that modern sectors are quicker in reacting against unexpected changes in circumstances. The literature on such aspects of Japan during the assumed period is almost nil. There have not been abundant estimates of sectoral factor augmenting rates of technical progress either. We have decided here, therefore, to choose an arbitrary process: to set the capital augmenting technical progress at relatively low rates and jiggle the rates of labor augmenting technical progress so that the model simulation results resemble the Japanese history of the period concerned. The following tables (3.17 - 3.23) give the values of all the parameters/variables mentioned above for 10 years simulation.

Table 3.17. Rates of depreciation and factor augmenting technical progress.

	em		cs		sl		ul
Sector	dep	tp	dep	tp	ret	tp	tp
1	0.14	0.035	0.09	0.018	0.04	0.044	0.085
2	0.12	0.025	0.07	0.012	0.035	0.036	0.083
3	0.07	0.022	0.04	0.010	0.03	0.028	0.071
4	0.09	0.010	0.06	0.005	n.a.	n.a.	0.042
5	0.08	0.011	0.05	0.008	0.03	0.018	0.052
6	0.13	0.020	0.08	0.018	0.04	0.044	0.088
7	0.06	0.009	0.04	0.007	0.03	0.018	0.062
8	0.07	0.009	0.04	0.005	n.a.	n.a.	0.028

Table 3.18. Parameters in expectation formation.

Sector	Unskilled wages	Cost for equipment capital	Cost for constructed capital	Domestic demand	Exports
1	0.6	0.45	0.3	0.4	0.4
2	0.6	0.45	0.3	0.4	0.3
3	0.5	0.45	0.3	0.3	0.3
4	0.5	0.35	0.2	0.2	0.3
5	0.5	0.45	0.3	0.4	n.a.
6	0.6	0.50	0.4	0.5	n.a.
7	0.4	0.45	0.2	0.3	n.a.
8	0.2	0.25	0.2	0.25	0.2

Note: these values are adjustment parameters in expectation formation equations (see Section 3.1.8).

Table 3.19. Population and labor force growth rates.

	Urban %	Rural %
Population	0.88	1.10
Labor force	2.01	1.50

Table 3.20. World prices.

Year	Sector 1	2	3	4	8
1960	1.0	1.0	1.0	1.0	1.0
1961	0.9722	1.0211	1.0	0.98	0.9895
1962	0.9444	1.0421	0.9901	0.96	0.9895
1963	0.9196	1.0494	1.0	0.963	1.0588
1964	0.9197	1.0617	1.0233	0.97	1.1059
1965	0.9286	1.0988	1.0581	0.97	1.0941
1966	0.9107	1.1235	1.0814	0.95	1.1176
1967	0.8750	1.1235	1.0814	0.959	1.1059
1968	0.8571	1.0617	1.0349	0.962	1.0706
1969	0.8750	1.0988	1.0930	0.98	1.1412
1970	0.8920	1.234	1.1628	1.0	1.176

Table 3.21. World trade indices.

Year	Sector 1	2	3	4	8
1960	1.0	1.0	1.0	1.0	1.0
1961	1.0946	1.0741	1.0357	1.04	1.0341
1962	1.2027	1.1358	1.0952	1.09	1.0909
1963	1.3667	1.2222	1.1860	1.17	1.1406
1964	1.6333	1.3889	1.3256	1.20	1.1875
1965	1.7667	1.5556	1.4419	1.31	1.2344
1966	2.0333	1.7222	1.5581	1.40	1.2813
1967	2.2667	1.8889	1.5814	1.49	1.3281
1968	2.7000	2.3056	1.9302	1.63	1.483
1969	3.0333	2.6389	2.1860	1.75	1.4219
1970	3.3330	2.7778	2.325	1.90	1.5620

Table 3.22. Government consumption (billion yen in 1960 prices).

Year	Sector 1	2	3	4	5	6	7	8
1960	31.159	83.885	60.859	1.639	5.947	127.785	587.434	0.935
1961	38.392	84.802	48.669	2.868	5.371	132.657	650.242	0.875
1962	47.308	85.728	38.920	3.794	4.852	137.714	719.765	0.819
1963	58.301	86.665	31.124	2.333	4.382	142.964	796.722	0.767
1964	49.872	88.257	36.318	1.435	6.876	142.346	864.568	0.432
1965	42.661	89.878	42,379	1.110	1o.789	141.731	938.192	0.243
1966	42.338	97.867	41.165	0.858	11.980	167.638	960.252	0.120
1967	42.017	106.566	39.986	0.663	13.302	198.281	982.831	0.0
1968	41.698	116.039	38.841	0.513	14.769	234.524	1005.941	0.0
1969	41.382	126.353	37.729	0.39	16.399	277.393	1029.595	0.0
1970	41.060	137.580	36.640	0.35	18.200	328.090	1053.800	0.0

Table 3.23. Government investment and employment, and housing investment.

Year	Government investment (billion yen)	Government employment (thousands)	Housing investment (billion yen)
1960	675.9	1879	665.8
1961	810.4	1964	737.7
1962	1037.3	1993	837.297
1963	1196.0	2125	998.058
1964	1276.2	2140	1263.540
1965	1415.3	2125	1487.188
1966	1024.7	2081	1592.778
1967	1710.8	2301	1858.772
1968	1940.1	2257	2195.210
1969	2114.6	2287	2537.662
1970	2315.0	2360	2872.634

APPENDIX 1 TO CHAPTER 3

EIGHT SECTOR SOCIAL ACCOUNTING MATRIX AND SECTORAL COMPOSITIONS OF FINAL DEMAND OF 1960 JAPAN

Table 3A1.1.

Sector	1	2	3	4	5	6	7	8	Total II
Input-Output Relationship									
1	2994.	1132.	853.	23.	338.	161.	225.	200.	5926.
2	81.	1305.	130.	15.	569.	167.	107.	38.	2414.
3	169.	356.	2031.	16.	760.	81.	559.	195.	4166.
4	507.	2.	86.	5.	50.	103.	6.	0.	759.
5	17.	16.	21.	6.	3.	137.	59.	17.	277.
6	370.	229.	353.	36.	193.	327.	520.	65.	2093.
7	255.	301.	502.	16.	224.	123.	558.	49.	2028.
8	135.	6.	2267.	12.	26.	0.	66.	474.	2987.
II	4529.	3348.	6243.	128.	2162.	1100.	2100.	1038.	20650.
Value-Added									
wL	452.	815.	967.	165.	608.	1139.	1715.	—	5861.
rK	581.	541.	569.	38.	300.	1109.	1235.	—	4373.
YA	—	—	—	—	—	—	—	1759.	1759.
dK	219.	146.	138.	39.	61.	657.	265.	209.	1734.
SI	15.	20.	17.	0.	10.	39.	19.	0.	121.
IT	178.	97.	545.	10.	7.	220.	91.	48.	1197.
Sub	0.	0.	-46.	-8.	0.	0.	0.	-10.	-64.
VA	1444.	1620.	2190.	244.	987.	3165.	3325.	2006.	14982.
TC	5974.	4968.	8433.	373.	3150.	4265.	5424.	3044.	35631.

	HHC	GC	KF	SI	EX	IM	Tariff	Total FD	Total
Final Demands									
1	153.	31.	0.	15.	270.	-400.	-22.	470.	5974.
2	403.	84.	1706.	20.	506.	-152.	-14.	2720.	4968.
3	3618.	61.	29.	17.	746.	-151.	-55.	472.	8433.
4	9.	2.	0.	0.	1.	-391.	-7.	11.	373.
5	0.	6.	2857.	10.	0.	0.	0.	2873.	3150.
6	1791.	128.	15.	39.	259.	-60.	0.	2233.	4265.
7	2587.	587.	158.	19.	66.	-19.	-1.	417.	5425.
8	552.	1.	18.	0.	58.	-564.	-6.	624.	3044.
Total	9112.	900.	4782.	1907.	-1736.	-104.	121.	16821.	35631.

II = intermediate inputs, HHC = household consumption demand, GC = government consumption, KF = investment, EX = export, IM = import, SI = skill investment, FD = final demand, wL = labor income, rK = capitalists' income, dK = depreciation allowances, YA = agricultural income, IT = indirect tax, Sub = subsidy, VA = value added (gross), TC = total cost. Unit in billion yen 1960 yen in producers' price.

Source: Japan Statistical Year Books—A joint work of 7 ministries and agencies of the Japanese Government.

Table 3A1.2. Sectoral Composition of Final Demand in 1960 Japan.

Sector	II/Q	HHC/Q	GC/Q	KF/Q	EX/Q	(IM+Tarrif)/Q
1	1.0045	0.0243	0.0038	0.0	0.0395	-0.0720
2	0.5014	0.0796	0.0136	0.3477	0.0923	-0.0347
3	0.4988	0.4386	0.0027	0.0036	0.0818	-0.0255
4	2.0203	0.0231	0.0044	0.0	0.0023	-1.0500
5	0.0876	0.0	0.0020	0.9104	0.0	0.0
6	0.4955	0.4268	0.0296	0.0034	(0.0448)[a]	0.0
7	0.3120	0.5248 (0.2351)[b]	0.1225	0.0318	(0.0091)[a]	0.0
8	0.9827	0.1805	0.0003	0.0053	0.0186	-0.1874

[a] Handling charges for exports.
[b] This portion of sector 7 outputs is for the mark-up of consumption goods by retail and wholesale subsectors, i.e., it does not enter directly in the consumption demand functions.

Note: Q = total product

II = intermediate input

HHC = household consumption

GC = government consumption

KF = capital formation

EX = exports

IM = imports

APPENDIX 2 TO CHAPTER 3

SOME PRELIMINARY ECONOMETRIC RESULTS FOR MIGRATION PARAMETERS

Some preliminary econometric results for migration parameters are reported here. We assume that both net outmigration rates and urban-rural wage ratios are endogenous, and estimate the migration equation using a two-stage least-squares with the first order serial correlation*. The results are shown in Table 3A2.1. These results illustrate that, for the entire period, lagged investment is significant at the 2 percent level, whereas relative wages are not significant at the 5 percent level. When each of the pre- and post-World War II periods are examined, however, the reason for this becomes partially clear. During the pre-World War II period, wage differentials were important factors in pulling agrarian workers into urban activities. Table 3A2.1 shows that lagged investment, on the other hand, is not significant at 5 percent, although it is still significant at 10 percent. More non-agricultural jobs were available because new investments had a positive influence on outmigration. For the post-World War II period, however, results are incompatible with the conventional economic knowledge. The investment variable i(-1) is not significant and wage ratios (rw) have a negative and significant coefficient. The former problem is caused by the high multicolinearity during this period between i(1) and rw. Excluding rw in an ordinary least square (OLS) analysis results in a significant (at 1 percent) and positive coefficient for i (-1).

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*See Fair (1970).

Table 3A2.1. Estimated coefficients of the migration function.

	Variable			
Period	rw	i(-1)	ρ	dw
Entire period 1921-1940 1952-1970	1.53954 (1.7055)	0.13983 (2.6454)	0.76890 (7.1147)	1.83
Pre-World War II 1921-1940	1.69153 (2.70221)	0.34813 (1.91024)	0.53443 (3.48217)	2.55
Post-World War II 1952-1970	-3.01500 (-4.1538)	0.01567 (0.50831)	0.19503 (0.81985)	1.95

Note: t-statistics are in parentheses
ρ = the coefficient of first order serial correlation
dw = the Durbin-Watson statistics
rw = urban wages, agricultural wages
i(-1) = lagged investment.

The unexpected negative sign for rw, however, seems to come from misspecification. There is no longer a strong simultaneity between rw and net outmigration rates. The causality is presumably only from net outmigration rates to wage ratios during the period concerned for the following reasons.

There was a considerable spatial diffusion of nonagricultural investment after World War II, thus creating more jobs within a commuting distance from rural households. Table 3A2.2 shows this trend between 1965 and 1975. It shows the ratios of rural males who shifted to nonagricultural jobs without moving to cities (NM) to those males who actually moved (M). The ratio (NM/M) increased greatly in this decade, especially for those whose physical existence with the family was socio-institutionally more important, i.e., family heads and first sons. The advantages of not moving from the farm are many. There are few physical or psychic costs, or risks and uncertainties involved.

Table 3A2.2. The ratio of rural males who shifted to nonagricultural jobs without moving, to those males who did move.

Year	Household heads	First sons	Other male siblings
1965	9.0	3.3	0.8
1975	63.6	8.6	2.6

Furthermore, men who do not move are able to work on the farm from time to time. The marginal value products of labor, which is safely assumed to be close to contract workers' wages, are not the opportunity costs for nonmoving males, these wages are of relatively little concern as long as the benefits of changing jobs exceed costs. The extensive labor-saving mechanization of agriculture during the period 1965-1975 also helped accelerate this process. Less labor and more capital on the farm pushes up contract workers' wages, reducing the wage ratio variable as a consequence. Hence the results for this period in Table 3A2.1.

Further studies on urbanization during this period should be carried out with a more detailed data set, which includes the rate of spatial diffusion of nonagricultural investment, the type and magnitude of technical progress in agriculture, and the human capital stock of the rural people. For the purpose of this paper of simulating a macro model, however, we conclude that the use of both wage and investment variables in migration functions is appropriate for the pre-World War II period, and only the investment variable should be used for post-World War II. The latter has been done for this modeling effort by assuming

$$\text{shift} = \alpha_{mig} \times \text{(new jobs created by new investments)}$$

α_{mig}, in turn, was calibrated by only dividing the total number of shifts by the new investments multiplied by average labor-capital ratios, i.e., $[\sum_i I_i (\bar{L}_i/K_i)]$.

APPENDIX 3 TO CHAPTER 3

MODIFICATIONS OF THE BASE MODEL

The following modifications to the base model have been made:

1. Incorporation of urban and rural housing markets.

2. Incorporation of a simple market for speculative land holding.

3. Incorporation of endogenous interest rates by using a loanable fund equation.

4. Incorporation of endogenous treatment of agricultural labor supply.

5. Incorporation of endogenous treatment of saving propensities.

It is rather difficult to ignore the urban housing market when studying the pattern of urbanization and migration in a growing economy. The availability and costs of housing are factors that strongly influence potential migrants' decisions. Investment in housing also affects the overall economic growth by competing for funds with other directly productive investment demands. Housing sectors, however, are sufficiently complicated that we need some drastic simplication and abstraction in order to incorporate them in our economy-wide model. We have, therefore, made the following assumptions:

1. Urban housing requires both structures and land whereas rural housing requires only structures (in an economic sense); land is not scarce in rural areas.

2. Elasticity of substitution between structures and land in the production of urban housing service is assumed to be 1.

3. Housing stocks are completely mallable.

4. Urban housing rent is the same everywhere, i.e., the rent gradient has zero slope.

The production of housing services is specified as follows:

$$Q_{UH} = \alpha_{UH}\, cs_{UH}^{\beta_{UH}}\, hl_{UH}^{1-\beta_{UH}}$$

$$Q_{RH} = \alpha_{RH}\, cs_{RH}$$

where the subscripts UH and RH are urban and rural housing, respectively, and hl_{UH} is the urban housing land. Housing rents in the urban area are expressed by the cost function of the Cobb-Douglas production* function:

$$P_{UH} = \frac{1}{\alpha_{UH}}\, \beta_{UH}^{-\beta_{UH}}\, (1 - \beta_{UH})^{\beta_{UH}-1}\, r_{cs}^{\beta_{UH}}\, r_{hl}^{1-\beta_{UH}}$$

where r_{cs} and r_{hl} are the imputed rents of residential structures and land, respectively.

The use of a capital-land unitary elasticity assumption in urban housing is, to say the least, debateable. A recent review by McDonald (1981) shows that empirical estimates of the parameter in the United States ranges from 0.36 to 1.13, most of which is significantly less than 1. However, McDonald also points out serious land value measurement errors that bias the estimates towards zero. Knowing this we see no reason to elect to use a more complicated

*Some prefer to call this an aggregator rather than production (Arnott 1978), however, it actually is a function that reflects both technology and tastes.

production (aggregation) function than the Cobb-Douglas one. Further research is seriously called for in this regard.

The accumulation of urban housing stocks is carried out by investing in both land and structures in a similar manner as investing in "productive" capital stocks, i.e., through expectations. First, the expected urban housing demand for the next period (cd^e_{UH}) is

$$cd^e_{UH} = \xi_{UH} \left(1 + \frac{mig + fam}{tupop} + n_u\right) cd_{UH}$$

where

cd_{UH} = the observed total urban housing consumption this year

mig = the total migrants who actually moved to cities this year

fam = the family members who moved with mig

tupop = the present total urban population

n_u = the natural growth rate of the urban population

ξ_{UH} = a parameter (> 1) that implies the changing taste of people for more housing services per capita as time passes (improvement of desired housing quality)

The expected land rent is:

$$r^e_{hl} = \max \left(p_T \cdot i,\ \gamma_{hl}\ [r_{hl} - r^e_{hl}(-1)] + r_{hl}\right)$$

where p_T is the price of new urban residential land and i is the interest rate used for discounting. The expected structural rent is

$$r^e_{cs} = \gamma_{cs}\ [r_{cs} - r^e_{cs}(-1)] + r_{cs}$$

p_T is derived by solving the equilibrium of the derived demand for new residential land and its supply. This supply is assumed to be rather inelastic because of the developers' (and farmers') expectation that p_T will rise so quickly that witholding the sale of land for a while may be more profitable than its immediate sale. There is, in other words, room for speculation. The derived demand for new residential land (Δhl^D_{UH}) is, then, using Shephard's Lemma again

$$\Delta hl^D_{HU} = \frac{\partial p^e_{UH}}{\partial r^e_{hl}} (cd^e_{UH} - Q^e_{UH})$$

where undefined notations are

p^e_{UH} = the expected cost of urban housing

$= p_{UH}(r^e_{hl}, r^e_{cs})$

Q^e_{UH} = the expected supply of housing services in the absence of new investment

$= \alpha_{UH} \, [(1 - \delta) \, cs_{UH}]^{\beta_{UH}} \, hl_{UH}^{1-\beta_{UH}}$

where δ is the depreciation rate of housing structures.

The supply function of urban residential land is rather arbitrary. We assume that the supply comes only from land held speculatively. Supply, therefore, depends on the rate of inflation of urban land $\dot{p}_T/p_T$ as follows

$$p_T = g\left(\frac{\dot{p}_T}{p_T}\right) \Delta hl^s_{UH} + p_{al} \qquad \dot{g}' > 0$$

where p_{al} is the price of agricultural land (= agricultural land rent/i), namely, the faster urban land prices rise, the slower will be their sale. Holding land for speculative purposes is determined completely by the speculator's demand, and this is actually the demand for the conversion of agricultural land into urban land. The developer/speculator will purchase land as long as

$$\frac{p^e_T - C_T}{p_{al}(1+i)} > 1$$

where

p_T^e = the expected sales price of a unit of land to the urban housing sector

p_{al} = the purchase price of agricultural land

C_T = the cost of keeping the land idle for one period ($\partial C_T/\partial T > 0$ when T is the total amount of land held in speculation)

i = the discount rate.

This simply says that a speculator would buy land if the purchase of a parcel of land in one period and its sale in the next less the holding cost exceeds what would be obtained by keeping the same amount of money as interest bearing assests. C_T consists of taxes, interest and the cost of keeping the land in a sellable condition all the time and it is upward sloping because of the progressivity of tax for such land holdings. In addition, if bank loans are needed for these purchases then the interest cost would go up: the more one needs to borrow, the less priviledged financial markets one would have to depend on.

Demand for the new urban residential structure (Δcs_{UH}^D) is written as

$$\frac{p_{UH}^e}{r_{cs}^e}\,(cd_{UH}^e - Q_{UH}^e)$$

Rural housing investment takes the following simple form:

$$cs_{RH}^D = \max\left(\xi_{RH}\left(1 - \frac{mig + fam}{trpop} + n_R\right)cs_{RH} - (1-\delta)\ cs_{RH}\ \delta cs_{RH}\right)$$

where trpop is the total rural population; other notations are obvious.

Next, the interest rate used for discounting and capital user costs is endogenous here. We assume not all private savings enter the financial market as deposits or any other form of financial asset that can be mobilized for fixed capital formation. The rest of the private savings go straight to finance own sector capital stocks (in the case of corporate retained earnings) or housing (in the case of personal savings). We therefore assume a simple loanable fund supply equation (a share of private savings) and demand function for loans that includes traditional sector's physical investment demand and portions of the housing investments and purchase of speculative land. An interest rate equilibrates the demand and supply and is used for discounting. This rate also, of course, influences the investment decisions for the next period.

Among others Pigou (1943) and Metzler (1951) have stressed the importance of assets and real balances in personal consumption behavior, i.e., if the real value of one's assets or balances increases, then consumption propensities should increase even if income stays constant. In Japan too, there are some empirical evidences to support this proposition (Shiba 1979). Although the debates on Japanese high savings rates have been lively as mentioned in Chapter 2, and there are a few scholars who would argue otherwise, we assume here that saving propensities are influenced by macro growth rates (gy) and asset holdings.

For wage earners, assets are usually limited to owner-occupied housing stocks and deposits in financial institutions. Other means of holding assets were scarce due to the underdeveloped financial market. We also have to disregard deposits as assets influencing savings behavior, due mostly to the data problem and lack of past empirical research. Thus, the saving propensities (s_j) for urban wage earners are

$$s_j = s_j(gy, Q_{UH}) \qquad j = 1,2,3$$

and for rural residents

$$s_5 = s_5(gy, Q_{RH})$$

$$\frac{\partial s_j}{\partial (gy)} > 0 \quad , \quad \frac{\partial s_j}{\partial Q_{UH}} \; , \; \frac{\partial s_5}{\partial Q_{RH}} < 0$$

For convenience, only people in the income class 4 (capitalists) hold land for speculative purposes and

$$s_4 = s_4(gy, Q_{UH}, \frac{p_T T}{p})$$

where p is the GDP deflator and T is the amount of land held for speculation purposes. '$\dot{gy}$' is included in the argument because of the adjustment lag of consumption to the rapidly expanding income claimed by many scholars (Ohkawa and Rosovsky 1973, Shinohara 1970, among others). Although, as Williamson and de Bever (1978) point out, this argument is too *ad hoc* and convenient, the strong econometric results make it difficult to exclude this variable in this simple way of endogenizing saving propensities.

One final, and minor, change in this version of the model is to use a labor supply function in agriculture. This supply was assumed fixed period by period in the base version of the model. As more and more young siblings move out of agriculture, however, the older parents or females who would not normally be working in agriculture full time were forced to work. Thus, it is not so reasonable to assume predetermined labor force growth rates. We, therefore, assume here

$$ul_8 = pul_8 \; f\left(\frac{ya}{p_8}\right)$$

where subscript 8 denotes agriculture and

ul = unskilled labor

pul = potential labor

$f\left(\frac{ya}{p_8}\right)$ = logistic function

This formulation does not change the results qualitatively, but quantitatively some changes become less rapid, e.g., the improvement of the agricultural terms of trade.

APPENDIX 4 TO CHAPTER 3

HOW THE PROGRAM WORKS

A. SOLUTION ALGORITHM

The static version of the base models is solved in the following way.

(1) Guesstimate the domestic price vector (the initial value is the solution of the last period).

(2) Compute the value-added price vector, the purchaser's price vector, and the consumer's price vector.

(3) Compute the agricultural income given the value added price and factor endowments of the agricultural sector.

(4) Solve the wage determination mechanism to get all the nominal unskilled labor wages given the agricultural income and consumer's price indices.

(5) Compute the unskilled labor demand in all sectors given the wage vector and other fixed factors (Sector 4 needs iteration).

(6) Compute the supply vector given all factor demands and endowments.

(7) Compute the income of all income classes given the supply and price vectors.

(8) Compute the consumption demand.

(9) Compute the export demand.

(10) Compute the investment demand (only in NC)

(11) Compute the intermediate input demand.

(12) Compute government accounts.

(13) Sum up all demands.

(14) If the total demand for each sector equals its supply, program ends, if not a new guesstimate on price vectors must be made and go back to (1).

The above steps (1) to (14) constitute the program to solve the static solution. The convergence check at (14) is done by examining if the sum of the squares of excess demand of each sector is close to zero, i.e., the solution is obtained if

$$F(p) \leq \varepsilon$$

where

$$F(p) = \sum_{i=1}^{n+m} [D_i(p) - S_i(p)]^2$$

and

n = the number of sector goods to be cleared

m = the number of factors to be cleared

$D_i(p)$ = the demand for goods (factor) i

$S_i(p)$ = the supply of goods (factor) i

$\varepsilon = 1.0 \times 10^{-8}$ *

---

*After each 20 iterations, ε is multiplied by 5 to get the solution quickly.

Any updating of the guesstimates of the price vector (p) is done by using the Marquardt (1963) method, which is a modified Gauss-Newton method. Taking

$$f_i = D_i - S_i$$

$$J = \text{Jacobian of } f \quad (J_{ij} = \frac{\partial f_i}{\partial p_j})$$

$$H = \text{Hessian of } F \quad (H_{ij} = \frac{\partial^2 F}{\partial p_i \, \partial p_j})$$

The new guess of p at $(n+1)^{th}$ iteration is made by

$$p^{(n+1)} = p^{(n)} + \Delta$$

where

$$\Delta = -2 \{[H^{(n)}]^{-1} + \alpha^{(n)} I\}^{-1} \cdot [J^{(n)}]^{1} f^{(n)}$$

the number in parentheses showing the number of iteration. $\alpha^{(n)}$ is the scaling parameter devised by Marquardt.

The FI closure can get to the solution within 20 iterations and quite often within 10 iterations. The NC and IX solutions, however, sometimes took more than 20 iterations. The CPU time for each solution is about 30-40 seconds* on Unix VAX 11/780.

B. PRINTING OUTPUT

When the solution is obtained, we proceed to:

(15) Given the solution price vector, compute all the relevant endogenous values and print.

*Increasing the number of sectors (number of excess demand equations) increases the time require quite rapidly. 12 sector models take about 60-70 seconds CPU time to solve.

C. UPDATING THE INPUT

After the output has been printed out, we then proceed to update the input files*

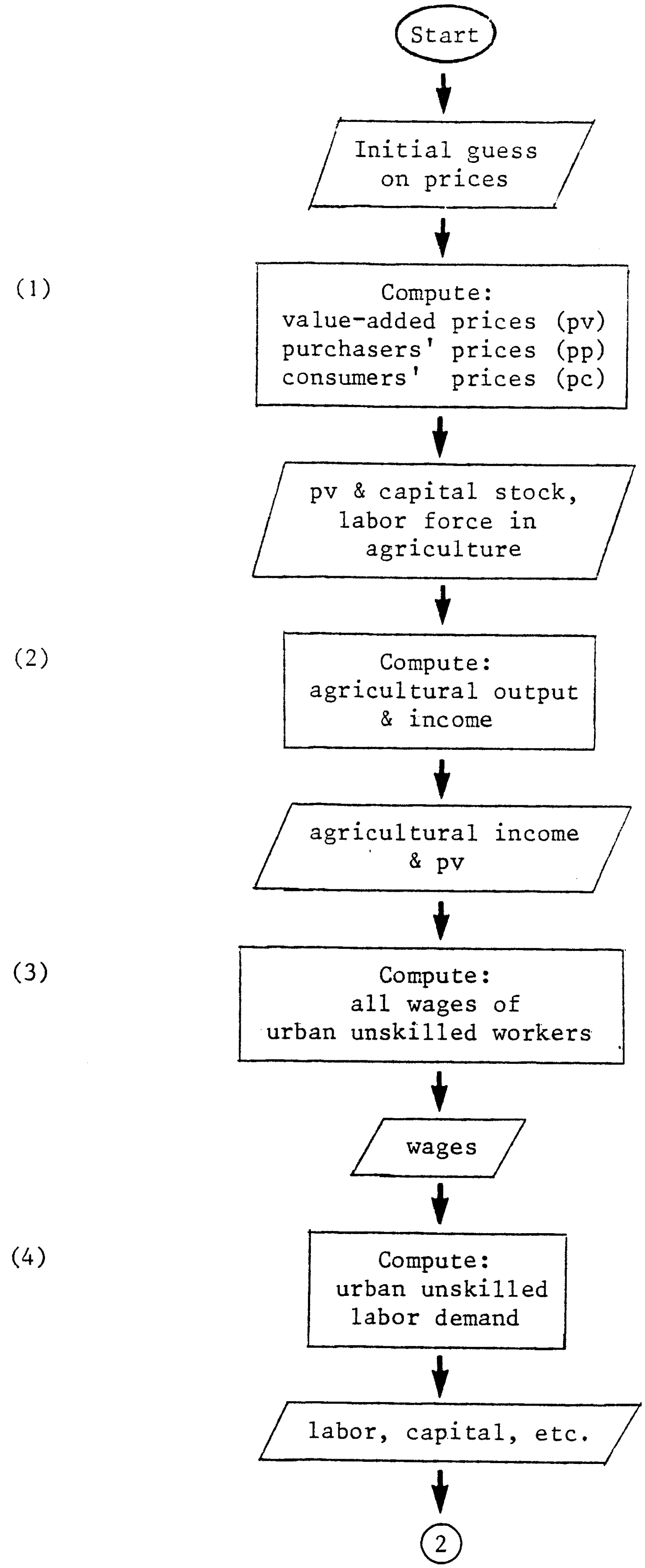
(16) Given the solution prices, wages, and total demand, compute expected labor and capital costs and expected next period demand.

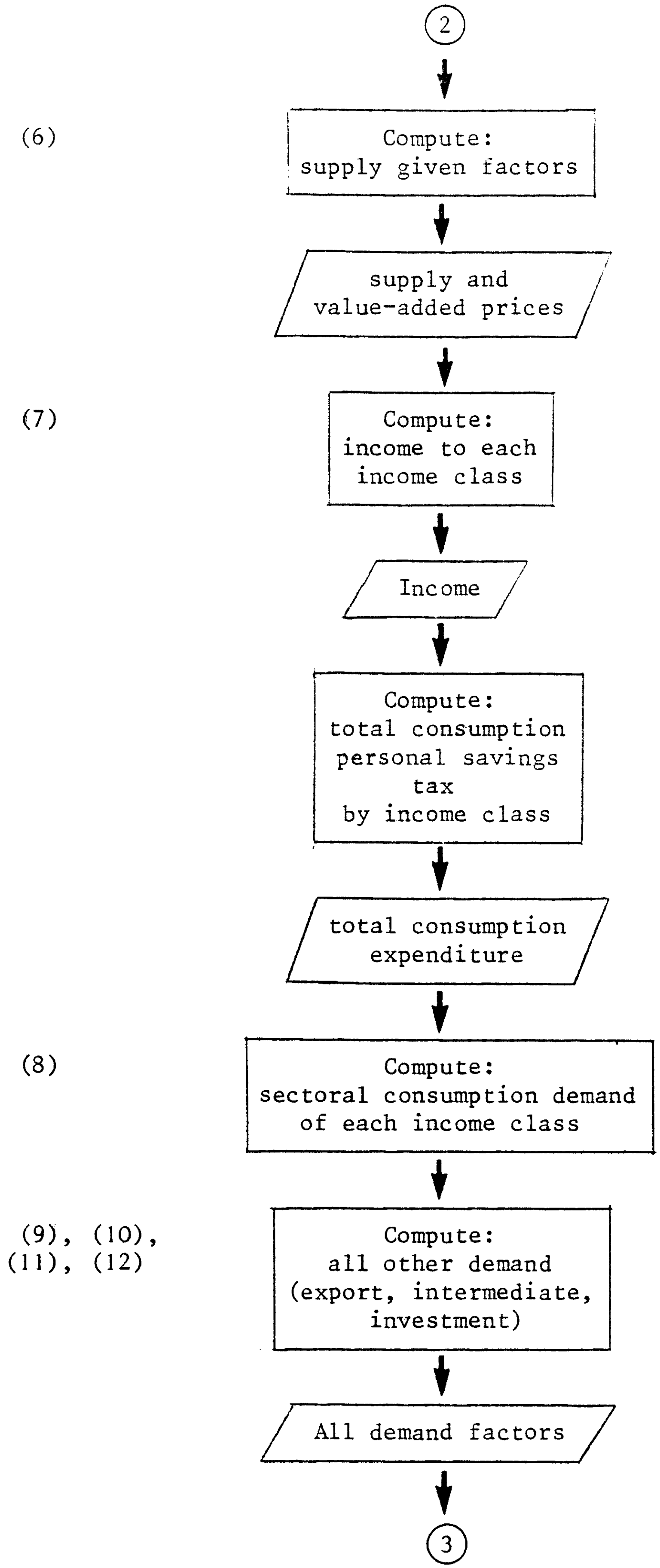
(17) Compute the animal spirit parameters for each sector and for each kind of capital and obtain the following year's desired investment.

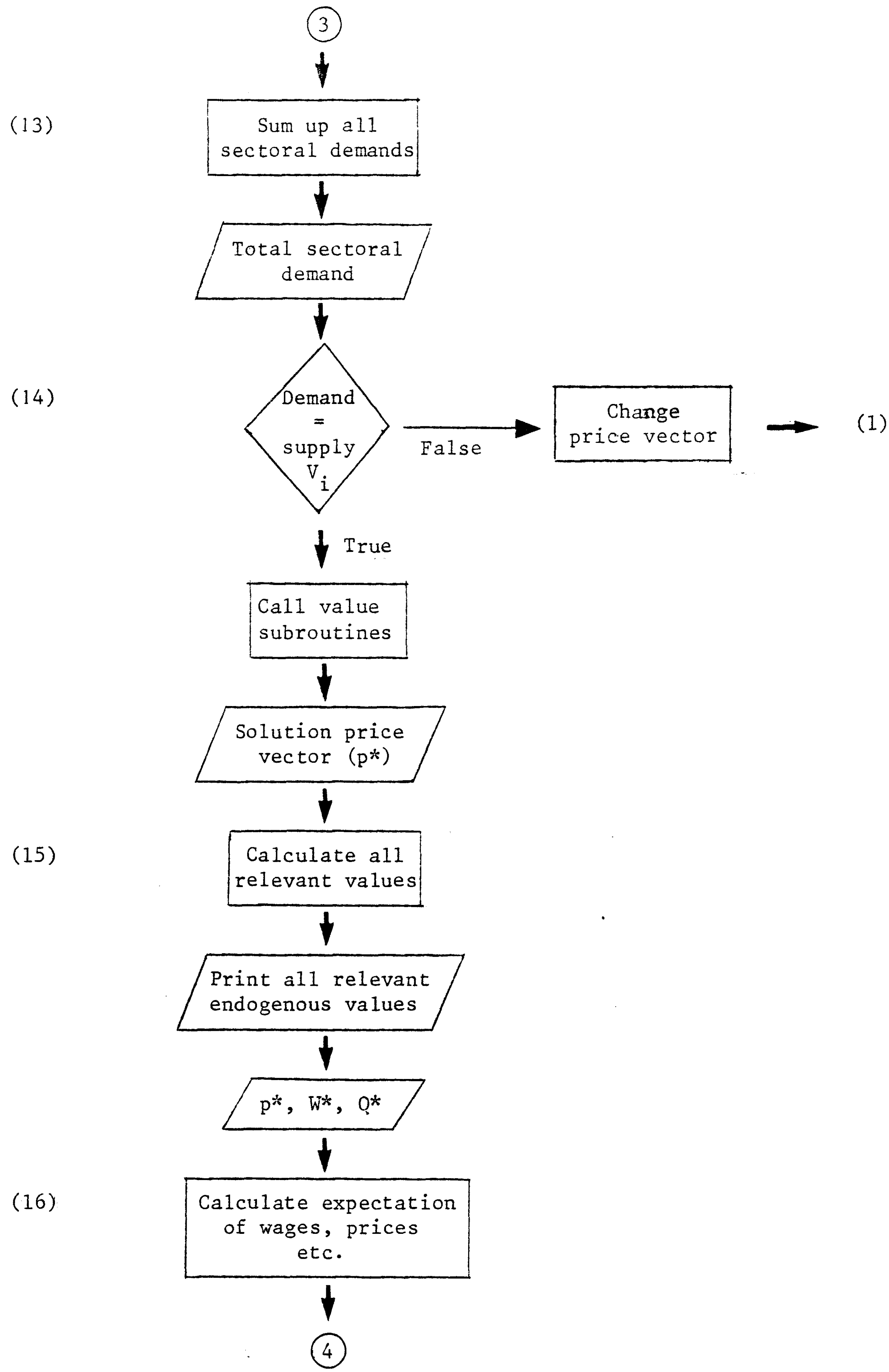
(18) Using exogenously given data and the solutions of this period, update all the values that are exogenous to the solution algorithm in (A) above, i.e., urban and rural populations, sectoral capital stocks, urban and rural labor forces, taking into account the period's investment and rural urban migration, etc.

The following simplified flowchart describes this process.

*This is a combination of Stages I and II from Adelman and Robinson (1978).

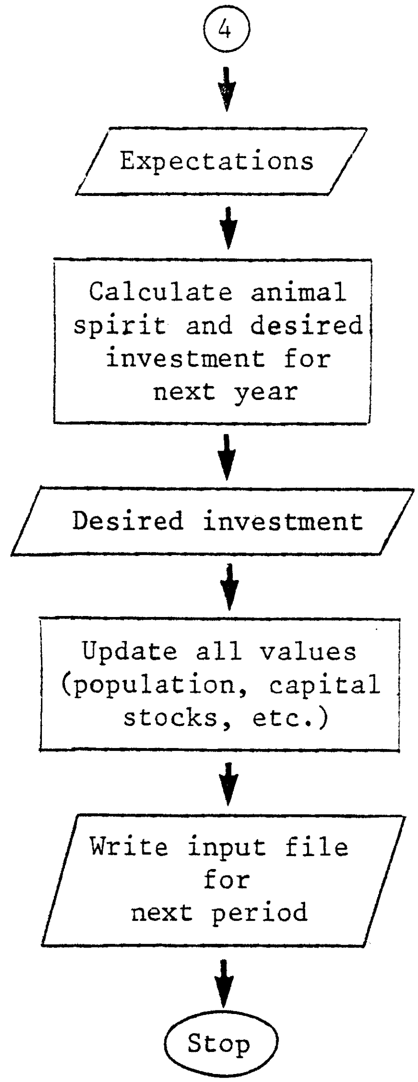

Start
Initial guess on prices
(1)
Compute:
value-added prices (pv)
purchasers' prices (pp)
consumers' prices (pc)
pv & capital stock, labor force in agriculture
(2)
Compute:
agricultural output & income
agricultural income & pv
(3)
Compute:
all wages of urban unskilled workers
wages
(4)
Compute:
urban unskilled labor demand
labor, capital, etc.
2


2
(6)
Compute:
supply given factors
supply and
value-added prices
(7)
Compute:
income to each
income class
Income
Compute:
total consumption
personal savings
tax
by income class
total consumption
expenditure
(8)
Compute:
sectoral consumption demand
of each income class
(9), (10),
(11), (12)
Compute:
all other demand
(export, intermediate,
investment)
All demand factors
3


(3)
(13)
Sum up all sectoral demands
Total sectoral demand
(14)
Demand = supply V_i
False
Change price vector
(1)
True
Call value subroutines
Solution price vector (p*)
(15)
Calculate all relevant values
Print all relevant endogenous values
p*, W*, Q*
(16)
Calculate expectation of wages, prices etc.
(4)

(17)

(18)


4
Expectations
Calculate animal spirit and desired investment for next year
Desired investment
Update all values (population, capital stocks, etc.)
Write input file for next period
Stop

CHAPTER 4: BASE SOLUTIONS

In this chapter, the 10-year solutions of three different closures of the model are described. The first section describes the FI solution in detail because, for reasons stated later, this solution looks superior to the results of the other two closures: the neoclassical (NC) and the hybrid of NC and FI, called IX. The comparison of the NC and IX solutions with the FI appears in the second section of this Chapter.

4.1. BASE REFERENCE SOLUTION OF THE MODEL

In this section, the 10-year solution of the FI closures is described in detail. This solution will be the reference for the rest of this chapter. The GDP in constant 1965 prices grew in Japan at the rate of 10.7 percent per annum during the 10 years starting in 1960, whereas the model shows an annual growth rate of 10.3 percent for real GDP*. Sectoral growth rates of production are shown in Table 4.1. The growth rates are somewhat underestimated in the modern manufacturing sectors and overestimated in the traditional manufacturing and service sectors. Table 4.2 shows similar results for labor employment. The large discrepancy between model results and actual figures in sector 4 (mining), shows the incapability of this kind of model to replicate the history of those sectors where policy variables played major roles. The

*Because we use 1960 as the base year and prices in the model are all 1 in that year, the "real GDP" referring to the model output should be understood as the GDP in 1960 prices.

Table 4.1. Average annual growth rates (in percent).

Sector	Base Solution	Actual
1	13.2	15.1
2	14.9	16.7
3	10.8	8.2
4	4.2	2.0
5	11.8	11.2
6	12.0	11.6
7	11.2	8.9
8	3.0	2.1

Table 4.2. Average annual growth rates of sectoral labor employment (in percent), 1960-1969.

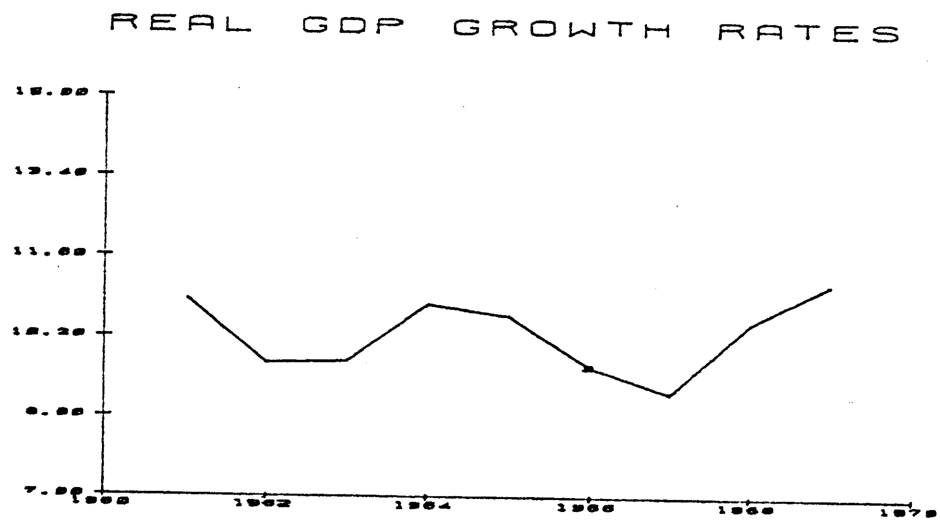
	Base solution		
Sector	Unskilled	Skilled	Actual total employed
1	-0.8	5.3	3.1
2	3.4	6.0	5.2
3	4.4	3.0	4.1
4	1.8	n.a.	-8.5
5	6.2	5.8	8.1
6	7.7	6.8	6.0
7	7.1	7.4	7.6
8	-2.2	n.a.	-2.2

Japanese government, seeing that there was not much future for Japan's mining sector and a potential for cheap imported oil, was instrumental in closing many coal mines which encouraged the labor force in that sector to shift to other more productive sectors. The model, where policy aspects are insufficiently endogenized, is unable to capture this and just shows that mineral resources in Japan got less and less, raising the cost of exploiting new resources. This is why the model shows a 1.8 percent increase in employment instead of an 8 percent decrease in the labor force. We disregard this for the moment, however, because the mining sector is a very small sector in terms of both employment and output (1.3 and 1.7 percent of the total in 1960, respectively).

Table 4.3 compares the growth rates of trade variables in the model with the actual figures. Exports are fairly well replicated. The tendency of the model to overshoot somewhat the actual value in sector 3 is counteracted by the opposite tendency of sector 1. Overall the amount of exports is almost exactly the same as the actual value. Similar things can be said with regard to imports, below actual values for manufacturing, but above for raw materials (sectors 4 and 8).

It is suspected that some of the discrepancies between model outputs and actual values can be attributed to the use of constant intermediate input-output coefficients for 10 years, unless the parameter values chosen or functional specifications are completely unrealistic.

Next we turn to the year-to-year values of some model outputs. Figure 4.1 shows the annual growth rates of real GDP, and unskilled labor share of GDP. Figure 4.2 shows the historical values for real GDP growth rates and changes in the labor share.



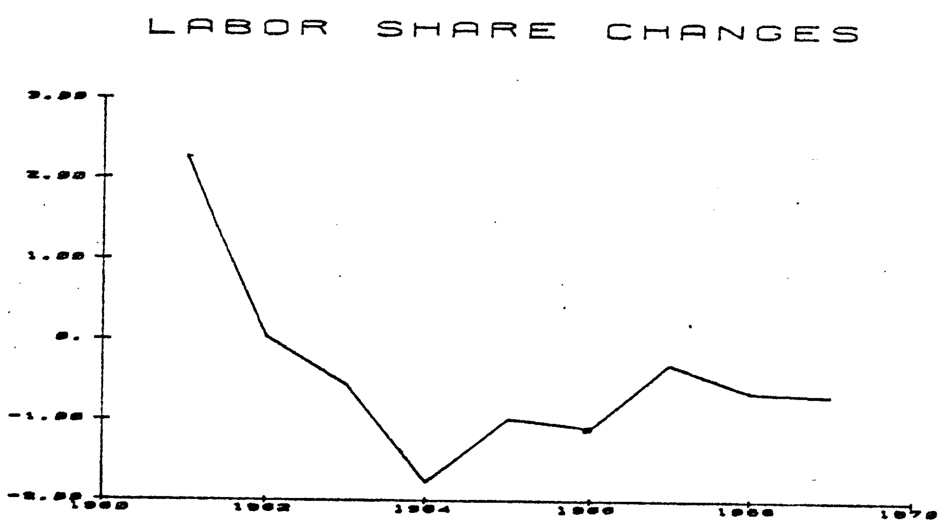


Figure 4.1. Real GDP growth rates and rates of change in unskilled labor share in FI base run (in percentage).

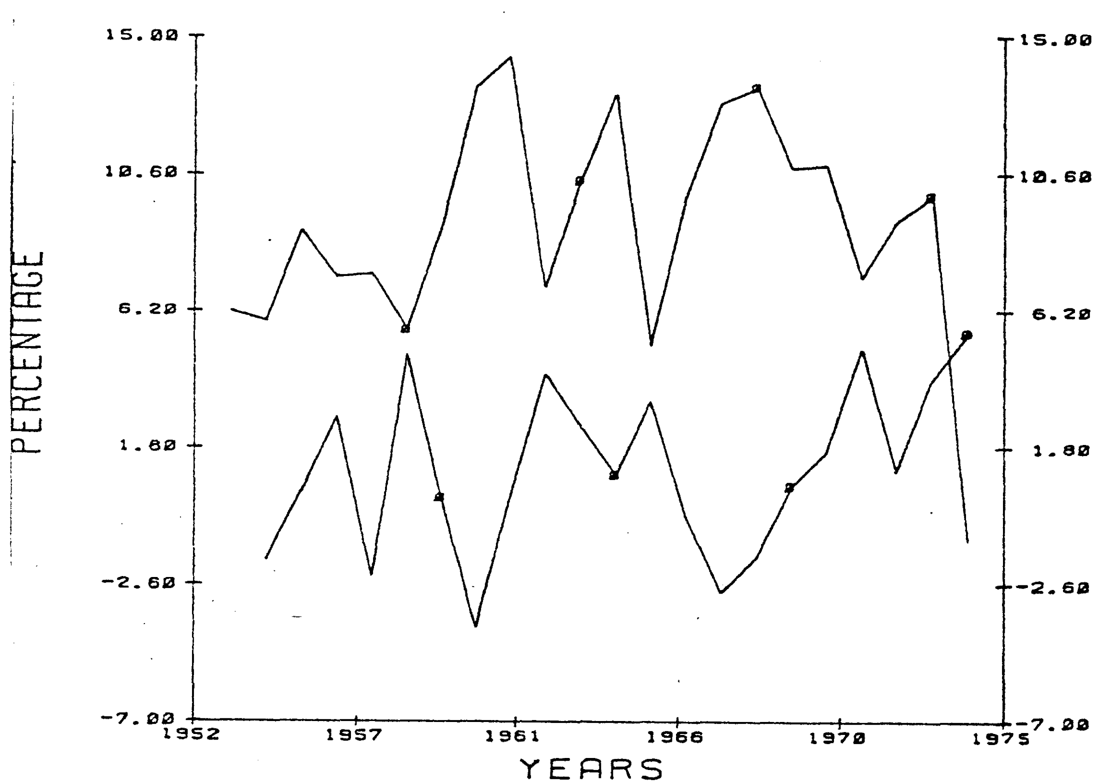


Figure 4.2. Historical values of real GDP growth rates and changes in labor share.

Source: Annual Report on National Income Statistics.

Table 4.3. Comparison of growth rates of model trade variables with the actual figures (in percent).

		Model	Actual
Exports of sector	1	18.8	20.1
	2	23.7	23.2
	3	11.7	8.5
Imports of sector	1	13.1	14.1
	2	10.1	15.5
	3	11.9	16.5
	4	17.8	15.7
	8	12.3	11.8

In general, the unskilled labor share has a declining trend (-0.59 percent per annum), and moves in opposite directions to the real GDP growth rates, i.e., the faster the economy grows, the less share the unskilled labor receives. The major reason for this happening in the model is the less-than-unity elasticities of substitutions between the unskilled labor and the composite capital that we have elected to use.

When the economy grows faster, it does so in FI closure by employing more unskilled labor whose supply is perfectly elastic. The faster growth means, therefore, capital shallowing in the short run. With limited elasticity of substitution, the labor share has to decrease. As we discuss in Chapter 5, higher elasticities of factor substitution will have a completely different distributional outcome than this one. According to Minami and Ono

(1981), however, the labor share moved counter-cylically as in Figure 4.2. which conforms to the present model outputs. One could naturally argue that this phenomenon of the opposite movement of GDP and labor share growth in reality has been caused by completely different factors, e.g., lags in wage adjustment to growth. Such institutional explanations, however, are too *ad hoc* and with the existence of "bonus"* payments which enable the employers to be responsive to market conditions, it is difficult to believe that wage lags have been so consistently conspicuous. In any case, at least from this distributional aspect, it is difficult to refute the model as irrelevant. The first years of the simulation, however, exhibit a high GDP growth and higher labor share growth. This is because the base year chosen, 1960, was a year with high growth rates. For this year we took the historical values of fixed capital formation that are higher than most other years relative to the stocks of capital. As a result, the second simulated year exhibits strong capital deepening, and an improved functional distribution in the second and (moderately) the third years. Essentially this is what happens throughout the simulation with versions of macro closure where physical capital stocks grow relatively fast whereas the labor force growth is rather limited.

Shares of skilled labor force increase consistently throughout the ten years because the total composite capital share increases and because the quantity of skilled labor stock increases less rapidly than the rest of the capital stocks with similar factor-augmenting rates of technical progress.

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*It is a well spread institution in Japan that employers pay a "bonus" twice a year according to the employee's productivity and profit rates of the company. This can be quite a substantial part of wage income, worth five to 20 months contract income. Mizoguchi et al. (1980) state that this is the major cause of the inequality in size distribution of income in post-war Japan.

As a result, capital owners' share decreases at the average annual rate of 1.0 percent.

In the actual history, the labor share, although moving counter to the growth rates, had a slight increasing trend (Minami and Ono) during the 1960s after a sharply declining trend in the 1950s. Although this seems to contradict with the declining labor share in Figure 4.1, it should be noticed that the figure is only for unskilled labor. If we take both skilled and unskilled labor shares, the sum does produce a slight increasing trend of the labor share. The question, then, is whether these disaggregated labor shares behaved as the model output show in the actual history, i.e., a decreasing unskilled share and an increasing skilled share. There is no readily available data set or study in this regard. Studies on wages definitely show that the skill-unskilled wage gaps narrowed during the 1960s (e.g., Minami 1973, Chapter 8), but such results do not say anything about shares. A very crude check on this aspect, however, seems to say that the disaggregated labor shares did indeed move as they do in our model. See Table 4.4—it shows the percentage changes in labor force sizes and average nominal wages by occupation between 1960 and 1970. Regrettably, the occupational wage data are available only for production process workers, and the average of managerial, administrative, and clerical workers.

If we assume that only managers and administrative workers are skilled workers, and that average nominal wage increase for them was in fact 180 percent, than their total wage bill increased 494 percent in 10 years. The nominal national income increased 346 percent during the same decade. The skilled workers definitely increased their share in the national income. Even if we assume that clerical workers are also skilled, which is not quite a realistic assumption but more consistent with the data here, the wage bill

Table 4.4. Percentage changes of labor force, wages, and wage bill by occupation.

	Share in urban labor force in 1970	$\frac{\Delta L}{L}$		$\frac{\Delta W}{W}$	$\frac{\Delta WL}{WL}$	
Managers and administrative workers	5 %	112	72	180	494	381
Clerical workers	17 %	63			n.a.	
Sales workers	15 %	32		n.a.	n.a.	
Production process workers and laborers	39 %	32		222	326	

Source: Japan Statistical Yearbooks.

for the skilled increases by 381 percent, a still higher value than the national income growth rate. The wage bill for production process workers increased, however, by only 326 percent, less than the growth of the nominal national income. As long as we can assume these production process workers represent the unskilled workers in general, we can say that the unskilled labor share had a decreasing trend in the 1960s despite the narrowing of wage gaps. This is a very rough method of examination, but it certainly has a clear message within its limitation.

The average rates of annual increases in nominal wages are shown in Table 4.5. The relative wage rates (sector 1 unskilled wage 1.0) for 1960, 1964 and 1969 are also in the same table. From these we can see that all unskilled wages except for the mining sector become closer toward 1. Japan definitely experienced a narrowing of the gaps between the different sector wages during this period (see Minami 1973, Mizoguchi et al. 1980, Minami and Ono 1981, and Ono 1973). Due to the peculiar aspect of the mining sector

Table 4.5. Average annual growth rate of nominal wage increase and the relative ratios.

Sector	Base solution		Relative wages for unskilled		
	Unskilled	Skilled	1960	1964	1969
1	5.1	6.7	1.00	1.00	1.00
2	6.8	11.7	0.91	0.98	1.00
3	9.9	18.1	0.54	0.65	0.77
4	7.4	n.a.	1.02	1.11	1.20
5	9.2	15.5	0.67	0.78	0.89
6	4.9	6.9	1.11	1.11	1.09
7	10.3	10.0	0.48	0.19	0.70
8	16.9	n.a.	0.17	0.24	0.42

as stated above, we disregard this sector and discuss the overall trend of the other sectors.

The relative growth rates of nominal wages of unskilled labor conform to the actual values. The growth rates of skilled labor wages for sectors 3 and 5, however, grow much faster. This is because proprietors (self-employed) and skilled labor are assumed to be perfect substitutes for each other in production functions. The existence of large pools of self-employed proprietors in these sectors pushes down the skill investment, thereby increasing the wages for skilled labor to such high levels.

The wage dualism decreases in this run naturally because urban wage gaps narrow. Not only the urban gaps, but also the urban-rural gap decreases. The urban wage dualism is measured by the ratio of the weighted average of modern sectors (sectors 1, 2, and 6) wages (W_M) to the weighted average of traditional sectors (sectors 3 and 7) wages (W_T). Weights are employment shares. This measure decreases from 2.02 to 1.47. The measure between the rural and urban traditional sector wage defined by (W_T/W_A) also decreases from 3.00 to 1.72*. These are consistent with actual history.

We now take a look at a measure for welfare. We literally take the belief that consumption functions usually have underlying (direct or indirect) utility functions. The linear expenditure system (LES) that has been employed has the following utility functions

$$U = \prod_{i=1}^{n} (cd_i - gcd_i)^{\beta_i}$$

where

U = utility level

cd_i = consumption of sector i goods

gcd_i = subsistence consumption of sector i goods

β_i = marginal propensity to consume sector i goods

We assume that the actual utility level is a montonic transformation of this value. The growth rates of the value U for each income class appears in Table 4.6. This value is often used to measure some type of satisfaction level of the people concerned, however, whether or not we should really believe such values reflect monotonic transformations of the utility level is up to the reader. We decided to use this measure mainly because there is no other index that is definitely superior in measuring the welfare level in such economy-wide models.

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*Note that this measure has agricultural wage as the denominator. If we use the average income of agricultural workers, the same value moves from 1.125 to 0.645, i.e., agricultural average income is higher than the wage level of traditional workers.

Table 4.6. Average annual growth rates of per capital utility levels (in percent).

Sector	Growth rates
1	11.2
2	31.1
3	16.1
4	13.9
5	22.7

Of course, however, these utilities are in some sense absolute, because they are based on the consumption of persons concerned and levels of consumption of others do not have any influence on these utilities. But in the development literature, relative equality of income distribution has been discussed intensively, with a belief that less extreme distribution of income is somehow better from the socio-political and perhaps even the economic efficiency point of view. We therefore examine here how size distribution of income changed over time. Regrettably again, there is no single index of distribution that is better than others in all aspects. We therefore examine four measures of distribution of income of total population and that of urban residents. The four measures are Atkinson's measure* with $\varepsilon = \frac{1}{2}$, called $A(\frac{1}{2})$, Atkinson's measure with $\varepsilon=2$, $A(2)$, Theil's measure**, T, and Gini coefficient, G. A(2) and G tend to catch the changes

*

$$A(\varepsilon) = 1 - \left[\sum_{i=1}^{n} \left(\frac{y_i}{\bar{y}} \right)^{1-\varepsilon} \cdot x_i \right]^{\frac{1}{1-\varepsilon}}$$

Smaller $\varepsilon(\geq 0)$ tends to emphasize higher income brackets, and higher ε tends to emphasize the poorer people -- where y_i=income share of group i, x_i= population share of group i, $\bar{y}$=average income. Within group inequality is disregarded.

**

$$T = \sum_{i=1}^{n} y_i \log \left(\frac{y_i}{x_i} \right)$$ (notations are same as in the above footnote).

in distribution of income of those at modal points or lower, whereas the other two tend to be sensitive to the changes in the upper tail of income distribution. Table 4.7 shows these indices. The close fit with the real GDP growth rates are striking in all indices. When the real GDP grows fast, the inequality measures increase.

There is little change in overtime patterns of distribution between urban and total populations. But in between two sets of measures with different emphases there is a clear distinction, i.e., in between A(2) and G on one hand, and A($\frac{1}{2}$) and T on the other. The first set, which emphasizes the modal and lower distribution, is quite stable or declining after the initial rapid decrease. The second set, however, shows a distinctive increasing of inequality. This set is sensitive to changes in distribution of higher income brackets. This means that there was an overtime improvement of income distribution at lower income brackets, but that it deteriorated at higher income brackets. Indeed Lorenz curves would show these trends exactly (Figure 4.3).

Mizoguchi et al. (1980) compute different sets of inequality measures for post World War II Japan*. Their Gini coefficients of employee households show an overall trend of decline in the 60s, after an increasing trend in the 50s. A year-to-year observation shows (Figure 4.4) in the 60s, the Gini coefficient and the real GDP growth rates moved together fairly well as our model output does, until around 1967. In the 50s it is more ambiguous, but if we take the three-year moving averages of both Gini coefficients and

*We should realize that Mizoguchi et al. (1980) is the result of detailed data studies from different surveys of expenditure, savings, and employment. To compare their results with outputs of general equilibrium models might be doing them an injustice. Care should be taken to delimit the comparison only to the general trends.

Table 4.7. Distribution indices of base runs (FI).

	Total population				Urban only			
Year	A $\varepsilon = \frac{1}{2}$	$\varepsilon = 2$	T	G	A $\varepsilon = \frac{1}{2}$	$\varepsilon = 2$	T	G
1	0.207	0.358	0.601	0.408	0.239	0.426	0.660	0.464
2	0.184	0.326	0.525	0.376	0.217	0.397	0.592	0.439
3	0.180	0.319	0.514	0.371	0.213	0.389	0.579	0.432
4	0.182	0.318	0.526	0.369	0.216	0.388	0.595	0.429
5	0.192	0.327	0.564	0.376	0.227	0.396	0.638	0.4344
6	0.198	0.330	0.587	0.377	0.233	0.398	0.664	0.4335
7	0.200	0.330	0.599	0.373	0.237	0.399	0.682	0.431
8	0.198	0.325	0.595	0.368	0.233	0.391	0.675	0.420
9	0.205	0.331	0.626	0.372	0.240	0.394	0.707	0.418
10	0.214	0.336	0.669	0.374	0.250	0.397	0.753	0.416

A = Atkinson's measure

T = Theil's measure

G = Gini coefficient

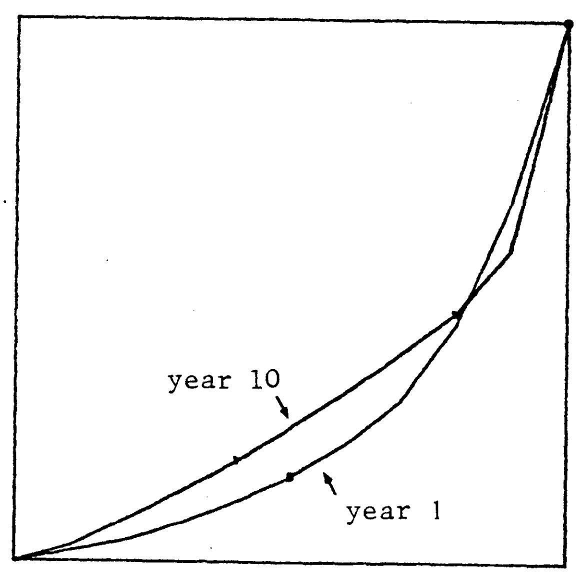

Figure 4.3. Lorenz curves of FI run (year 1 and year 10).

growth rates, we can observe that two sets of indices moved really together, again, until around 1967. Another interesting thing to note in Mizoguchi et al is that all the indices behave similarly until around 1967. After that time, indices that include all data shows stable or increasing inequality trends, whereas indices that look at only employee households have decreasing trends. The log-variance of the total households increases most in the second half of the 60s. Considering that the log-variance is another measure of inequality that tends to be sensitive to the upper tail of the distribution, all of these tend to show that in actual history the general inequality level of size distribution of income around the modes decreased, but that the distribution of income at the upper end may have turned more unequal*. This is another trend that our model picks up. Whereas the danger of naive comparisons of outputs between two studies whose methods are vastly different is fully acknowledged; it is also interesting to note that these two different methods produce (crudely) similar results.

Agricultural terms of trade defined by the ratio of agricultural goods' price to the weighted average of urban prices improve monotonously and significantly. This is exactly what happened (Figure 4.5) in history during this time period. The price level defined by the GDP deflator in the model increases about 50% in the ten years. This is again almost exactly what happened in history (50.7%).

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*If we look at the share of net profits or corporate retained earnings in the national income, these decrease in the early 1960s but increase very rapidly in the second half of the 1960s. This also corroborates Mizoguchi et al.'s findings of the behavior of the long-variance.

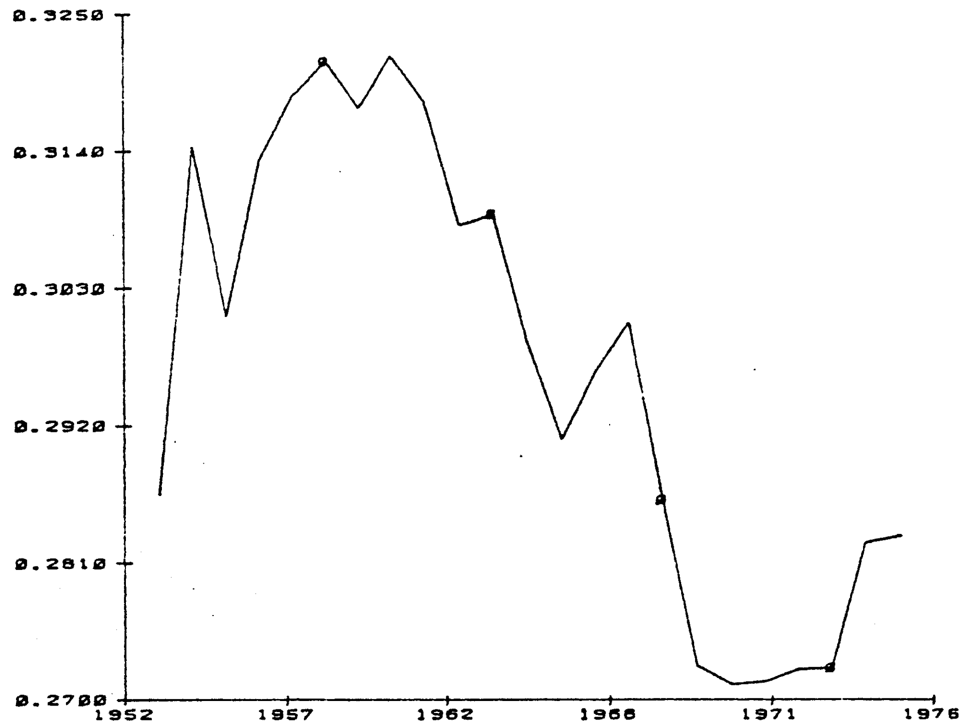

Figure 4.4. Historical values of Gini coefficients. Source: Mizoguchi et al. (1980).

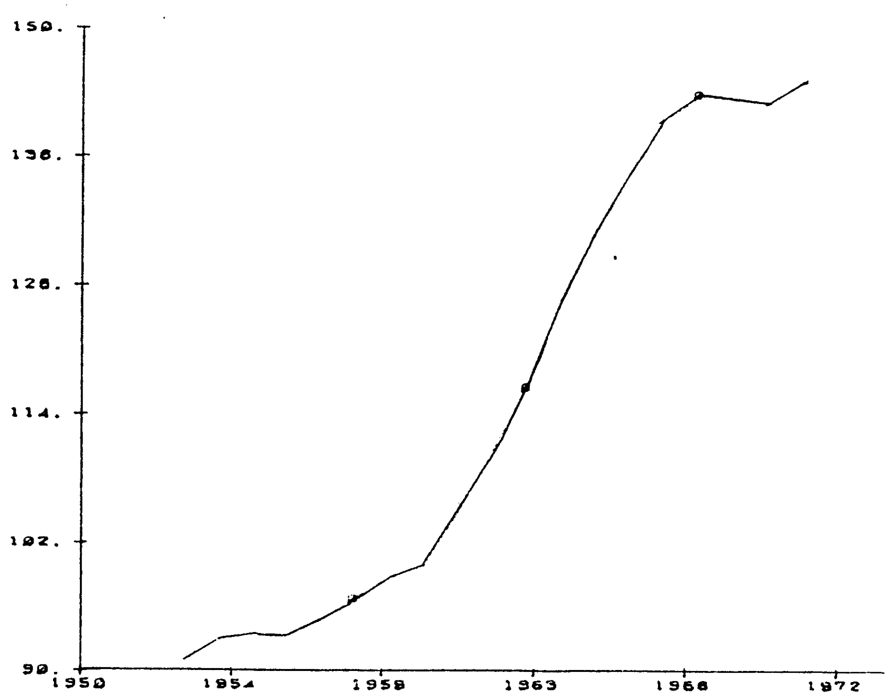

Figure 4.5. Historical values of agricultural terms of trade.

The overall performance of the model in replicating Japanese history is not striking. The general trends are captured, but not very precisely. A better replication of the history is, however, possible by jiggling the technical progress parameters, the investment function parameters, and the elasticities of factor substitution. It will be a time consuming and monotonous process. The solution stated above has been chosen as the reference because "qualitative" results that come out of the model seem to be very consistent and changing a few percentage points in the growth rates of any variable does not seem to change the qualitative results at all.

4.2. BASE SOLUTION COMPARED WITH OTHER MACRO CLOSURE SOLUTIONS

In this section, two ten-year solutions using different closure rules are compared with the base reference solution (FI). One closure (IX) uses the same investment specification as FI, but it assumes that urban labor supply is limited; hence, it is assumed that the urban wage level is endogenous. Another closure (NC) assumes, further, that the investment is determined by the savings available in the economy. Comparisons with completely the same specifications, however, have been impossible because of the spirally accelerating nature of the NC closure. NC has endogenous investment that is constrained by the amount of total savings. The total savings are the sum of private savings, government savings and foreign savings. Higher investments tend to lower the domestic prices in the next period and this decreases foreign savings by increasing exports and decreasing imports in the next period, which pushes down investment. This occurs because change in trade deficit is fully transmitted into the change in foreign savings, whereas change in domestic income caused by change in trade deficit is not:

a part of export income is consumed. Lower investment decrease the price further taking more foreign savings away from the economy. Of course, the appearance of this outcome and how long it lasts depend partly on the values of trade elasticities. In Japan (and in this model), the pressure for exports has been quite strong, and consequently a rapid spiral decline results from the simulation. By the sixth year of the simulation the real GDP growth rate becomes negative: a truely unrealistic outcome. Changing the trade elasticities enables us to evade this problem, but it is not the real solution.

The real problem here is the lack of monetary aspects in the model. We have endogenized trade deficits, but their monetary repercussions are left out. Continued trade surplus would actually increase *ceteris paribus* the money base of the economy by accumulating foreign reserves. This could give different price and interest rate profiles.

In anticipation of the future inclusion of monetary aspects, therefore, we have decided to "rescue" the NC closure from the problem of extremely large negative foreign savings by using a new numeraire; the general price level. The general price level can (and in the future should) be related to the price of money that comes from the interaction of money supply and money demand. As a start, however, instead of fixing the urban unskilled wage level as a numeraire, we have kept this price level exogenous, i.e.,

$$\sum_{i=1}^{n} \Omega_i \, p_i = C$$

where Ω_i is the base year GDP shares of sector i=1,...n, and C is an exogenous variable kept constant or varied by historical values of the general price level. In addition,

$$w_i = \omega_i W$$

where ω_i is the solution of the wage determination mechanism and W is the endogenous wage level.

At first sight it appears strange that changing the numeraire alters the solution of a "general equilibrium" model. It should be noted, however, that the model is not homogenous of degree zero with respect to commodity prices and factor returns because of the uncleared foreign exchange market with the Armington specification. Here we need to keep a fixed exchange rate because the market is not cleared, otherwise the model would be indeterminant*. With a fixed exchange rate, multiplying all other prices by the same factor changes the real part because of the volume of export and imports have to change. Care should be taken therefore in interpreting the results of this section: NC has a different numeraire than either FI or IX. The overall price level of NC is controlled, where as for the other closures it is not. With this much warning we will now proceed.

The average annual real GDP growth rates are for FI (the base reference solution) 10.3 percent, for NC 9.6 percent, and for IX 9.8 percent. The relative values in the last (tenth) year of the simulation for NC and IX appear in Table 4.8. For example, the first column of Table 4.8 shows the tenth year values of the sectoral outputs of NC and IX divided by the same value for FI. Because the first year solutions are almost identical in all three closures, the table shows how things can differ in different closures over

*Letting the exchange rate market clear, the model becomes completely homogenous.

Table 4.8. Macro closures compared.

		Output	Employment of Unskilled	Skilled	Equipment & machinery*
1	NC	0.974	1.076	0.917	0.877
	IX	0.919	0.856	0.958	0.968
2	NC	0.889	0.849	0.984	0.901
	IX	0.918	0.876	0.986	0.974
3	NC	0.942	0.905	0.996	0.944
	IX	0.927	0.857	0.988	0.982
4	NC	1.253	1.831	—	0.913
	IX	0.870	0.727	—	0.927
5	NC	0.658	0.405	1.017	0.898
	IX	0.951	0.910	0.988	0.980
6	NC	0.968	1.032	1.025	0.935
	IX	0.942	0.824	0.986	0.985
7	NC	0.864	0.778	1.020	0.951
	IX	0.899	0.823	0.995	0.984
8	NC	0.912	1.017	—	0.800
	IX	0.922	1.011	—	0.810

		Export	Import	Consumption
1	NC	1.148	0.480	0.821
	IX	0.978	1.021	0.929
2	NC	1.718	0.495	0.857
	IX	0.905	0.966	0.910
3	NC	1.557	0.794	0.851
	IX	0.871	0.959	0.945
4	NC	—	0.815	0.874
	IX	—	0.951	0.964
5	NC	—	—	—
	IX	—	—	—
6	NC	—	—	0.931
	IX	—	—	0.970
7	NC	—	—	0.959
	IX	—	—	0.924
8	NC	—	1.021	0.942
	IX	—	0.975	0.989

*This moves very similarly to "constructed buildings and structures".

time. We note first that the outputs of the capital goods producing sectors (sectors 2 and 5) grow quite slowly in the NC version, reflecting the reduced investment. The construction sector gets hit hard because this sector good is neither consumed nor traded. The reduction of investment is directly translated as a reduction in the demand for this sector's goods. Sector 2, on the other hand, suffers less than the construction sector. The commodity produced in sector 2 is not only an investment goods, but also a tradeable consumption good. The decline in investment demand is counteracted by relative increases in consumption and export, and the outcome is only an 11 percent decrease in the output of sector 2 as compared to that of FI where the decline in the construction output is 34 percent.

The outputs of NC in the other urban sectors are mostly higher than those of IX. This mostly occurs because of the higher exports and reduced imports in NC. (Recall that even service sectors have indirect demand for exports for transportation, storage, and insurance, etc.) Unskilled labor is allocated accordingly and in sectors 2 and 5 the amount of unskilled labor employed are higher in the IX solution than in the NC. The employment of unskilled labor in the construction sector of NC is again the lowest of all; less than one-half of the same amount in the base (FI) solution. The unskilled labor employment in the other urban sectors of the NC solution are all higher than those in the IX, reflecting the higher export demand, the higher import substitution, and for some inelastic intermediate input demand (e.g., the mining sector) of the NC solution. The unskilled labor forces in sectors 1, 4, and 6 in the NC solution are even higher than those of the FI. For sectors 1 and 6 this is partly because of the assumed wage determination mechanism and several of the demand factors cited above.

The modern sector wages are relatively high and less sensitive to the income level in the rural areas. In the NC solution the nominal agricultural income goes up about as fast as the FI base run. From the wage determination mechanism, the wage gap narrowing occurs in terms of ω, but the insufficient urban demand in general forces the wage level to go down for all sectors proportionately. The nominal modern sector wages, therefore, decrease most relative to the base solution. Hence the results obtained here for sectors 1 and 6.

The unskilled employment of the mining sector (sector 4) goes up even more in terms of percentage relative to the FI solution. This partially reflects the smallness in size of its original employment, but the major reason this happens is that with high export and import elasticities and a high elasticity of substitution assumed between capital and labor, this sector works as an adjusting sector reflecting the tightness of the unskilled labor market. When this market is tight, this sector releases the unskilled labor by importing more goods, and when the market is loose, this sector absorbs more labor by exporting more and importing less.

Physical capital stocks, equipment and machinery, and buildings and structures increase at higher rates in IX than in NC. This is the natural result of the fact that physical capital stock accumulation is completely up to the animal spirits of the investors in the IX solution, whereas accumulation in NC is rather stalled by the decline in the foreign savings. The capital stocks in IX are lower than in FI (the base reference solution) because of the lower expectations of demand growth. This happens despite the fact that higher wages in IX makes the desired capital-output ratios (which we conveniently call the animal spirit parameters) relatively high.

Skilled labor seems to have a somewhat erratic outcome. It is assumed that the equipment and machinery, and skilled labor are close compliments. The levels of skilled labor employment in sectors 3, 5, 6, and 7 in the NC solution are higher than those in IX despite the fact that the quantity of capital stocks are more in all sectors in IX than in NC. This, however, is not at all erratic. Skill investment *increases* as capital stock *decreases* from a certain skill capital ratio*. That is, at a relatively high value of S/K, the marginal return of skill is higher for smaller capital stocks. The skill capital ratio is by assumption very high in sector 6. The other sectors (3, 5, and 7) do not have such a higher ratio. The reason that these sectors behave similarly to the sector 6 is that these sectors have a substantial amount of self-employed proprietors. As stated earlier, these proprietors are assumed to be perfect substitutes of skilled labor in the production functions. Thence, the result of NC; the lower physical accumulation increases the investment in skill.

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*Taking again a two factor case

$$Q = (S^{\rho} + K^{\rho})^{1/\rho}, \text{ then}$$

$$\frac{\partial^2 (rK)}{\partial S \partial K} = A \left[(1 - 2\rho)\left(\frac{K^{\rho}}{S^{\rho} + K^{\rho}} \right) + \rho \right]$$

where A has a positive value, $\rho = 1-1/\varepsilon$ and $r = \partial Q/\partial K$. If $0 < \varepsilon < 1$, then

$$\frac{\partial^2 (rK)}{\partial K \partial S} \lesseqgtr 0$$

as

$$\frac{S}{K} \gtreqless \left(\frac{1}{1 - \varepsilon} \right)^{\varepsilon/\varepsilon-1}$$

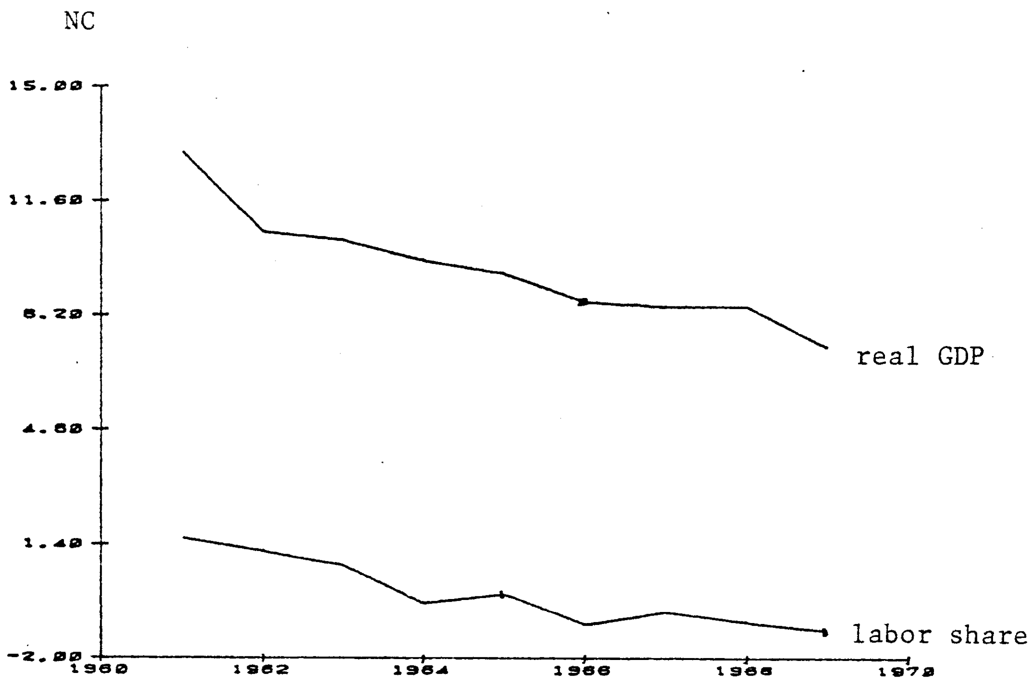
The fact that different closures produce different factor intensities has a profound impact on functional distributions of income. The average annual changes in the shares of unskilled urban labor are as follows

FI	-0.595%
NC	-0.534%
IX	+0.013%

Figure 4.6 shows the year-by-year real GDP growth rates and changes in labor for NC and IX closures. These outcomes are expected from the less-than-unitary elasticities of substitution. The limited labor force growth and high investment in IX produces the overall capital deepening, whereas in FI (Figure 4.1) the higher growth rates of labor force results in the capital shallowing in urban sectors. NC, ironically, also has a negative change in the labor share as the FI solution, but this time it is a capital shallowing from insufficient capital accumulation.

These aspects of functional distribution already tell us something about the welfare of different income classes. To be sure we now look at Table 4.9. This table shows the growth rates of measures of utility per capita of five income classes in the three closures. It is noticed that in IX the capitalists and skill-owners lose relative to FI, whereas unskilled labor and rural workers have fairly stable rates of increase in utility per capita between the two closures.

In NC, almost everybody is worse-off than in FI or IX reflecting the slower growth of NC. The income class 5 is better-off than in IX because of relatively higher agricultural terms of trade in NC. These terms of trade are measured by agricultural producers' price divided by the weighted average of urban prices. As mentioned earlier, they improved montonously in the



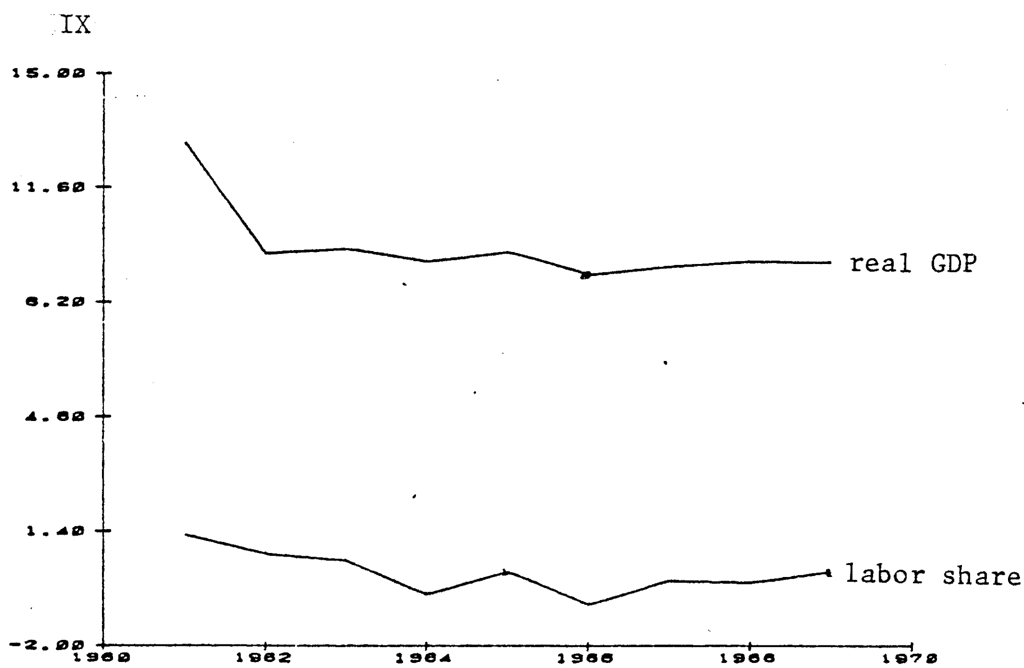


Figure 4.6. Real GDP growth rates and changes in labor shares in NC and IX.

Table 4.9. Average annual growth rates of utility per capita (in percent).

Income class	FI	NC	IX
1	11.16	5.50	10.15
2	31.08	23.63	29.98
3	16.14	6.46	12.57
4	13.95	9.09	10.15
5	22.67	26.37	22.47

actual history during the 1960s. Only FI, however, captures this. NC and IX have deteriorating agricultural terms of trade after the initial rapid improvement. The cause of this is the fact that IX and NC have a limited supply of unskilled urban labor. As soon as this labor becomes a strong constraint to growth, the urban wage level is bid up increasing urban prices relative to the agricultural prices.

IX naturally has a higher level of urban wages because of the high investment demand, this deteriorates the agricultural terms of trade more than in NC, and the utility per capita growth rate of rural residents is the lowest in IX. For the same reason, the unskilled labor gains most in IX whereas capitalists gains in FI.

The distribution of income also behaves without a good fit to the historical facts in NC and IX. Tables 4.10 and 4.11 show the same inequality measures of size distribution of income for NC and IX as were used for FI in the previous section. The distribution of income of total population in IX is strongly influenced by the changes in terms of trade. Urban indices,

Table 4.10. Distribution indices of base NC run.

	Total population				Urban population			
	$A(\frac{1}{2})$	A(2)	T	G	$A(\frac{1}{2})$	A(2)	T	G
1	0.207	0.358	0.600	0.408	0.239	0.426	0.659	0.464
2	0.181	0.314	0.523	0.361	0.226	0.403	0.623	0.443
3	0.174	0.306	0.499	0.356	0.209	0.378	0.572	0.416
4	0.175	0.308	0.503	0.359	0.208	0.376	0.573	0.417
5	0.176	0.309	0.505	0.361	0.206	0.370	0.567	0.410
6	0.175	0.308	0.500	0.363	0.200	0.360	0.550	0.400
7	0.178	0.311	0.513	0.363	0.204	0.364	0.567	0.400
8	0.178	0.311	0.516	0.363	0.203	0.359	0.565	0.394
9	0.182	0.317	0.527	0.368	0.202	0.356	0.568	0.389
10	0.183	0.313	0.534	0.360	0.208	0.360	0.586	0.388

Table 4.11. Distribution Indices of base IX run.

	Total Population				Urban Population			
	$A(\frac{1}{2})$	A(2)	T	G	$A(\frac{1}{2})$	A(2)	T	G
1	0.207	0.357	0.600	0.408	0.239	0.426	0.659	0.464
2	0.174	0.303	0.501	0.353	0.224	0.400	0.620	0.441
3	0.172	0.300	0.496	0.347	0.218	0.390	0.601	0.430
4	0.176	0.306	0.506	0.352	0.213	0.382	0.588	0.423
5	0.184	0.321	0.531	0.374	0.213	0.380	0.589	0.421
6	0.189	0.332	0.544	0.387	0.210	0.375	0.583	0.415
7	0.190	0.334	0.548	0.388	0.209	0.372	0.582	0.410
8	0.186	0.327	0.537	0.381	0.204	0.361	0.569	0.398
9	0.187	0.333	0.540	0.386	0.199	0.352	0.557	0.386
10	0.183	0.326	0.527	0.376	0.193	0.339	0.542	0.369

however, show that the real GDP growth rates and the inequality measures move counter to each other: the higher the growth, the more equal the distribution becomes. As explained in the previous section it is unlikely that such was the case in actual history, except for, possibly, the time period after 1968.

Finally, Table 4.12 shows the shares of the components of savings for the first year (same for all closures) and the tenth year of simulations. The most notable is the drastic decrease in foreign savings in the NC closure, clearly showing the cause of the problem with this closure. The negative foreign savings amounts to 26 percent of domestic savings. Between FI and IX, the results conform to the previous ones. In FI, the savings by capitalists keep the relatively high share whereas the unskilled workers' shares are relatively smaller. Completely the opposite occurs in IX.

Comparison of above results for different closures shows that the FI closure seems to be the clear winner for use in the study of Japanese economic history during the 1960s. Not only does it replicate growth rates of the real variables best*, it also behaves qualitatively similar to the history with respect to the relationship of growth and distribution, wage dualism, and agricultural terms of trade. IX and NC have deteriorating terms of trade while the opposite was true in the history. Their labor share and size distribution measures behave differently from the history

*As long as replicating the history of real variables alone is concerned, IX and NC may also be able to perform fairly well if we repeat enough exercises of changing various parameter values.

Table 4.12. Shares of savings by components.

Type	First Year*		Tenth year		Closures
Private savings					
Class 1	0.0875	(0.101)	0.0660	(0.071)	FI
			0.0985	(0.088)	NC
			0.0750	(0.088)	IX
Class 2	0.0789	(0.091)	0.1260	(0.136)	FI
			0.1446	(0.13)	NC
			0.1244	(0.145)	IX
Class 3	0.0145	(0.017)	0.0173	(0.019)	FI
			0.0221	(0.020)	NC
			0.0168	(0.020)	IX
Class 4	0.6103	(0.702)	0.6345	(0.687)	FI
			0.7516	(0.675)	NC
			0.5740	(0.670)	IX
Class 5	0.0781	(0.090)	0.0797	(0.086)	FI
			0.0970	(0.087)	NC
			0.0663	(0.077)	IX
Total private	0.8692	(1.000)	0.9235	(1.000)	FI
			1.1138	(1.000)	NC
			0.8565	(1.000)	IX
Foreign savings	-0.0319		-0.1866		FI
			-0.3530		NC
			-0.0650		IX
Government savings	0.1627		0.2631		FI
			0.2393		NC
			0.2086		IX
TOTAL	1.0000		1.0000		

*Same for the three closures.

at least until around 1967. The casual observation, however, that in the history starting from 1968, the inequality measure and the real GDP growth rates started to move counter to each other more or less consistently, may be telling us that FI closure ceases to work from around that time. In other words, it can be conjectured that the unskilled labor may have become a real constraint around 1967-68, and therefore a macro closure of NC* or IX may perform better in the 1970s.

The same is true with respect to the wage dualism. In IX, the measure for within-urban dualism oscillates and the measure for urban-rural dualism 'increases' over time. In NC, the within-urban dualism shows decreasing trend as in FI (and in history), but the urban-rural dualism oscillates and is stable overall as a trend during the ten years.

Finally, the FI closure also replicate the overall inflation rate: 4.89% per annum, whereas the historical rate was 4.61%. The IX closure actually has a closer rate (4.86%) to the historical value. However, it does not mean much because as one can see from the behavior of the terms of trade, the relative prices in IX closure is quite apart from the historical behaviors.

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*Given a disastrous growth performance of NC closure, NC may still be difficult for use in studying the 1970s, even if the above conjecture is correct.

CHAPTER 5: COMPARATIVE DYNAMICS OF DIFFERENT MACRO CLOSURES

The previous chapter described the base reference solution and the differences in solutions using different closure rules. These different model closures also make the model react to various impacts in quite diverse ways, and these are described in this chapter. The following experiments have been made:

1. A devaluation of the yen by 10 percent (HEX).
2. A higher export demand for the modern manufacturing sector's goods (HWT).
3. Higher elasticities of substitution between unskilled labor and composite capital. (HSIG).
4. Higher rates of population increase without proportionate labor force growth (HPOPH).
5. Higher rates of population increase with proportionate labor force growth. (HPOP)
6. A higher propensity to migrate from rural to urban areas (HMIG).
7. A higher tariff rate (HTF).

Each solution is compared with the solution of the same closure described in the previous chapter, and summary figures and tables are given for each solution.

5.1. DEVALUATION

5.1.1. FI Framework

A 10 percent devaluation of the yen in FI increases the real GDP by 0.92 percent in a static setting. The main cause of this is naturally an increase in exports and a decrease in imports. The response in trade values, as can be imagined from the small increase in real GDP, is limited. The total export goes up only 1.94 percent in the first year, despite the high elasticities of export assumed in some sectors of the model. This is because *the higher pressure for exports is translated into higher domestic prices.* Domestic urban prices increase about 9 percent cancelling most of the effect of devaluation. Agricultural price increases as much as 12 percent so that the exports of this sector actually decline.

Unskilled labor share decreases because more unskilled labor is employed to meet the higher demand. Consequently, the utility per capita for income classes 1 and 2 decreases by 2.9 and 8.3 percent respectively, while all other income classes gain in utility per capita. The real income per worker* in each income class shows a slightly different profile. It decreases in all labor income classes (income classes 1, 2, and 3). This decline is largest in income class 1 (-4.33 percent) followed by income class 2 (-3.86 percent). The skilled labor (income class 3) loses marginally (-0.36 percent).

These are, however, static effects. If we look at the dynamic effects, the outcome is quite different. First of all, in the second year of the simulation the total exports actually *decreases* relative to the base run, despite devaluation. This comes from the higher investment demand in this year. The

*The discrepancy in real income per worker and utility per capita comes from the assumption that dependents are distributed in accordance with the numer of workers in each income class. This amounts to the assumption that additional unskilled workers come from all income classes with equal probability. This may not be accurate, but the assumption that additional workers of a kind only come from the people of the same income class is equally, if not more, unrealistic.

higher export demand in the first year pushes up the demand expectation for the following year, and as a result investment demands go up in most sectors. Inflationary pressure is thus exerted and the total export in the second year decreases (-0.24 percent) relative to the base run.

The third year again shows an increase in exports. This, of course, is partly the result of higher supply capacity due to the increased capital stock because of the high investment in the second year. This higher supply pushes down prices and increases exports. The amount of exports peaks around the fourth year and then gradually declines to the level of the base run by the tenth year. *This last decline is the result of wage expectation rising less rapidly than the expected user cost of capital.* Nominal agricultural income is around 13-14 percent higher in this run than in the base run, which increases the nominal urban wage rates by about 6-7 percent. The expectation of capital user cost, however, goes up around 10 percent relative to the base run because it is closely related to pk (the price of capital that is a weighted average of urban prices) and pk goes up around 10 percent due to the demand pressure caused by devaluation. This low wage-rental ratio depresses investment and decreases the supply capacity. Exports decrease relative to the base run during the second half of the simulation, because prices go up while demand factors stay more or less the same.

Figure 5.1 and Table 5.1 summarize these results. Real GDP relative to the base run oscillates around the level that is 1.3 percent higher than the base run. The peak years are the second (1961) and the seventh-eighth year (1966-1967). The unskilled labor share shows completely the opposite movement, troughing in 1961 and 1966. If we examine the sectoral breakdown, we notice that the movement of real GDP is governed mostly by the physical capital investment, rather than the export demand.

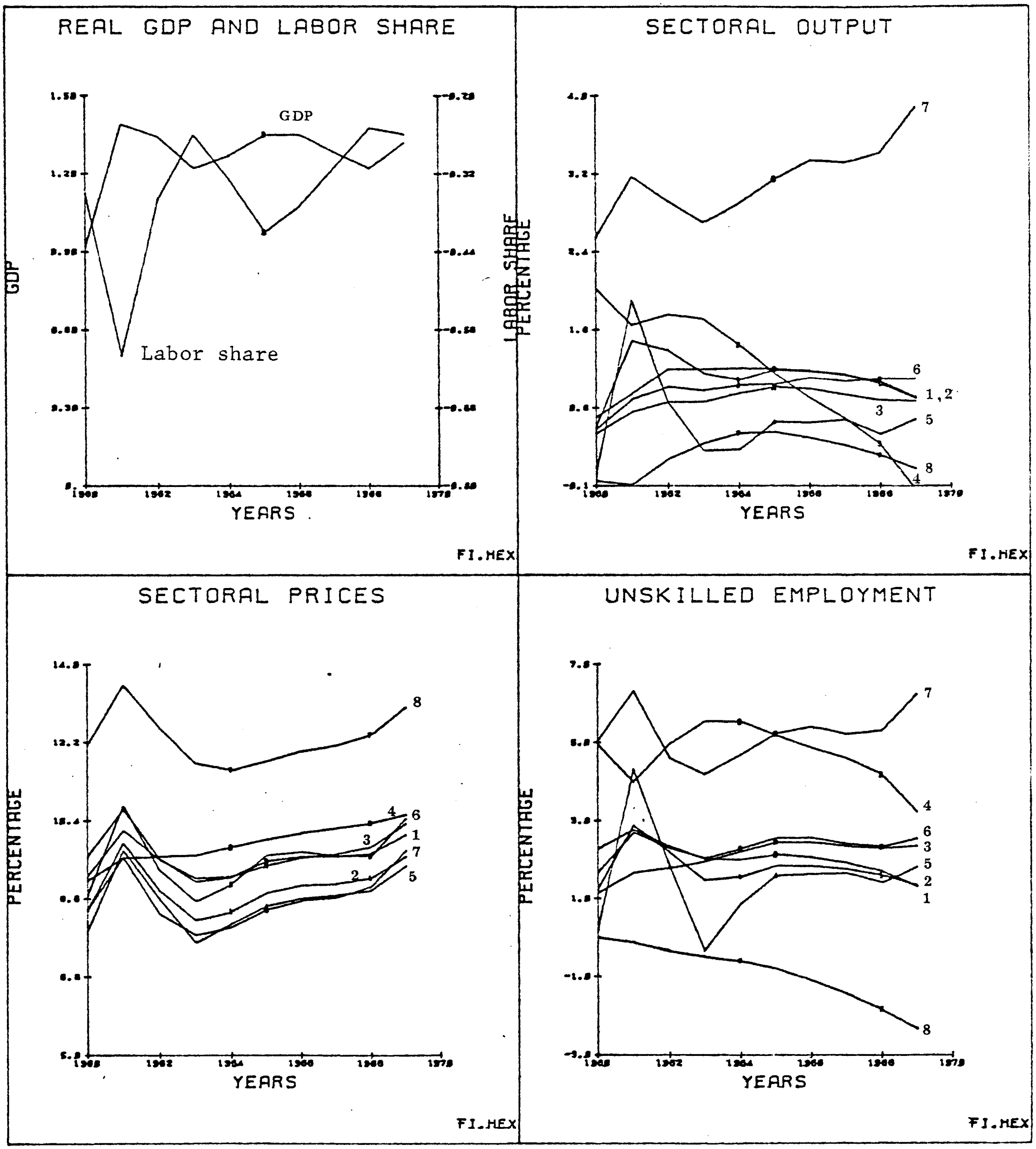

Figure 5.1. Results of a 10 percent devaluation (HEX) in FI framework.

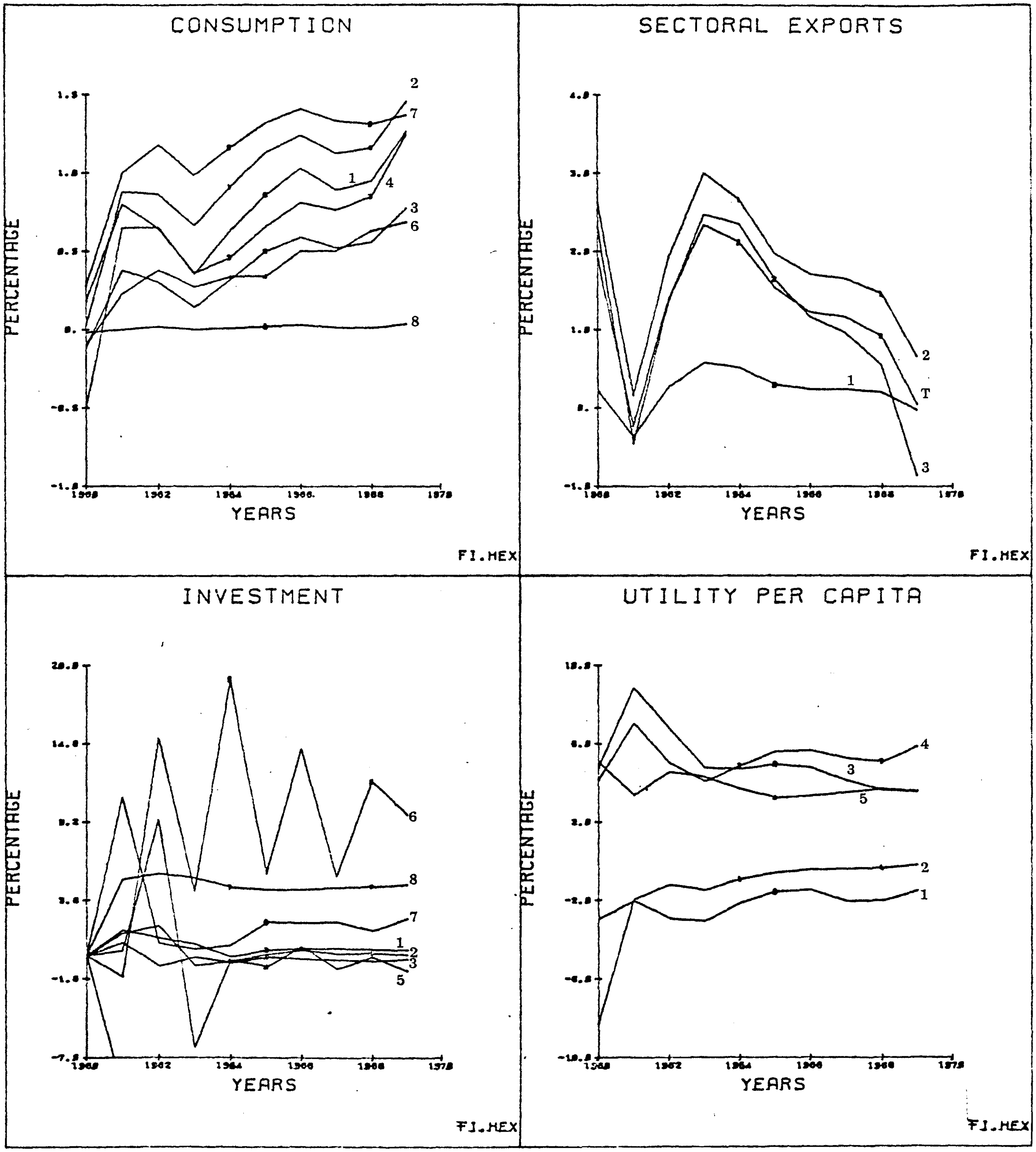

Figure 5.1 continued.

Table 5.1. Results of a 10 percent devaluation (HEX) in the FI framework.

A. Rates of percentage change of distribution measures

Year	A(½)	A(2)	T	G
		Total population		
1	1.45	0.00	2.16	-0.25
5	2.08	0.61	2.66	-0.27
10	1.87	0.89	2.99	-0.27
		Urban population		
1	2.51	1.41	3.33	1.29
5	2.64	1.52	3.61	1.15
10	2.80	1.76	3.85	0.96

B. Rates of percentage change of dualism measures

	Year 1	Year 5	Year 10
M/T[a]	1.25	0.95	0.90
T/A[b]	-7.03	-7.03	-8.27

[a]modern wages/traditional wages
[b]traditional wages/agricultural wages

C. Compositions of savings

	Year 1		Year 5		Year 10	
1	0.08372	(0.09757)	0.08841	(0.08845)	0.06178	(0.06850)
2	0.07819	(0.09113)	0.11159	(0.11165)	0.12330	(0.13672)
3	0.01423	(0.01658)	0.02086	(0.02087)	0.01660	(0.01840)
4	0.60372	(0.70359)	0.68157	(0.68191)	0.62217	(0.68989)
5	0.07819	(0.09113)	0.0907	(0.09712)	0.07799	(0.08648)
TPS[a]	0.85806		0.99950		0.90183	
fs[b]	-0.03404		-0.21780		-0.17277	
gs[c]	0.17598		0.21831		0.27094	
s[d]	5306.59172		6702.60860		18188.9887	

[a]Total government savings, [b]foreign savings, [c]government savings,
[d]total nominal savings

Note also that the welfare levels (utility per capita) of the unskilled labor are always below the base run levels. Instantaneous effects are such that rural workers benefit most from devaluation because the agricultural terms of trade in this run jump to a level of 4 percent higher than the base run in the first year. Without an increase in investment in the first year, the higher exports push up the demand for agricultural goods, as the urban traditional manufacturing, where agricultural intermediate input demand is substantial, expands. In the second year, however, the increased demand comes more from a higher level of investments. The intermediate demand of agricultural commodities from investment goods producing sectors is quite limited, and agricultural terms of trade worsens. To the extent that real GDP growth rate is governed by the physical capital accumulation, agricultural terms of trade and, therefore, the level of rural utility per capita, worsens as real GDP grows faster. When the export demand pressure is relatively higher, the agricultural terms of trade improve.

Throughout this simulation, the total physical investment is increased slightly (except for the first year, of course). The increased savings come from income classes 2 (traditional unskilled), 4 (capitalists) and 5 (rural workers), and the government. Class 2 has higher savings mostly because sector 7 expands strongly, increasing the unskilled employment. One main reason for this sector's output expansion is its high intermediate demand from the tradeable sectors. Capitalists increase their savings share (i.e., income share) because of the increased total employment of the unskilled labor that pushes the capital-labor ratio down. The rural workers' higher contribution to savings comes from the improved agricultural terms of trade. Finally, the government increases its savings because of the higher GDP. This expands the government revenues. With the government expenditures fixed, the government savings have to increase. Relative contributions of foreign savings and the modern skilled workers naturally decline.

The higher unskilled employment is accompanied not only by reduced labor share, but also by worsening overall income distribution, as one can observe from Table 5.1. Only the Gini coefficients show signs of improved income distribution. These coefficients actually picked up the improved terms of trade in agriculture. All other measures show worsening income distribution. This worsening, of course, occurred in the urban sectors. The reduced unskilled labor share with higher employment means higher population share and lower income share for the unskilled in general, and vice versa for capitalists. This alone increases the inequality. The increased intraurban dualism, however, adds to it. Modern sector unskilled wages go up relatively faster than the traditional unskilled wages. This might sound inconsistent with the assumption in the model, i.e., traditional wages are more closely tied to the rural income than modern wages. The wage determination mechanism described in Chapter 3, however, uses the real wages as arguments.

Nominal wages are deflated by the urban and rural consumer's price indices. The determinants of the wages are not only nominal agricultural income, but also the rates of change in consumer's price indices. Because we assume that the modern sector workers are more sensible to the changes in real wages, it is the same as saying that modern sector employers are more willing to compensate for the erosion of the salaries of their employees caused by inflation. Rural-urban wage dualism, of course, decreases, reflecting the improved agricultural terms of trade.

5.1.2. NC Framework

A 10 percent devaluation in the NC framework seems to make the already bad situation only worse. Figure 5.2 and Table 5.2 summarize the results. An increase in exports further reduces investment through a decrease in foreign savings. Real GDP is higher than in the base (NC) run only in the

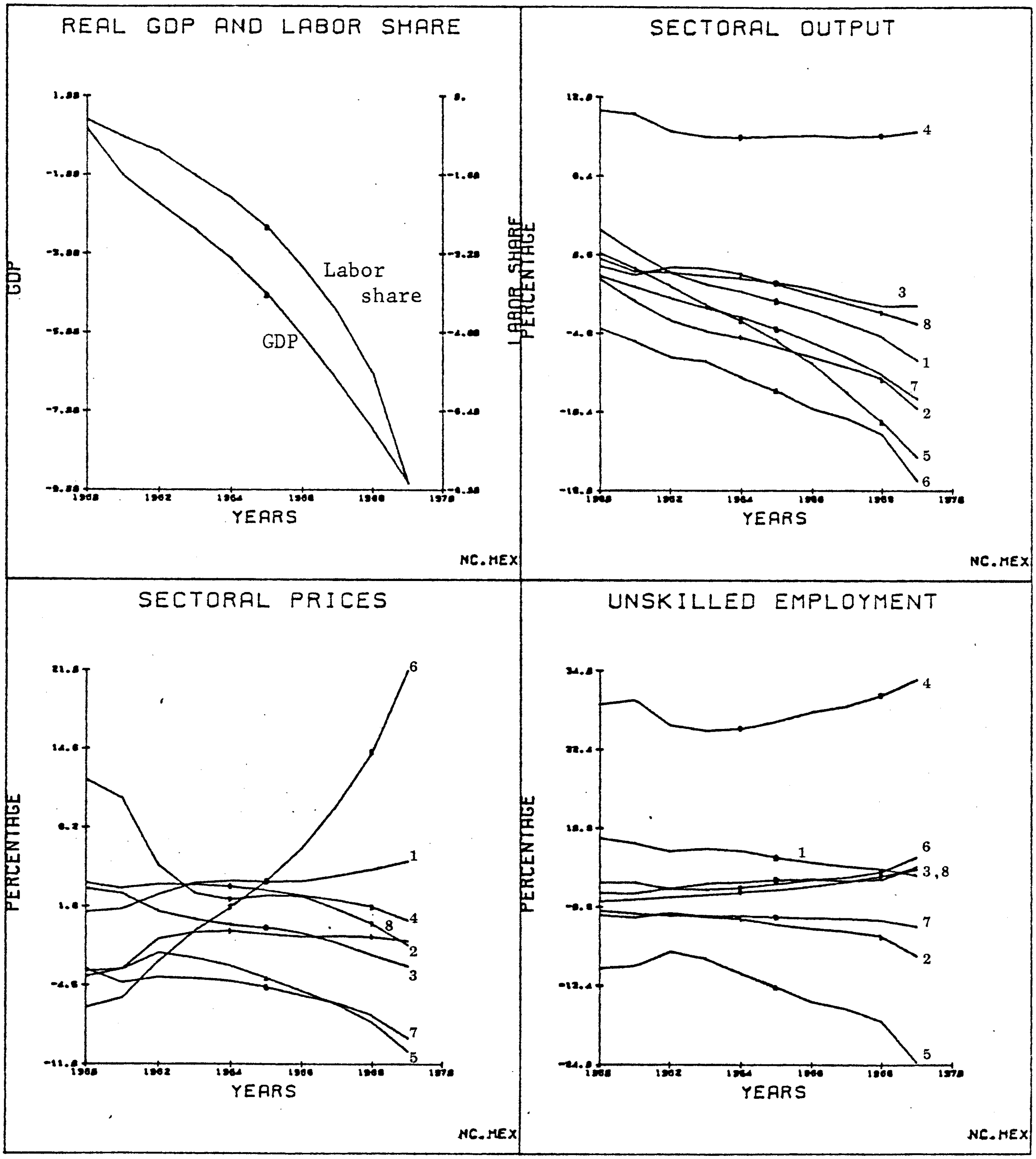

Figure 5.2. Results of a 10 percent devaluation (HEX) in the NC framework.

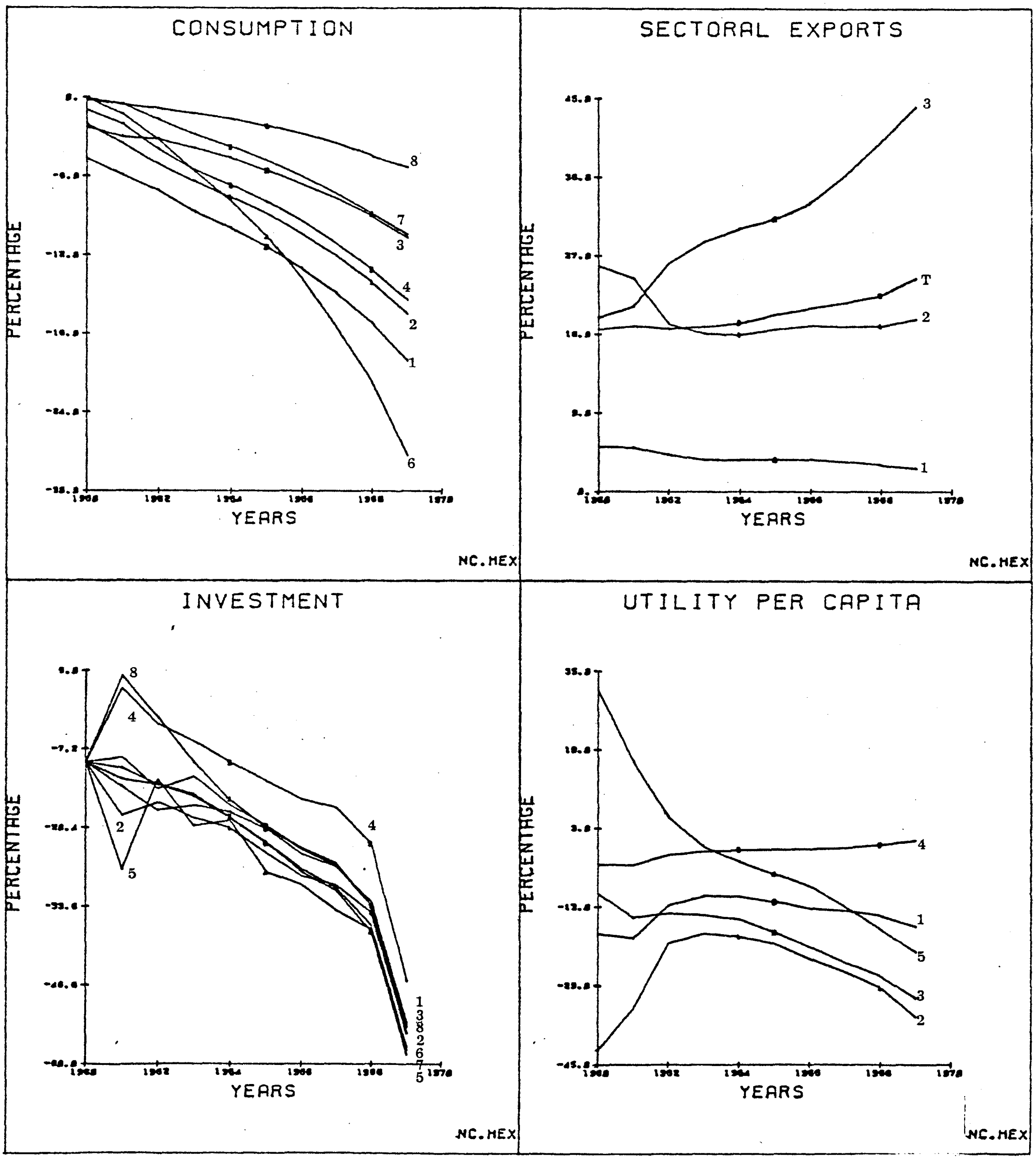

Figure 5.2 continued.

Table 5.2. Results of a 10 percent devaluation (HEX) in the NC framework.

A. Rates of percentage change in distribution measures.

Year	A(½)	A(2)	T	G
		Total population		
1	-5.80	-6.15	-5.33	-6.37
5	3.98	2.27	5.15	0.55
10	21.31	15.66	25.09	13.06
		Urban population		
1	0.00	-0.47	0.45	-0.43
5	6.31	4.89	7.06	4.15
10	22.6	17.78	25.43	17.01

B. Rates of percentage change in dualism measures

	Year 1	Year 5	Year 10
M/T	- 6.44	-0.62	6.21
T/A	-16.81	-8.12	-9.8

C. Composition of savings

	Year 1	Year 5	Year 10
1	0.09137 (0.09852)	0.09432 (0.09296)	0.13254 (0.08421)
2	0.08281 (0.08281)	0.11171 (0.11009)	0.16249 (0.10324)
3	0.01510 (0.01628)	0.02072 (0.02042)	0.02370 (0.01506)
4	0.64332 (0.69364)	0.68687 (0.67692)	1.13147 (0.71890)
5	0.09486 (0.10228)	0.10108 (0.09961)	0.12370 (0.07859)
TPS	0.92746	1.01470	1.57389
fs	-0.10498	-0.21204	-0.89264
gs	0.17753	0.19734	0.31874
ts	4326.5664	6059.6344	6169.963

first year. This increase occurs because of the reallocation of labor from the sectors with lower labor productivity to those with relatively higher labor productivity, e.g., from sectors 2, 5, and 7 to sectors 1 and 6. But this increase in the real GDP is only 0.2 percent.

From the second year, the real GDP decreases relative to the base NC run consistently. By the 10th year, real GDP is almost 9 percent below the base year rate. The share of urban unskilled labor income goes down as well. This is again due to the increased labor-capital ratio as a result of the decrease in capital stock relative to the base run. Annual accumulation diminishes to less than half of the base NC run by the 10th year. The physical capital stocks are around 20 percent less than the base run values in that year. Production goes down very rapidly, despite the fact that sectors 1, 3, 4, and 6 produce more than the base run in the first year due to the higher exports. By the third year all sectors, except for the mining sector, are producing less than the base run and going down fast. Exports shoot up naturally as a result of the devaluation. The total exports are 24 percent higher than the base run in the 10th year. Most of the increase occurs because of the increase in exports of sector 3 goods, whose export elasticity is as high as 2.87. Despite the increase in exports the overall aggregate demand is rather stable. This stability occurs as a matter of course because trade deficits are included in savings and any increase in exports and/or decrease in imports automatically change the savings by the same amount.

Over time, the accumulation of physical capital stock declines and, therefore, the supply capacity falls as well relative to the base run. The relative fall in physical capital stocks is the largest for capital goods producing sectors (sectors 2 and 5)—around 25 percent less than the values in the 10th year of the base run. The next largest fall can be seen in the modern sectors (sectors 1 and 6)——around 20 percent. The capital stocks of the traditional sectors decrease still less; around 16 percent for sectors 3 and 7, and around 12 percent for sectors 4 and 8. These supply factors, together with the aforementioned demand factors, interact and determine how relative prices move over time. Sector 6 prices shoot up from being the lowest to the highest. This rise is, of course, because the supply capacity relative to the base run goes down rapidly through less capital stock, while the demand for this sector's goods picks up due to the increased export handling charges. In addition, this sector is not hurt so much from the decline in investment because it contributes very little to the physical capital formation, nor does it supply a great amount of intermediate inputs to capital producing sectors.

Another sector whose relative price increases consistently is sector 1. Compared with sector 6, sector 1 commodities are traded directly and any hike of relative prices decreases the export demand and increases the import substitution thereby limiting the price hike.

All other sector prices have falling trends. The agricultural price falls very rapidly from 12 percent above the base run in the first year to 2 percent below in the 10th year. The major reason this occurs is that, relatively speaking, *this sector does not lose the supply capacity so much.* As mentioned above, the decline of capital stocks in this sector is among the lowest in the economy. In addition less urban investment keeps agricultural workers from migrating to cities or shifting to nonagricultural jobs. This sector's supply, therefore, decreases less rapidly than most other sectors, which quickly worsens its terms of trade.

Sector 2 has a price movement that is more or less opposite from sector 8's prices. Its price decreases first due to the decrease in investment. The increase in export demand for this sector's goods is not enough of course. Capital formation has more than three times as much weight as export among various demands for this sector's goods (see Appendix 2 of Chapter 3). The price climbs back up, however, becoming closer to the base run values during the next few years because the capital stock of this sector decreases fast whereas the real investment demand stays at a relatively stable level of about 10 percent below the base run. During the rest of the simulation period, the price of sector 2 stays at a constant level of 1 percent below the base run price. The reduction of consumption and investment demand and the increase in the export demand pressure for this sector's goods, together with the lower supply capacity balance out to produce this result.

If we turn to the levels of utility per capita, the shifting effects of agricultural terms of trade dominate. *The rural residents are the only gainers*, increasing their utility per capita by 31.2 percent relative to the NC base solution for the first year. Traditional urban workers lose most severely, by 42 percent. Urban unskilled workers in modern sectors lose 18.4 percent, skilled workers by 10.3 percent, and capital owners by 4.4 percent. The dynamic picture is, however, completely different. Rural residents lose continuously as agricultural terms of trade worsen because more agricultural workers stay in the area, and a relatively small decrease in capital stocks in the same sector is shown. Skilled workers also lose continuously. The reason for this is the "increase" of skilled labor stock relative to the physical capital stock. The latter is about 20 percent less than the base run in the 10th year, whereas the skilled labor is only 1-5 percent less.

With the very low elasticities of substitution between skill and physical capital assumed in the model, skilled workers lose their share among "capital" owners substantially. The two classes of mostly unskilled workers have a similar pattern; relatively increasing utility per capita until the fourth year, and then declining rapidly.

The first increase in utility per capita for unskilled workers occurs because of the relatively strong aggregate demand while the capital stocks are rapidly decreasing. In other words, the level of urban wages increases, relatively, until the fourth year. The decrease is due to the economy-wide decline through the sharply reduced accumulation of capital stocks. The decline in utility per capita of the traditional worker class, however, is faster than its modern counterpart, and this is related to the wage determination mechanism: traditional unskilled worker wages move more closely with the agricultural income than do modern unskilled wages, and agricultural income decreases rapidly during the whole period.

The only income group whose utility per capita increases over time is the physical capital owners' group. Even if the economy as a whole diminishes rapidly, capitalists manage to have an absolutely "higher" level of per capita utility than the base run in the 10th year. This is all related to the increasing share of total income they receive as the physical capital stocks become relatively smaller and smaller.

The differences between dynamic effects and static results are striking. In the static experiment, all urban residents lose and only the rural residents enjoy an increased level of utility per capita. With dynamic effects, however, the rural residents are the most hard hit, and only capitalists enjoy a higher level of utility per capita than the base run by the 10th year of simulation.

As can be seen from the rapid change in utility levels per capita, the distribution impacts are profound. As the economy first adjusts to the shock of increased pressure for exports and decreased pressure for investment (through decreased savings), labor demand becomes weaker because the labor intensive sectors, i.e., machinery (sector 2) and construction (sector 5) suffer. However, agricultural demand is hightened as a result of, as explained earlier, the direct impacts of reduced imports and increased demand for intermediate inputs. Agricultural income, therefore, goes up. Through the wage determination mechanism, traditional sector wages go up relatively more than modern sector wages. The weak labor demand in urban sectors, however, drives the whole wage structure down, resulting in a drastic improvement as far as distribution measures are concerned, in the first year of devaluation. Through the deterioration of agricultural terms of trade as discussed above, the inequality measures increase rapidly. The intraurban wage dualism behaves similarly because traditional wages move quite closely with agricultural income. The measure of rural-urban dualism is rather stable. Actually, this reflects the relatively abundant supply of urban labor throughout the simulation.

5.1.3. IX Framework

A 10 percent devaluation in the IX closure, i.e., saving-investment relations is that of FI, but the urban unskilled labor supply is constrained as in NC, has very little impacts as far as the total aggregates are concenred. The real GDP in the first year is only 0.01 percent higher than that of the base run, and even though it decreases relative to the base run as time goes by, this decrease is only 0.16 percent by the 10th year.

All nontradeable sectors produce less output than the base IX run in the first year because tradeable sectors absorb more unskilled laobr in order to meet the increased export demand as a result of devaluation. The real GDP increase is, however, much less than the first year of devaluation in NC because the high investment demand keeps the employment of such low labor productivity sectors as the construction sector relatively high. This, therefore, keeps the employment of high labor productivity sectors (modern sectors) low (Figure 5.3 and Table 5.3).

The slow decline in real GDP relative to the base run from the third year is *due to the lower investment*. The second year has a very high investment as a result of the sudden increase in demand in tradeable sectors, but this increase in investment demand brings about higher prices (note that in the second year, the physical capital stocks in all sectors are still the same as the base run), then this, in turn, tends to reduce export demands. The third year shows the opposite effect; investment is lower and together with the higher supply capacity due to higher investment in the second year, tends to reduce the price level that now increases export demand. During the second and third years these two forces, export and investment, cancel out and the resulting real GDP is almost exactly equal to the base run values in these years. The continued relatively lower investment in most sectors, however, slowly, but surely, decreases the real GDP relative to the base run. The lower investment is caused by the decline of both animal spirit parameters and future expectations of domestic demand. The former comes about because the capital price is higher than the base-run value by around 8~9 percent, whereas the nominal wage levels increase by around 6~7 percent (from the second year). The latter, the slow increase in demand expectations, is caused by both slower investment growth and weak household consumption demand.

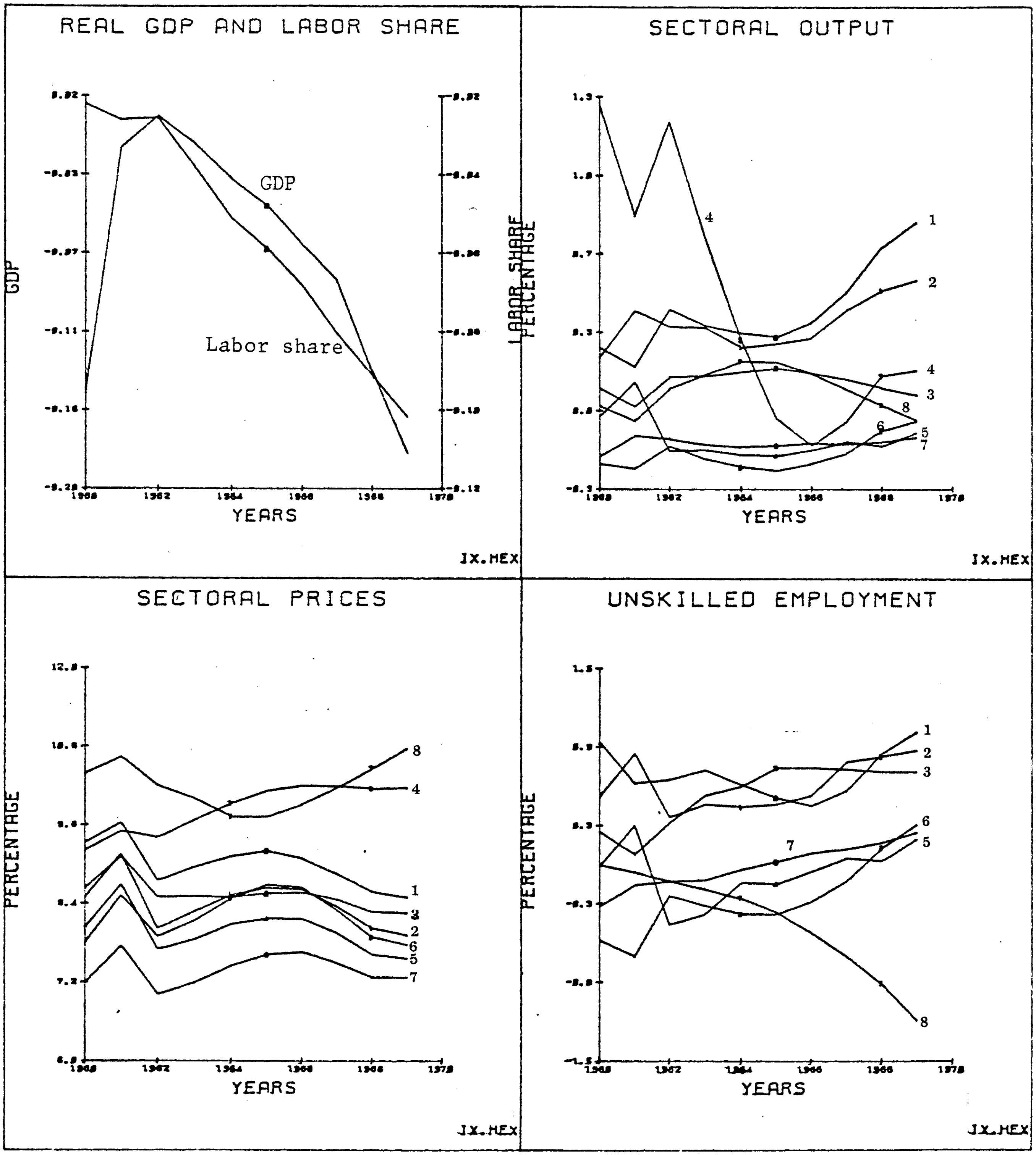

Figure 5.3. Results of a 10 percent devaluation (HEX) in the IX framework.

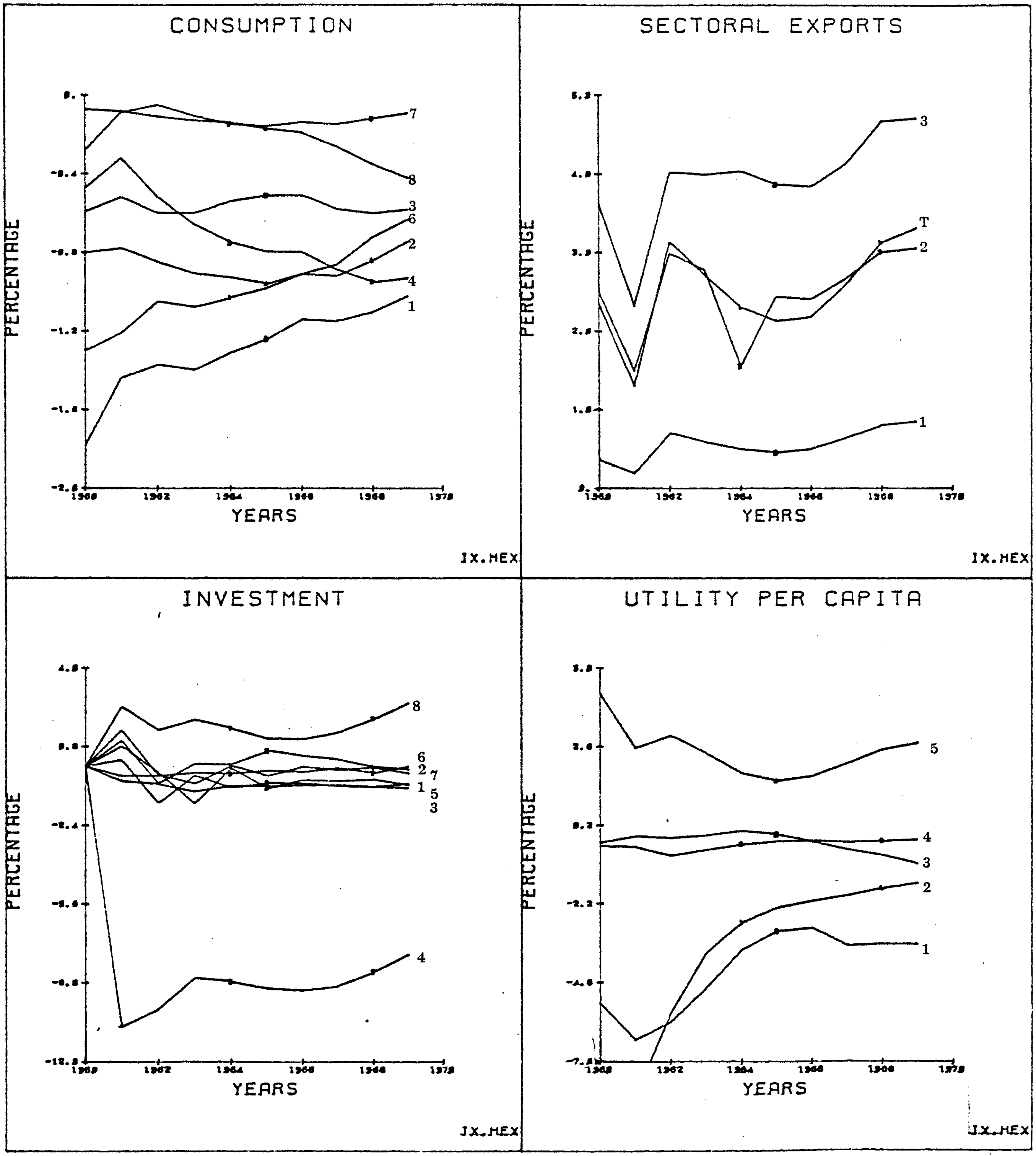

Figure 5.3. continued.

Table 5.3. Results of a 10 percent devaluation (HEX) in the IX framework.

A. Rates of percentage change in distribution measures.

Year	A(½)	A(2)	T	G
		Total population		
1	-0.48	-0.56	0.0	-0.98
5	0.0	-0.31	0.19	-0.80
10	-0.55	-1.23	0.0	-1.33
		Urban population		
1	0.84	0.47	1.06	0.43
5	0.94	0.79	1.02	0.24
10	1.04	0.89	1.11	0.27

B. Rates of percentage change in dualism measures.

	Year 1	Year 5	Year 10
M/T	1.42	1.65	0.44
T/A	-2.57	-3.47	-5.60

C. Composition of savings

	Year 1	Year 5	Year 10
1	0.08581 (0.09921)	0.08589 (0.09306)	0.07373 (0.08622)
2	0.07785 (0.09002)	0.10461 (0.11335)	0.12364 (0.14459)
3	0.01447 (0.01674)	0.01974 (0.02139)	0.01667 (0.01950)
4	0.60750 (0.70240)	0.62418 (0.67630)	0.57374 (0.67093)
5	0.07925 (0.09163)	0.08852 (0.09591)	0.06735 (0.07878)
TPS	0.86488	0.92293	0.85513
fs	-0.03987	-0.11308	-0.07303
gs	0.17498	0.19014	0.21790
TS	5181.62394	7364.0950	17352.7074

Observe the two distinctive patterns in both output growth and investment. One is the pattern of investment goods, the other is that of tradeables. Sectors 1, 2, 3, and 6 are the latter and sectors 2 and 5 the former. Sector 2 goods are tradeables as well as investment goods, and show somewhat less distinctive patterns of investment goods than the construction sector does. In any case, these two sets of commodities tend to move in opposite directions. Compare, for example, the investment in sectors 2 and 6.

Utility level per capita again shows a wide discrepancy among income classes in a static sense (i.e., in the first year), but the discrepancy tends to narrow as time goes on. In the first year, the winner is again the rural group with a 4 percent increase in utility level per capita, and the biggest loser is the urban traditional workers group, i.e., a decline of more than 11 percent. This group, however, improves its lot rapidly because, of course, the smaller the original utility per capita the bigger the percentage increase in utility per capita is when consumption is increased by the same amount.

The increase of the rural utility per capita relative to the base run diminishes because the supply capacity increases as a result of higher investment in the sector. The agricultural terms of trade, however, improve again in the second half of the simulation because the labor force in agriculture shrinks as a result of high migration which, in turn, is the result of higher rates of turn-over in urban employment. This overwhelms the low investment in the migration function.

The unskilled labor share is lower than the base run throughout the 10 years. The share, however, has an inverted "U" shape over the simulation period. The earlier increase is due to the shift of the labor force from sectors with low labor shares to those with higher shares. The increase in overall capital stock in the third year also helped to increase the labor share relatively. From then on, however, the higher migration and lower investment worked against the unskilled labor classes constantly.

The high investment in the second year is financed by higher foreign savings that occurs because of the higher price level. The inflation-caused redistribution of income in favor of the capitalists, i.e., the high savers, does not work here because the higher price levels do not lower the real wages very much. With urban labor fully employed, the only way to increase the urban labor supply is to have more migration or more births, neither of which occurs very quickly. Wages, therefore, go up almost as much as value-added prices. How then does the economy keep the amount of investment constant, for example, in the first year, with "reduced" foriegn savings? There is, of course, a slight shift of income to the capitalists, but the real savings (nominal savings deflated by a capital price) of capitalists actually declines. The loss of foreign savings is made up for by the shift of income toward agriculture because of the changing terms of trade, and the government. The government, of course, benefits from the increased value of imports in "yen" because the tariff is *ad valorem*. Real imports only go down around 1.0 percent whereas the value increases 10 percent. We might also recall, although it is only a small thing, that government worker's wages are exogenously given by nominal terms. Any inflationary pressure thus increases the government savings in this regard as well.

Overall, however, the distributional aspects, as well as the real physical structure of the economy, do not vary very much in this sensitivity run. The inequality measures generally decrease, reflecting the improved agricultural income vis-a-vis other income streams. The urban population would suffer a slight worsening effect of size distribution of income which reflects the decreased labor share as previously explaind, and the relatively worse urban wage dualism that, again, is caused by the high inflationary pressure.

5.1.4. Overview of devaluation

Generally speaking, the ineffectiveness of devaluation in any closure is striking, but this result is somewhat expected from the past literature on devaluation in developing countries (see, for example, Taylor 1979, Krugman and Taylor 1978). It quite simply does not have the expected effects of expansion of economic activities. On the contrary, the NC closure has a devastating result in that it shrinks the economy with severely worsening income distribution. The decreasing foreign savings is the cause for this sprial decline of the economy. The other two closures fare a little better, but far from what is expected by traditional proponents of devaluation. In both the FI and IX closures, the devaluation is translated to almost as much domestic price inflation, nullifying most of the effects of devaluation.

In both cases, the distribution of income shifts towards capitalists, agricultural workers, and the government. The urban unskilled workers suffer most in that their income share decreases. The initial effect is that the traditional sector unskilled workers experience more severity than the modern sector counterparts because of the interaction between the inflation and the wage determination mechansim. The intraurban wage dualism tends to worsen, whereas the rural urban dualism tends to lessen. In IX, the real GDP actually declines over time realtive to the base run, because high inflation with a reliatvely slow increase in nominal wages, pushes down the "animal spirit" of the investors and also of some factors of final demand.

The overall magnitude of change in the IX closure, however, is quite small. Being a full employment model, all that can happen is a reallocation of urban labor whose total supply is more or less fixed.

In the FI closure, with the elastic urban labor supply, the economy can grow, but the magnitude of growth is only about 1.3 percent higher than real GDP throughout the simulation, accompanied by a considerable worsening of income distribution.

5.2. HIGH EXPORT DEMAND

The next set of experiments involve increasing the world demand for Sector 1 (modern manufacturing) goods by 20 percent for 4 years starting in 1963.

5.2.1. FI Framework

The exogenous shock has a fairly expected result for FI (Figure 5.4 and Table 5.4). The output of sector 1 increases 2-3 percent during the export boom. Most other sectors also enjoy output expansion during the boom. Sector 7 expands relatively more because of its high consumption and intermediate demands. The expansion of sector 6, on the other hand, is mainly due to the export handling charges. Sectors 2 and 5, the capital goods producing sectors, once again have similar patterns over time in both physical capital investment and output. The only sectors whose output is reduced in the first year of the export boom are 2 and 3. They both have higher outputs than the base solution from the second year of the boom. For sector 2, this higher output is due mainly to the increase in the investment demand. For sector 3, however, it is the increased consumption demand that does the trick.

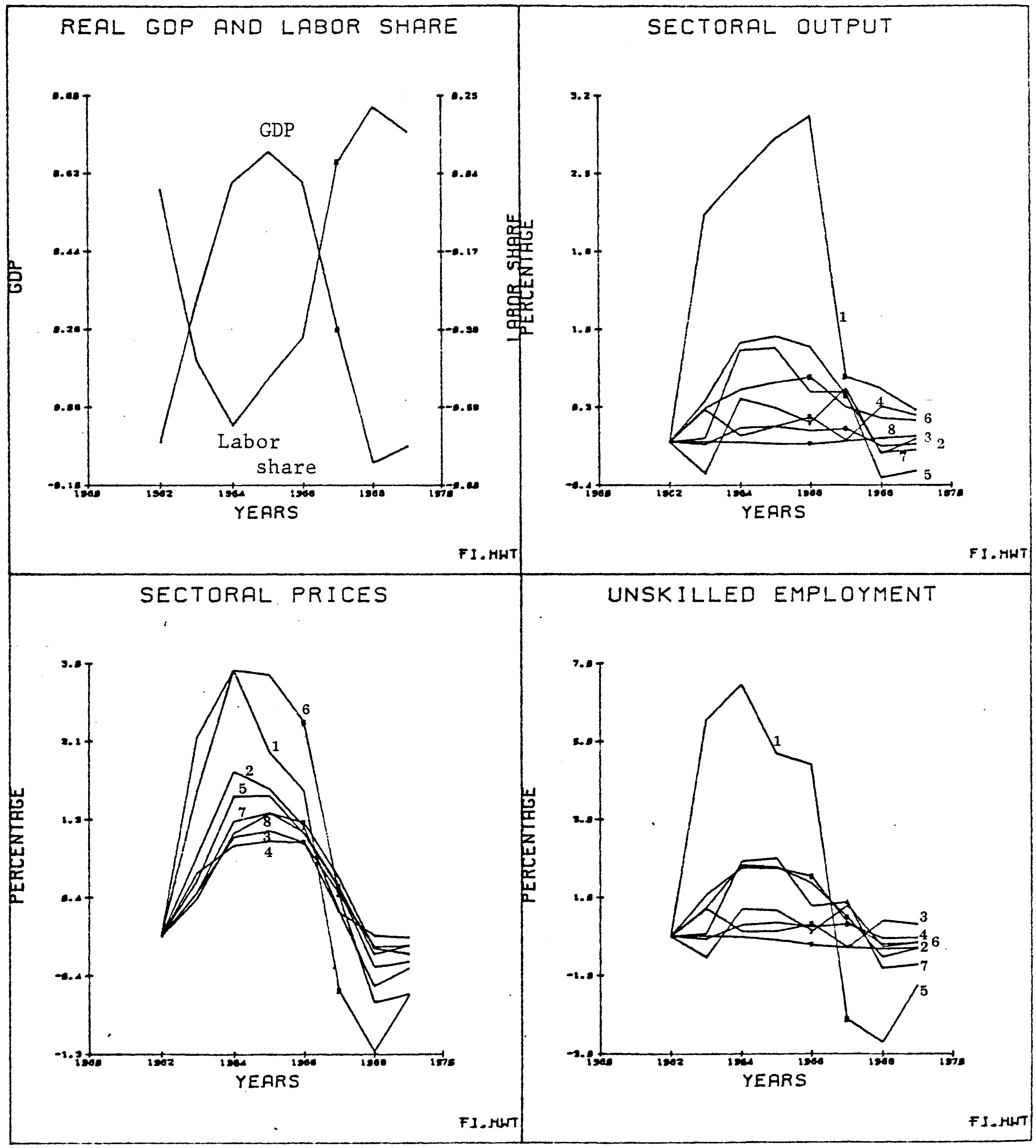

Table 5.4. Results of increasing the world demand for Sector 1 goods by 20 percent (HWT1) in FI framework.

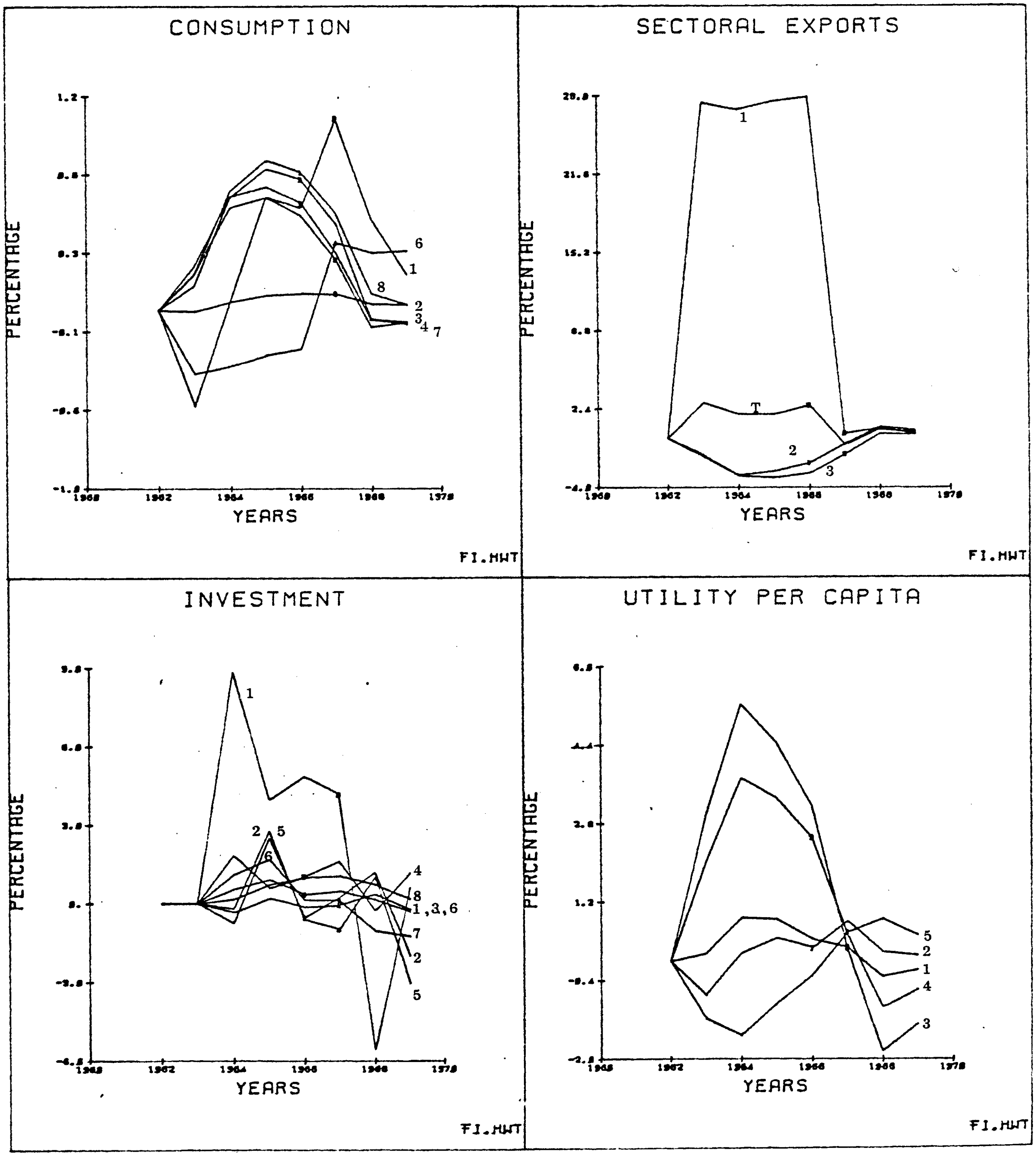

Figure 5.4 continued.

Table 5.4. Results of increasing the world demand for Sector 1 goods by 20 percent (HWT1) in the FI framework.

A. Rates of percentage change in distribution measures.

Year	A(½)	A(2)	T	G
		Total population		
4	1.72	1.37	1.95	1.18
5	2.79	2.02	3.10	1.68
6	1.92	1.64	2.54	1.39
10	-0.37	-0.30	-0.48	-0.48
		Urban population		
4	1.44	1.08	1.64	0.89
5	2.13	1.49	2.56	1.24
6	1.76	0.98	2.12	0.99
10	-0.32	-0.14	-0.36	-0.36

B. Rates of percentage change in dualism measures.

	Year						
	4	5	6	7	8	9	10
M/T	0.44	2.06	0.65	0.38	-0.06	-0.56	-0.27
T/A	-0.42	-1.11	-1.13	-1.03	-0.48	0.08	0.09

C. Composition of savings.

	Year 4	Year 6	Year 10
1	0.10489 (0.09836)	0.08562 (0.08570)	0.06632 (0.07160)
2	0.11260 (0.10559)	0.11519 (0.11529)	0.12658 (0.13666)
3	0.02200 (0.02063)	0.02172 (0.02174)	0.01731 (0.68643)
4	0.72252 (0.67752)	0.68379 (0.68438)	0.63579 (0.68643)
5	0.10441 (0.09790)	0.09281 (0.09289)	0.08022 (0.08661)
TPS	1.06643	0.99914	0.92622
fs	-0.24862	-0.22877	-0.18963
gs	0.18220	0.22963	0.26341
TS	4733.55440	7406.32170	15780.09680

Investment has a much larger function than consumption on outputs. The second year of the boom sees a radically increased investment demand for sector 1, and moderate increases in sectors 6 and 7. These are direct and indirect consequences of the export increase. Overall, the animal spirit parameters decline, because *capital price increases faster than wages*. Investment, therefore, decreases in sectors at times when the demand pressure is realtively weak. For example, sectors 2, 3, and 5 in the second year of the boom: sectors 2 and 3 due to decreased export in the first year of the boom, and sector 5 due to a lack of investment increase in the first year of the boom to counteract the decrease in the animal spirit parameter.

The increase in investment in the other sectors during the second year of the boom, however, heightens the expectation of demand for capital producing sectors, and, therefore, the investment in these sectors jumps up in the third year. Similar oscillation is repeated later. Sector 1 naturally has larger ups and downs in investment; investment in this sector goes up by almost 9 percent relative to the base solution in the second year of the boom, but delcines to a level of 5.6 percent below the base run immediately after the boom.

During the boom, utility levels per capita are higher for urban income classes, but lower for rural residents. The latter is caused by the lower price hike in agricultural goods as opposed to urban goods. Of the urban income classes, the physical capital owners and skill owners improve on their welfare level quite substantially during the boom, whereas the unskilled urban workers increase their utility levels only marginally. When the boom is over, however, the order is completely reversed. Agricultural terms of trade improve because urban goods are now less expensive relative to their own products. Capital owners suffer because the higher accumulation during the boom results in higher stocks of both physical capital and skill, whereas the demand pressure is not so high anymore.

Real GDP and the labor share summarize this. The real GDP increases during the boom but decreases after it, while the labor share again moves in a completely opposite way. Naturally, the savings that finance the increased investment come from the urban income classes plus the government. Especially capitalists and skill owners increase their savings conspicuously. Unskilled worker classes also contribute to increased real savings, except for the traditional unskilled, in the first year of the boom. (This happens because the rate of overall inflation is not too high due to the deterioration of the agricultural terms of trade.) Contrary to what occurs in the case of devaluation, there is now a shift of income from rural to urban areas. This clearly shows up in the distribution measures. All indices during the boom show that overall distribution deteriorates more severely than urban distribution, showing the worsening position of the rural areas. Intraurban distribution also gets worse due to the shift of income away from the unskilled toward capital owners and the increased intraurban wage dualism among the unskilled. The latter occurs because the agricultural income effect is so small in the wage determination mechanism that it is overwhelmed by the inflation effect.

The government, once again, benefits from the increased tax and tariff rates (because higher GDP increases imports), revenues and the fixed nominal wages of government employees.

5.2.2. NC Framework

With an NC closure, the consequences of the export boom look rather different (Figure 5.5 and Table 5.5). The output of sector 1 goes up during the

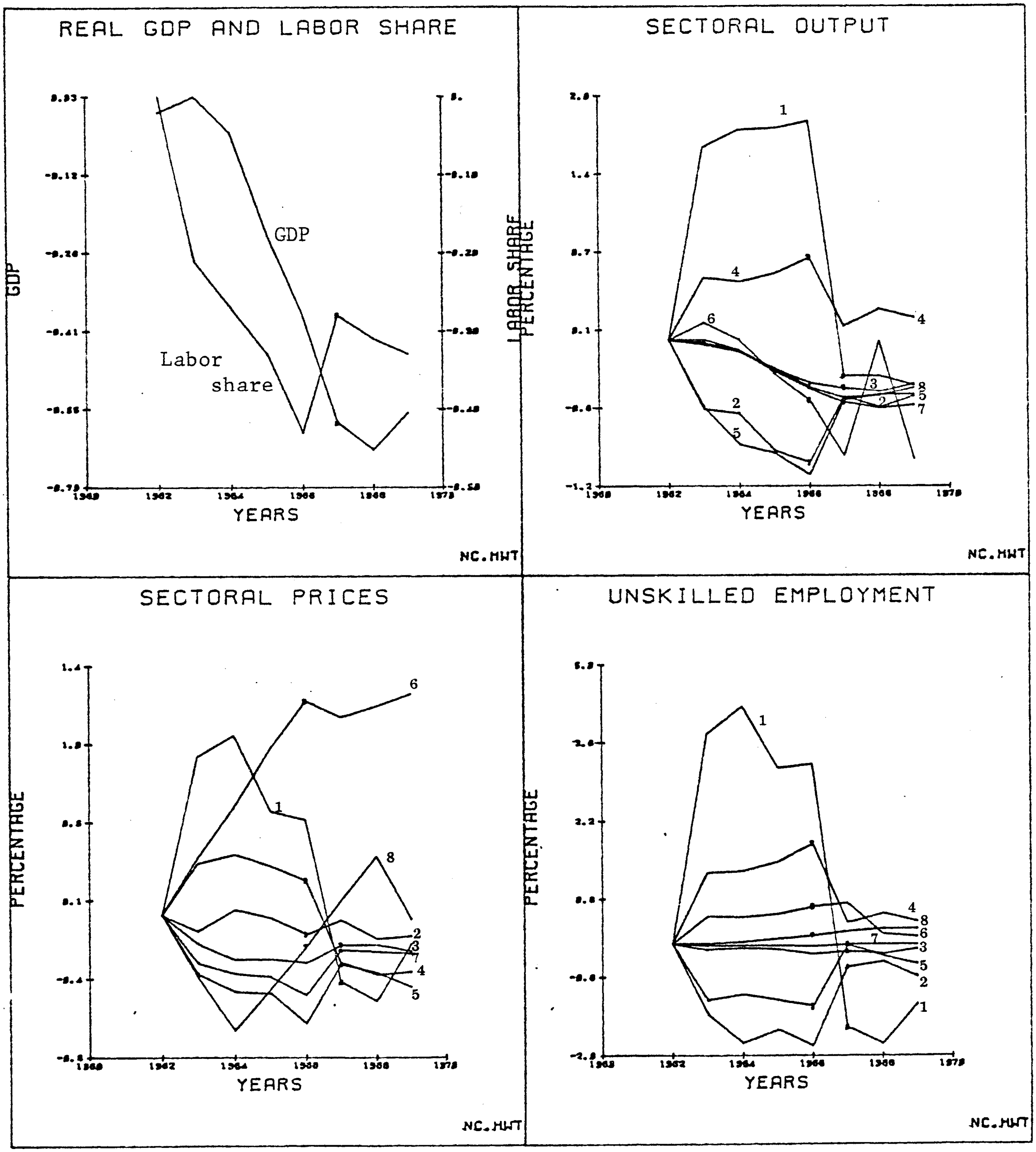

Figure 5.5. Results of increasing world demand for sector 1 goods by 20 percent (HWT1) in the NC framework.

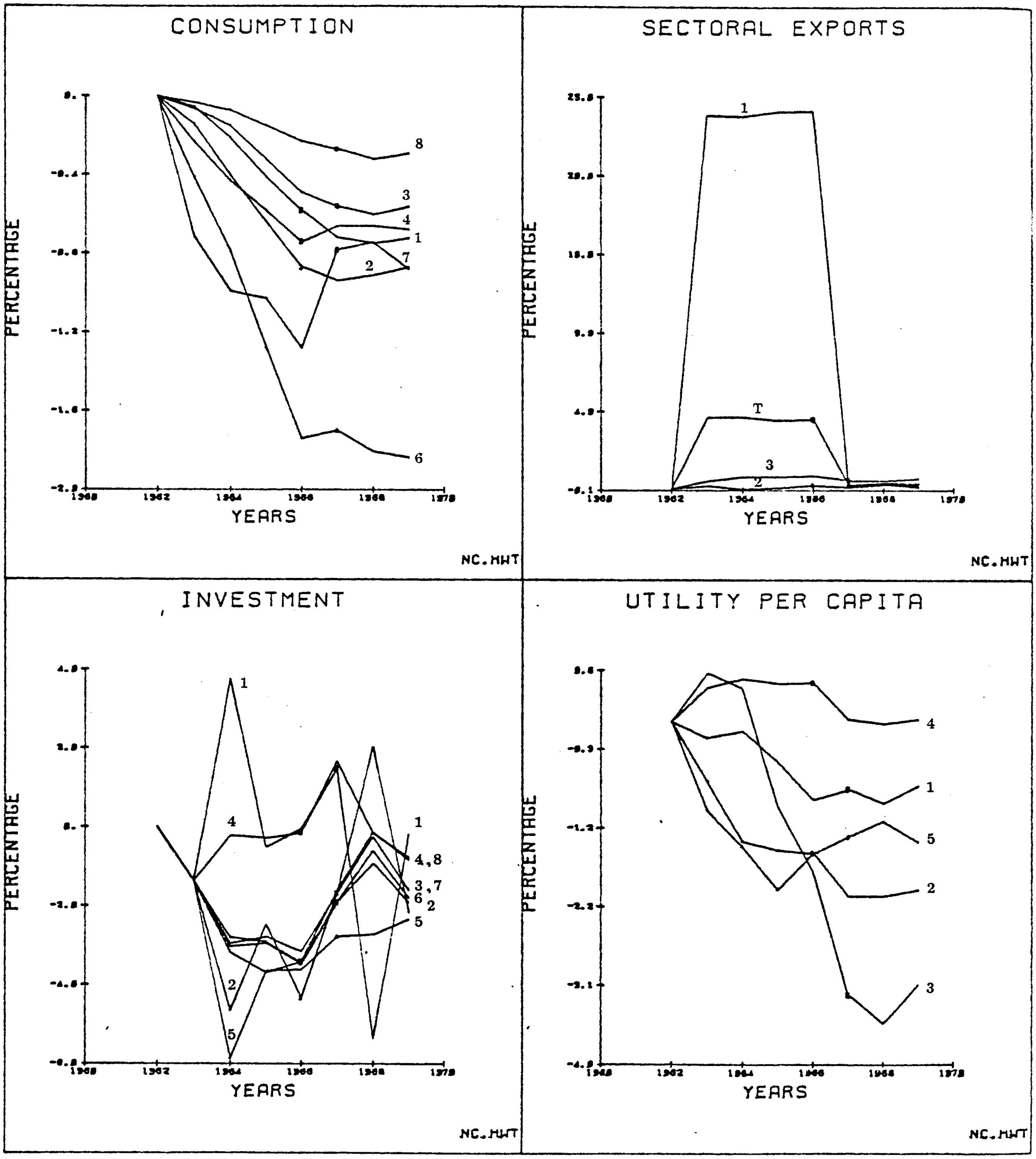

Figure 5.5 continued.

Table 5.5. Results of increasing world demand for sector 1 goods by 20 percent (HWT1) in the NC Closure.

A. Rates of percentage change in distribution measures.

Year	A(½)	A(2)	T	G
		Total population		
4	0.97	0.65	0.80	0.56
6	2.86	2.59	2.80	1.93
10	1.09	0.64	1.12	0.56
		Urban population		
4	0.48	0.54	0.52	0.48
6	3.00	2.50	3.64	2.00
10	0.96	0.83	1.20	0.77

B. Rates of percentage change in dualism measures.

	Year 4	Year 6	Year 10
M/T	0.16	0.44	0.44
T/A	0.09	0.10	-0.22

C. Composition of savings.

	Year 4	Year 6	Year 10
1	0.08586 (0.09697)	0.08934 (0.09320)	0.09899 (0.08816)
2	0.09915 (0.11198)	0.11595 (0.121)	0.14430 (0.12852)
3	0.01966 (0.02220)	0.02218 (0.02314)	0.02184 (0.01945)
4	0.59108 (0.66758)	0.64224 (0.66999)	0.76046 (0.67729)
5	0.08966 (0.10126)	0.08883 (0.09267)	0.09721 (0.08658)
TPS	0.88540 (1.00000)	0.95858	1.12279
fs	-0.05096	-0.15830	-0.36241
gs	0.16556	0.19972	0.23961
TS	6492.5866	7347.09430	9022.0679

boom, but apart from the mining sector whose intermediate input to sector 1 is high, all other sectors have lower outputs than the base run. The key reason can be seen in sectors 2 and 5. Their outputs decrease during the boom showing that the capital investment is below the base run level during this period. Indeed, the investment decreases for the same reason it does when devaluation is used: the decreased foreign savings through higher export demand. With the lower accumulation of capital stocks the real GDP relative to the base run values goes down continuously.

The labor share also decreases continuously, except for one year after the boom. In the first year of the boom, the decline is caused by the shift of urban unskilled labor towards the low labor share sectors, i.e., sectors 1 and 3. The once-and-for-all increase in the share in the year immediately following the end of the boom is caused by the reallocation of unskilled workers in the opposite direction, i.e., away from sectors 1 and 3. The rest of the declining trend in the urban unskilled labor share is explained by the slower physical capital accumulation resulting in a higher labor-capital ratio.

The per capita utility levels show that only capital owners and skilled workers gain in the first year of the boom, although skilled workers' improved welfare is short lived due to the higher rate of growth in skill stock than that of the physical capital stocks. The decline in nominal wages and the decrease in the unskilled labor share, coupled with slower growth, make sure that unskilled labor classes are the losers. Agricultural terms of trade worsens fast, then improves, but finally worsens again. This oscillation is reflected in the utility per capita level of rural residents. The first decline in agricultural terms of trade is due to the higher demand for urban goods relative to rural goods. The last decline is caused by the increased supply capacity of agriculture due to fewer migrants out of agriculture.

The distributional aspects seen from the inequality and dualism measures, also look dismal. They all worsen. Both of the dualism measures increase because the real income of agricultural workers decreases. With the absence of an inflation effect, this naturally pulls down all unskilled wage levels; traditional wages more than modern wages.

5.2.3. IX Framework

The IX closure has a constrained urban unskilled labor supply, while the investment is not constrained *ex ante* by the savings. With the high export demand for sector 1 goods, sector 1 increases its production by absorbing unskilled labor from other sectors. The wage level climbs up to the level of 4.2 percent higher than the base run by the second year of the export boom reflecting the tightness of this labor market. The price of sector 1 goods increase 3.8 percent by that time, but because other prices do not increase as much, the value-added price of this sector goes up almost 6 percent, enabling the expansion of unskilled employment (Figure 5.6 and Table 5.6).

Because sector 1 increases its unskilled employment, some other sectors have to lose it. Sector 4, with high trade and factor substitution elasticities, is one releaser of unskilled workers. Sectors 2 and 3 also lose unskilled workers, not only because they have price-responsive demands, i.e., exports and consumption, and inflationary pressure caused by the export boom reduces these demand quickly, but also because they have very small input ratios to sector 1. The output expansion of sector 1 hardly increases the intermediate input demand from sectors 2 and 3. As a result, these sector prices do not increase enough to counteract the wage increases, therefore, losing the unskilled employment.

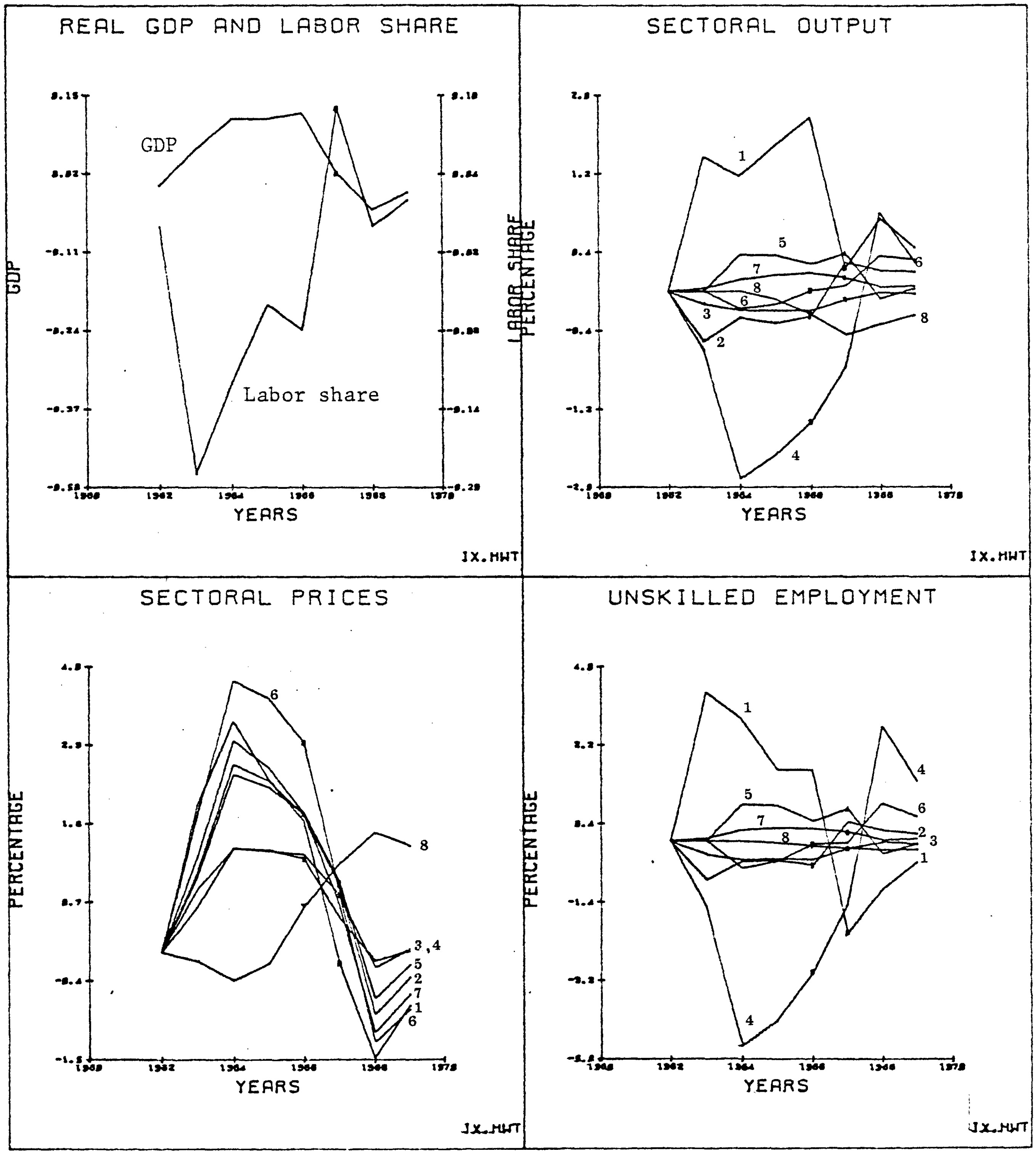

Figure 5.6. Results of increasing world demand for sector 1 goods by 20 percent (HWT1) in the IX framework.

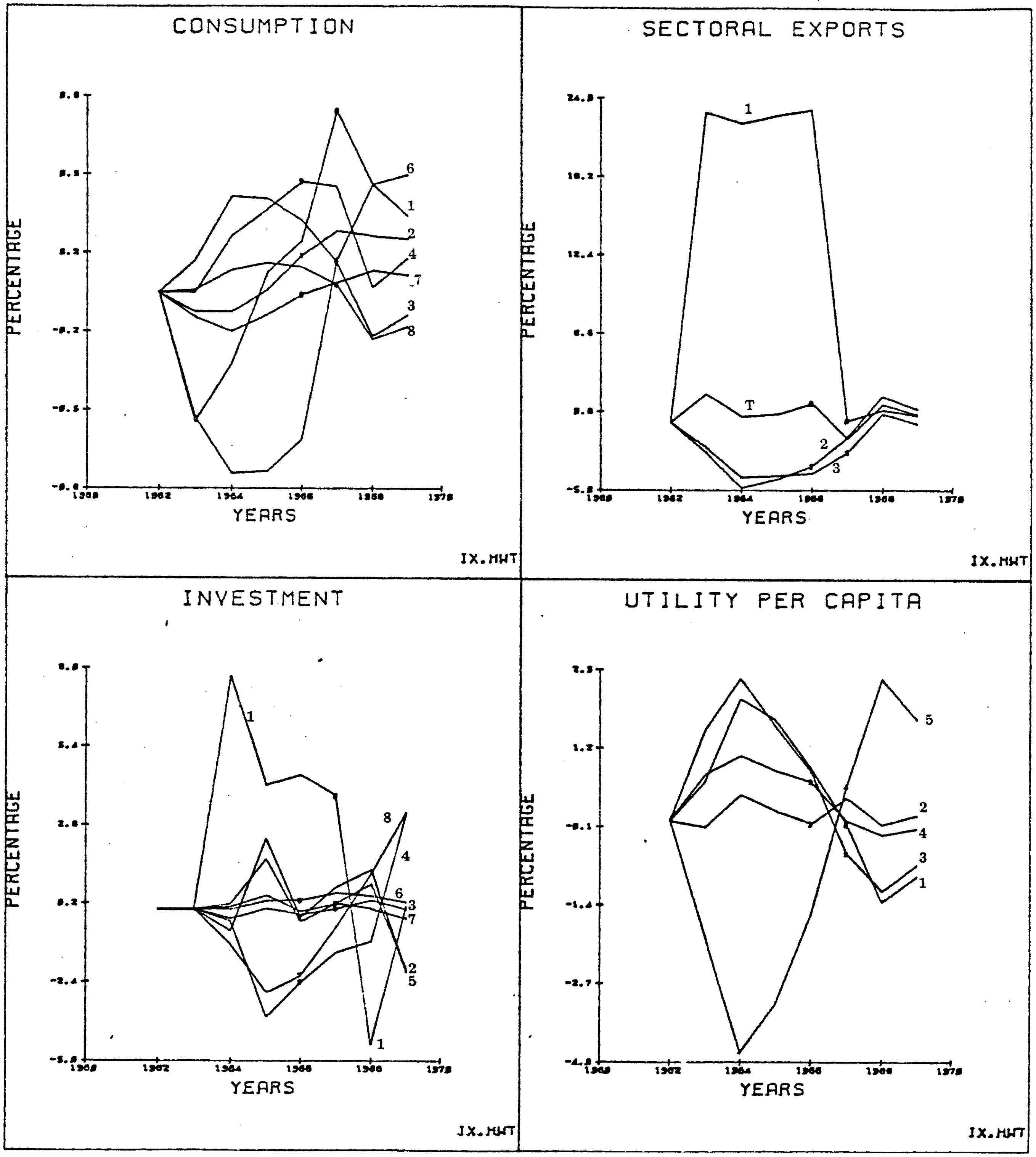

Figure 5.6 continued.

Table 5.6. Results of increasing world demand for sector 1 goods by 20 percent (HWT1) in the IX closure.

A. Rates of percentage change in distribution measures.

Year	A(½)	A(2)	T	G
		Total population		
4	1.14	0.98	1.19	1.14
6	1.06	1.51	1.47	1.55
10	-0.55	-0.92	-0.57	-0.80
		Urban population		
4	0.47	0.52	0.68	0.47
6	0.48	0.53	0.52	0.72
10	0.0	0.0	0.0	0.0

B. Rates of percentage change in dualism measures.

	Year 4	Year 6	Year 10
M/T	1.03	2.07	-1.04
T/A	1.31	3.00	-2.01

C. Composition of savings.

	Year 4	Year 6	Year 10
1	0.09119 (0.09655)	0.08781 (0.09358)	0.07479 (0.08728)
2	0.10246 (0.10847)	0.11143 (0.11875)	0.12462 (0.14544)
3	0.01951 (0.02066)	0.02093 (0.02231)	0.01673 (0.01953)
4	0.63337 (0.67055)	0.63839 (0.68035)	0.57366 (0.669448)
5	0.09801 (0.10377)	0.07976 (0.08501)	0.06707 (0.07827)
TPS	0.94455	0.93832	0.85687
fs	-0.10947	-0.13493	-0.06532
gs	0.16492	0.19660	0.20845
TS	5628.14240	7898.5252	16065.658

The patterns of investment over time look very similar to the FI closure for sectors 1, 2, 3, and 5. Sectors 4 and 8, the primary sectors, however, have much less investment than the base run during the boom, reflecting the lower demand for their goods. Sector 4 that actually has lower real wage (w/pv), has reduced employment, output and investment. This is caused by the very high import elasticities assumed in this model. The moderate increase in this sector's commodity prices induces so much import as to reduce the domestic output relative to the base run. Sector 8 has lower investment because of the worsening of its terms of trade, due mainly to the decrease in intermediate demand.

We now turn to the utility levels per capita. Most noticable is the ups and downs in the level of welfare of rural residents. This is strongly related to the agricultural terms of trade as can be seen in the diagram of prices. Modern workers, both skilled and unskilled, gain most during the boom. This increase in modern sector workers' utility levels is natural considering the increase in demand for sector 1 goods. Note that in FI, the increase of utility per capita for this group of people during the boom is much less than in the IX case, and the increase in the capital owners utility level much higher. This is because in FI the labor supply is perfectly elastic whreas in IX it is not. The reaction after the boom is suddenly over, is a mirror image of what goes on during the boom. The utility levels of modern unskilled workers and skilled workers declines sharply, reflecting the high accumulation of both physical and skill capital stocks in many sectors, in particular, sector 1.

The way total savings become equal with the value of investment is similar to that in FI. Foreign savings decline, although only slightly because of the higher prices and higher GDP. Personal savings and government savings go up. Among the personal savings, the capitalists, skilled workers and modern unskilled workers increase their contributions. In other words, all the classes with higher than average incomes benefit more or less equally. The inequality measures, therefore, do not go up very much compared with the FI case. The urban population especially only suffers a marginal increase in inequality measures. As can be observed, this marginal increase comes from the intraurban wage dualism that worsens much more than in FI. Rural-urban dualism *increases* in IX, reflecting the tight urban unskilled labor market and the deteriorated agricultural terms of trade. Urban wages go up whereas rural income is relatively stagnant.

All in all, this closure, where urban unskilled labor supply is limited, reacts to the exogenous increase by inflation, with wages rapidly increasing to keep total employment unchanged. The real GDP only goes up around 0.1 percent at most (in FI it increased 0.78 percent), and the GDP deflator goes up by 2.6 percent(1.7 percent in FI), in the second year of the boom. Thus, the total benefit to the economy in terms of increased output is small, whereas the losers (rural workers) suffer much more seriously.

5.2.4. Overview of Increased Modern Manufacturing Export Demand

The increased export demand for modern manufacturing goods shows the expected effects of increased outputs and utilities in FI. The loss of foreign savings is compensated for by the shift of income from rural to urban, and within the urban area from unskilled workers to the capitalists and skilled workers. Both the overall and urban income inequality measures increase. However, even the traditional unskilled workers enjoy higher utility per capita during the boom. Only the rural workers lose, but their loss in utility is minor compared to what happens in other closures.

In IX, the overall pattern of response seems similar to that of FI. However, the limited unskilled labor supply does not allow for a rapid growth from the export boom. Certain sectors have to lose unskilled workers to increase the output of sector 1 whose export expands. True,there is a severe shift of income from rural to urban population via changing terms of trade. Within the urban sectors, however, the unskilled workers do not lose their share very much because urban employment does not increase. As a result, wages go up very much, pushing up the inflation and worsening the agricultural terms of trade. The increase in output is marginal whereas the loss of the rural population's utility is substantial.

The NC case shows that there is no possibility for export-led growth in the neoclassical paradigm. The decreased foreign savings are not made up by any segment of the economy. The economy, therefore, experiences a very rapid decline in capital accumulation and the labor share declines as a by-product of the decreased capital-labor ratio. However, this by no means makes up for the loss of savings. Again, the NC fails to work.

5.3. HIGHER ELASTICITIES OF CAPITAL-LABOR SUBSTITUTION

In the next set of dyanmic sensitivity analyses, elasticities of substitution between the composite capital and unskilled labor are increased in most urban sectors. This experiment involves changing the elasticity values for sector 1 from 0.55 to 0.65; for sector 2 from 0.6 to 0.8; for sector 3 from 0.85 to 1.15; for sector 5 from 0.95 to 1.25; for sector 6 from 0.55 to 0.70; and for sector 7 from 0.95 to 1.35. These elasticitiy values reflect some conventional, although not unanimous, knowledge, which says that, especially for traditional sectors and construction, the elasticity of substitution is typically higher than unitary.

5.3.1. FI Framework

In an FI framework, the real GDP grows more rapidly when the elasticities are larger. The real GDP in the 10th year is 5.5 percent more than the base run counterpart. The unskilled labor share declines first and then becomes larger than the base run values. This is because during the first few years capital stocks are growing more rapidly than the unskilled labor force even in efficiency units. With the elasticities of substitution higher than those of the base run, the labor share has to decrease when the production is within AOK in the diagram (Diagram 5.1), and where the capital-labor ratio is close to the base run production point, e.g., C. This is what happens. During the first two years, the capital stocks are exactly the same as in the base run, and the unskilled labor force in each sector does not change significantly (Figure 5.7 and Table 5.7).

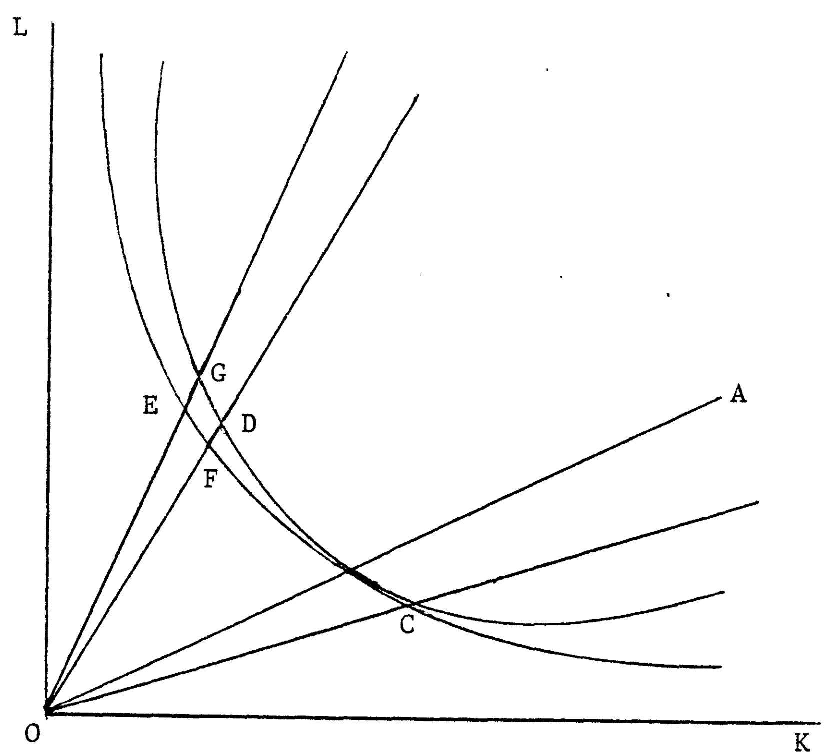

Diagram 5.1.

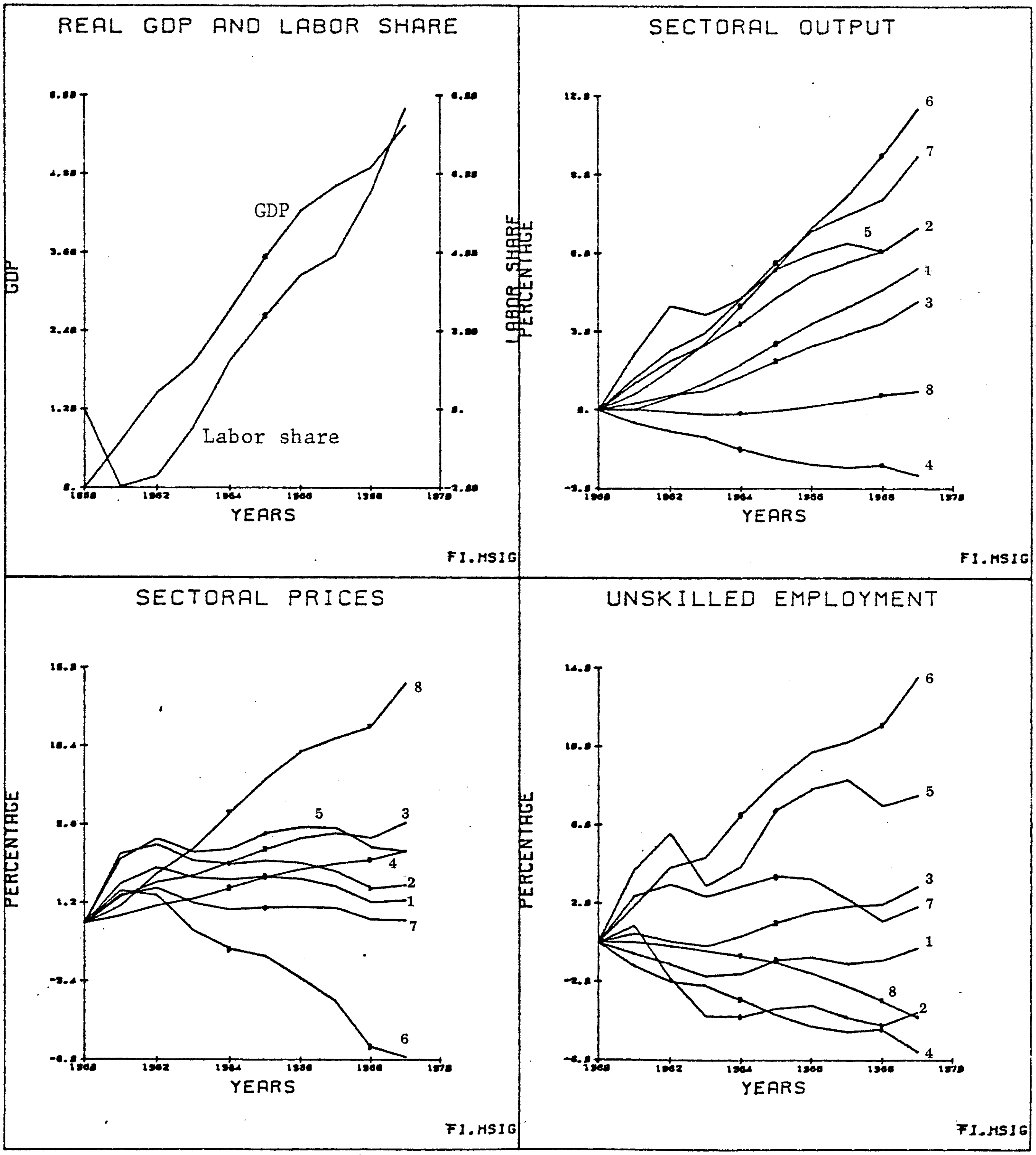

Figure 5.7. Results of a higher elasticity of substitution between unskilled labor and compsoite capital (HSIG) in the FI framework.

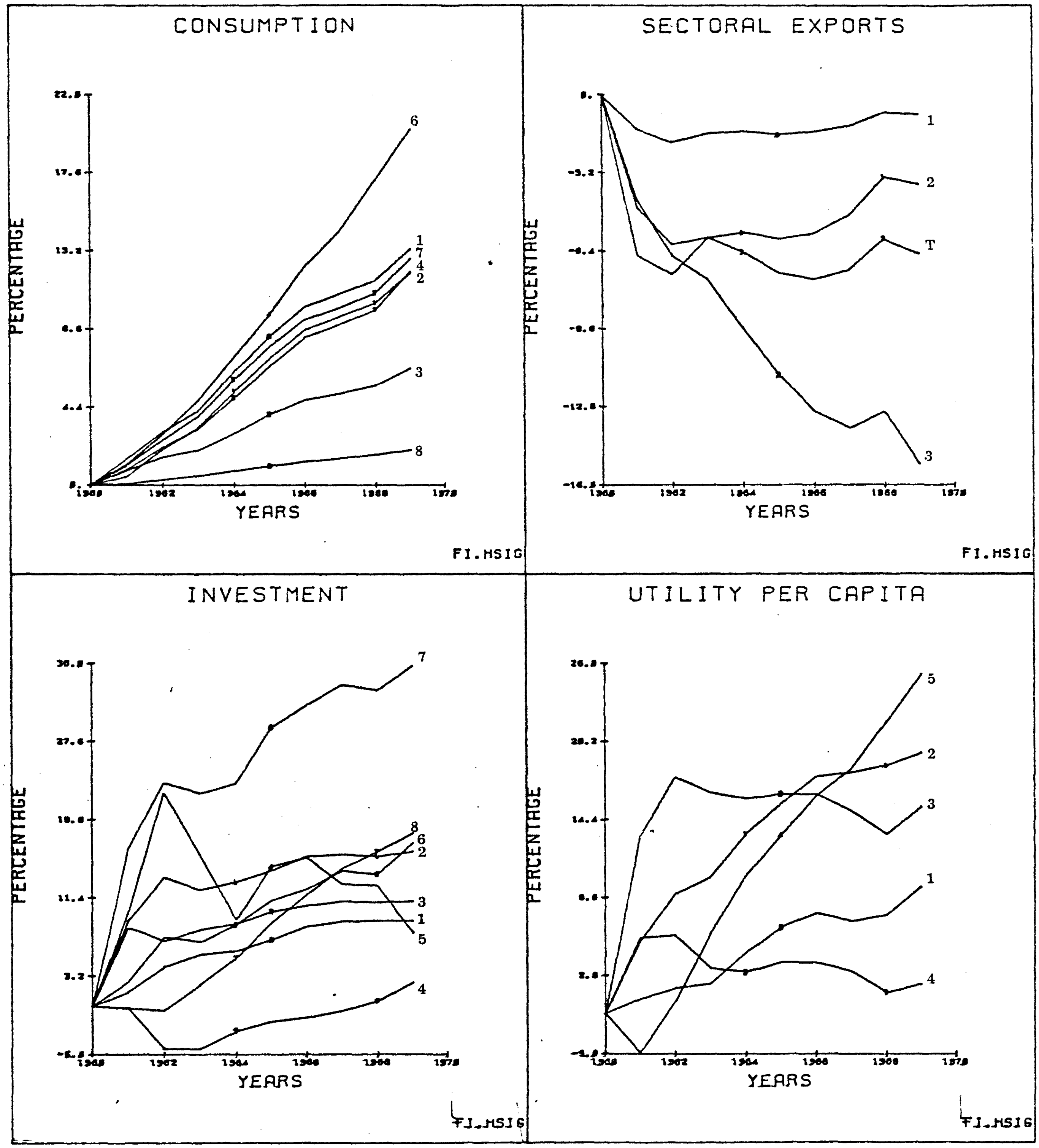

Figure 5.7 continued.

Table 5.7. Results of a higher elasticity of substitution between unskilled labor and composit capital (HSIG) in the FI closure.

A. Rates of percentage change in distribution measures.

Year	A( )	A(2)	T	G
	Total population			
5	- 3.13	-2.75	- 3.37	-2.66
10	-11.22	-9.82	-12,26	-9.36
	Urban population			
5	- 2.64	-2.27	- 2.82	-2.07
10	- 9.20	-7.05	- 9.83	-6.49

B. Rates of percentage change in dualism measures.

	Year 5	Year 10
M/T	-2.54	-5.49
T/A	-7.37	-6.38

C. Composition of savings.

	Year 5	Year 10
1	0.08666 (0.09158)	0.06330 (0.07550)
2	0.10959 (0.11582)	0.12451 (0.14850)
3	0.02192 (0.02317)	0.01834 (0.02187)
4	0.63397 (0.67003)	0.55063 (0.65673)
5	0.09405 (0.09940)	0.08166 (0.09740)
TPS	0.94619	0.83844
fs	-0.14801	-0.09709
gs	0.2081	0.25865
TS	6681.7898	18180.658

When these initial effects are over, the interaction of effects of higher elasticities and of changing capital-labor ratios start to come in, and this results in a monotonous increase of the unskilled labor share. This result comes from the strong upward pressure of the share in sectors 3, 6, and 7 relative to the base run. At first sight, it might look contradictory that all of these four sectors have increased shares, because sector 6 experiences capital shallowing realtive to the base run, and the rest experience capital deepening. The puzzle, however, is solved if we realize that in efficiency units all of these sectors are relatively labor intensive sectors. Then, referring to Diagram 5.1, the comparison is done in the area AOL when the labor share is increasing. For sectors 3 and 7, the shift of the production point inbetween the base run and this run can be characterized by a move from point G to F*, whereas for sector 6 it is from D to E. In both cases, with a sufficient change in the elasticity value, but a limited change in the capital-labor ratio, the labor share increases.

Investments are generally higher than the base run from the second year. This is due to the higher animal spirit parameters** (aided later by higher

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*Sector 5 experiences the same pattern, but the labor share only starts to improve in year 9.

**Assuming C = cost function $= (r^{1-\sigma} + w^{1-\sigma})^{1/1-\sigma}$ the animal spirit is

$$AS = \frac{\partial C}{\partial r} = [1 + (\frac{w}{r})^{1-\sigma}]^{\sigma/1-\sigma}$$

Taking a logarithm of AS and getting the first order derivative with respect to σ will give us

$$\frac{\partial(\ln AS)}{\partial\sigma} = \frac{1}{(1-\sigma)^2} \ln [1 + (\frac{w}{r})^{1-\sigma}] + \frac{\sigma}{1-\sigma} \frac{(\frac{w}{r})^{1-\sigma}}{1 + (\frac{w}{r})^{1-\sigma}} (\ln r - \ln w)$$

This means that if $\sigma \gtrless 1$ and $r \lessgtr w$, then the animal spirit parameters increase with the increase in σ. In the other cases, the Taylor expansion of the first order around w/r = 1 is

$$\frac{\partial(\ln AS)}{\partial\sigma} \simeq \frac{\ln 2}{(1-\sigma)^2} + \frac{\frac{w}{r} - 1}{2}$$

So only in the case where σ is substantially big and w/r significantly less than 1, the animal spirit parameter decreases with the increase of σ

expectations of demand). The increase in these parameters occurs despite the lower expected wage-rental ratios than in the base run. *This naturally is the result of the fact that the economy is already relatively capital intensive.* Although the unskilled employment is lower for sectors 1 and 2 than the base run, the production goes up. This is partly due to this higher physical capital accumulation.

Nearly everybody enjoys a higher level of utility per capita than when the elasticities are smaller due to the higher GDP. Only rural residents lose during the first year or so. This loss is due to the low output growth of sector 3 whose intermediate input coefficient for agricultural goods is quite high. But as physical capital accumulation in agricultural lags behind, and workers leave the agricultural sector, the agricultural terms of trade improve and rural utility per capita increases. Among the urban classes, the utility levels of capitalists and skill workers behave similarly. Both improve rapidly at first as the labor share decreases, but when the accumulation of stocks has proceeded enough and as the labor share starts to increase, the two unskilled labor classes improve on their welfare persistently. The level of utility per capita of the traditional workers' class increases much faster than the modern counterpart, reflecting the higher nominal wage growth of the traditional sectors caused by the rapid increase of agricultural income. The earlier part of the increase in traditional workers' utility is, however, amplified by the fact that some capital income and sector 7 skilled labor income are included in this income class. These factors and the increase in construction workers, account for most of the first years' increase of this class's income growth.

The economy first feels the change of the technical parameters in the second year, when the demand for investment goods suddenly increases due to the high animal spirit parameter in the first year. Because the capital stock is still at the same level as the base year, the increased investment has to be produced by increased unskilled employment, which, of course, accompanies the inflation. Urban sector prices, especially the capital goods related sectors increase their output prices. Agricultural prices do not go up as much. The intraurban wage dualism, therefore, increases slightly in the first two or three years because the inflation effect is much larger than the agricultural income effect. Then, as capital stock increases and the demand for agricultural goods picks up, the latter effect takes over and the intraurban dualism tends to go down. Inflation, however, does not worsen the distribution of income very much because of the higher elasticities of substitution assumed. The inequality measures go down very quickly after the fourth year of the simulation. In addition, we can observe that $A(\frac{1}{2})$ and T go down more than the other two, showing that the upper part of the distribution is becoming more equal.

Capitalists are definitely losing their share. This is also visible from the composition of savings. Everybody has increased real savings but only capitalists lose their share by the fifth year. Note also that the higher price and higher GDP depress exports and increase imports, thus increasing foreign savings significantly.

5.3.2. NC Framework

The situation is not radically different in NC (Figure 5.8 and Table 5.8). The overall change, however, is small. The real GDP goes up and is 2.9 percent higher in the 10th year than in the same year of the NC base run. The labor share declines during the first half of the decade and then increases during the second half. The first decline is again explained by the higher

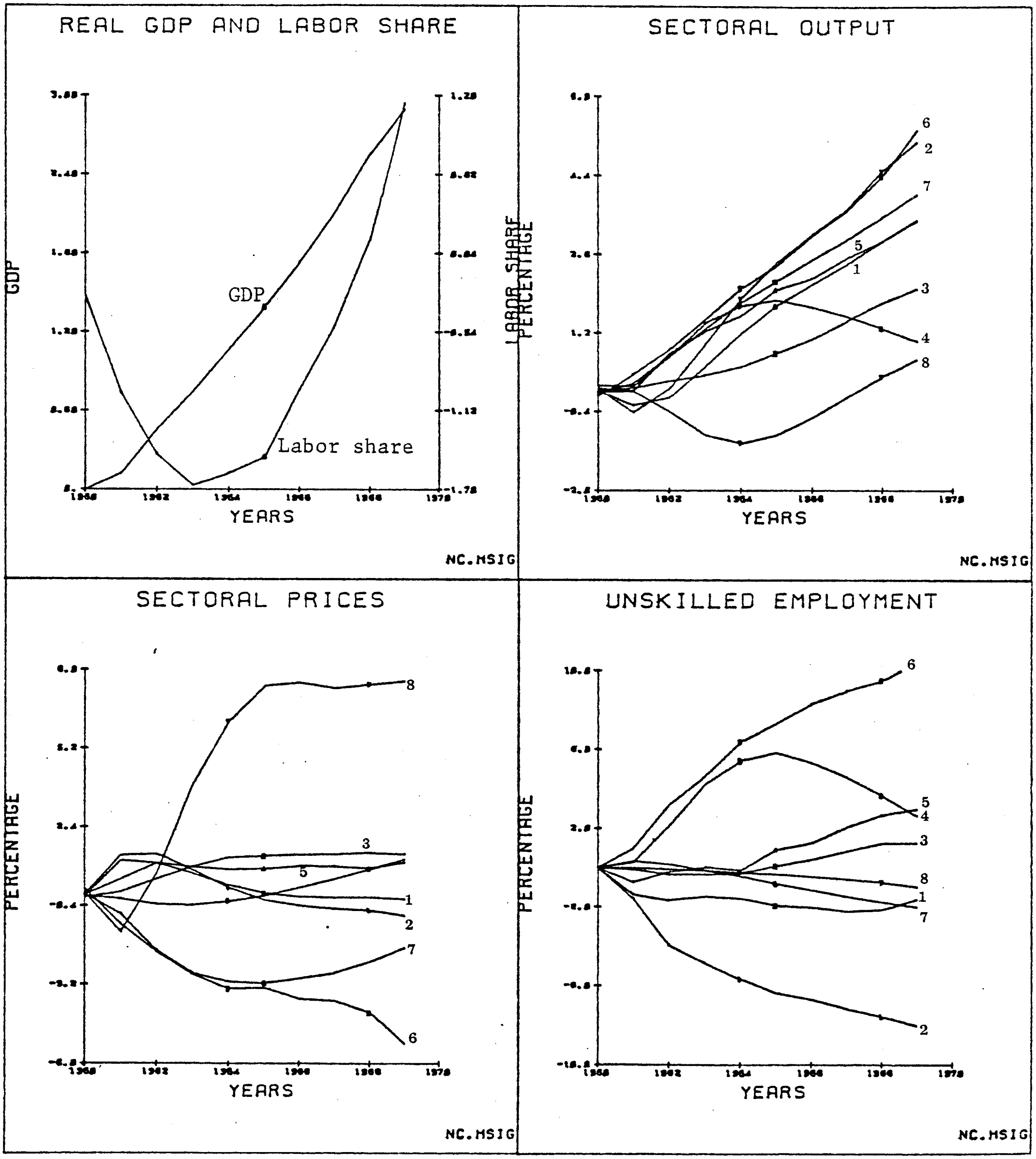

Figure 5.8. Results of a higher elasticity of substitution between unskilled labor and composite capital (HSIG) in the NC framework.

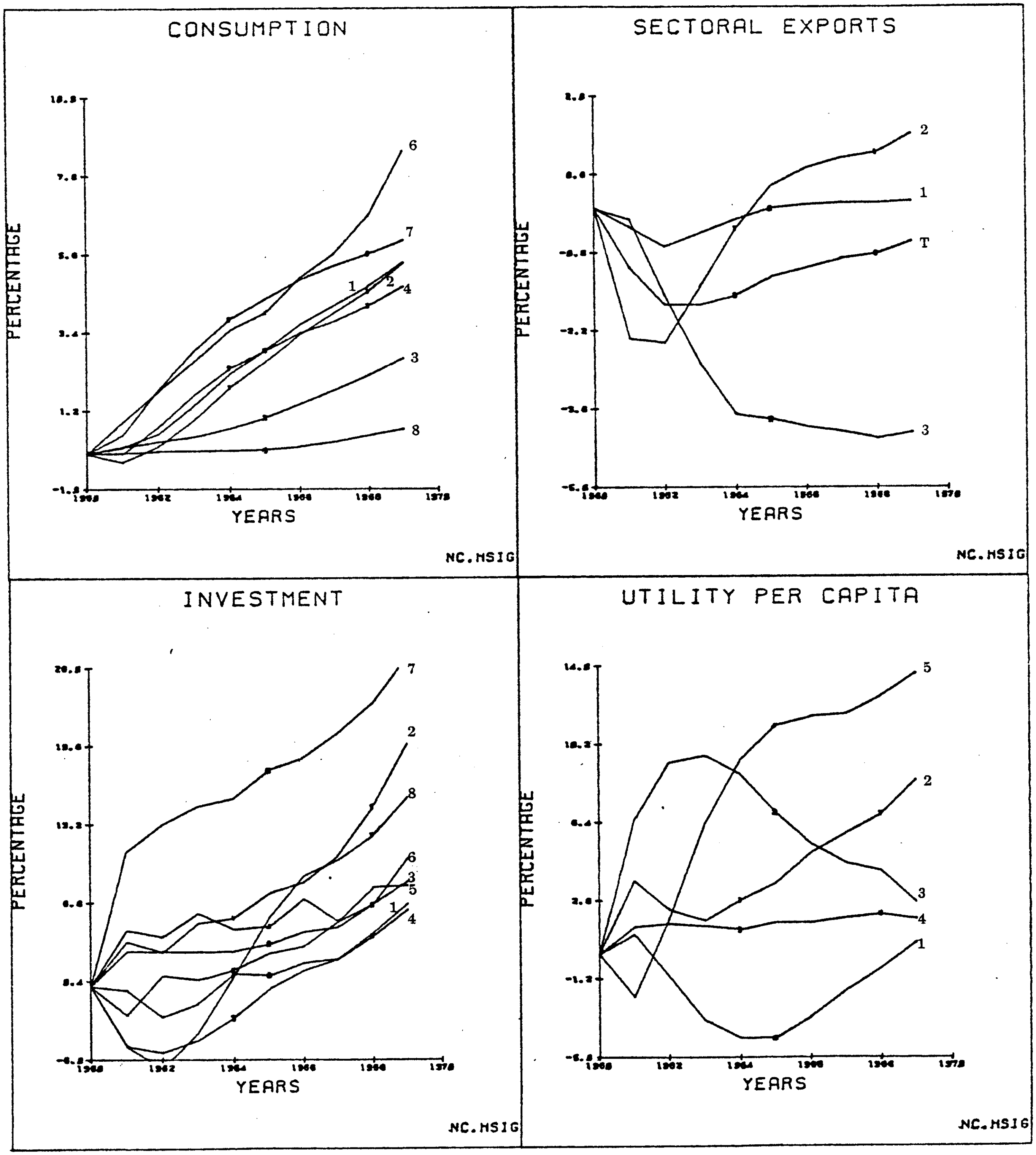

Figure 5.8 continued.

Table 5.8. Results of a higher elasticity of substitution between unskilled labor and composit capital (HSIG) in the NC closure.

A. Rates of percentage change in distribution measures.

Year	A(½)	A(2)	T	G
	Total population			
5	-1.71	-1.94	-1.58	-2.49
10	-4.92	-5.11	-5.24	-5.28
	Urban population			
5	0.0	0.27	0.18	-0.24
10	-2.89	-2.50	-2.90	-2.84

B. Rates of percentage change in dualism measures.

	Year 5	Year 10
M/T	-3.54	-5.49
T/A	-7.37	-6.38

C. Composition of savings

	Year 5	Year 10
1	0.08193 (0.09273)	0.09388 (0.08874)
2	0.10384 (0.11750)	0.13947 (0.13184)
3	0.02176 (0.02463)	0.02286 (0.02161)
4	0.58549 (0.66270)	0.70332 (0.66480)
5	0.09048 (0.10241)	0.09840 (0.09302)
TPS	0.88350	1.05793
fs	-0.06465	-0.29839
gs	0.18115	0.24046
TS	7197.2238	9692.1338

elasticities without significant changes in factor allocations from the base run. Also, the higher speed of capital accumulation in this run relative to the base run after the third year delays the recovery of the labor share. The increase of this share in the second half of the decade comes from the fact that there are more urban unskilled workers than in the base run, and more of them are employed in the high labor share sector (sector 6).

Sectoral outputs mostly go up relative to the base run except for the second year when reallocation of the unskilled labor before capital stocks are adjusted causes a minor dip in modern manufacturing sectors. Wages in these sectors are kept relatively high with unchanged capital stocks, decreasing the labor employment and output. The mining sector output goes up during the first half of the simulation and then declines. This wave is caused by the movement of the unskilled labor employment. It is worthwhile to repeat that with the high trade and technical elasticities of the mining goods, this sector indicates how tight the urban unskilled labor market is when the supply of this factor is fixed. Agricultural output shows an opposite pattern to that of mining, it decreases then increases. This is because the faster employment shift out of agriculture decreases its labor force during the time when the capital stock in this sector is not yet high.

The real investment grows relatively slowly at first. This can be explained by the higher relative price of the capital, particularly sector 2 goods, caused by the slower growth of this sector's output compared to the others. The capital price increases whereas the consumer's price index or GDP deflator goes down. Consequently, the total savings deflated by the capital price is relatively small at first compared with the base run values. Those sectors without significant increases in animal spirit parameters, therefore, have lower physical investment than the base run at first, i.e, sectors 1, 4, 6, and 8. As explained earlier, these are the sectors with no or relatively small increases in the elasticity of substitution.

The increased investment from the second year onwards is first financed by skilled workers and expanded foreign and government savings, later being joined by the traditional unskilled and rural residents.

Utility levels per capita behave more or less as expected from the above. Rural utility starts low but shoots up rapidly, and from the fifth year is the highest relative to the base run of all the five income classes. This, again, is a reflection of the movement of the relative price of agricultural goods. The slow investment and increased outmigration are the reasons why this price goes up so fast. Urban unskilled workers have first reduced and then increased utilities per capita relative to the base run. This is the result of the movement of the unskilled labor share. Of course, with higher elasticities and more stocks of physical capital in the economy than in the base run, the demand for unskilled labor tends to go down. But as the economy grows more rapidly, the unskilled labor demand starts to go up again, causing these U-shapes in the utility levels of the unskilled workers.

The workers in traditional sectors are better off relatively than the modern unskilled. This is because the increase in unskilled labor shares is larger in the traditional sectors than in the modern sectors due to the larger change in elasticities, and because agricultural income goes up faster than in the base run. Skilled workers have very high utility per capita at first, but this graudally decreases to almost the level of the base run by the 10th year. The larger increase in skilled labor over physical capital stocks is the cause of this. As a reflection of the slow increase in capitalist's income and improved agricultural terms of trade, the inequality measures of the total population as well as the dualism measures, decrease.

However, the decreased income for the modern unskilled workers, and the high increase in skilled income worsens the intra-urban distribution at first, but this problem quickly disappears as the unskilled labor demand picks up.

5.3.3. IX Framework

In IX, the real GDP is 5.2 percent higher than the IX base run in the 10th year, a value much closer to the FI version than to the NC. The labor share goes down first and then goes up: the same pattern as in the last two versions. But the dip is shallow, and the speed of increase very slow. This is naturally a result of the interaction of complex factors, i.e., technologies and factor intensities of all sectors, but essentially it is explained by the higher physical capital accumulation in this run. The labor-capital ratio remains low, even in efficiency units. With an elasticity of substitution higher than in the base run, the labor shares are kept low in many sectors (Figure 5.9 and Table 5.9).

The sectoral output growth rates overall look similar to those of NC. The differences are that the general growth rates are higher in IX; the construction sector in particular, goes faster in IX, and the mining sector declines first in IX. These are explained by the higher investment in IX. With higher investment, the economy grows faster, especially the capital goods producing sectors, and if the economy is growing faster, the mining sector can easily lose because the unskilled labor market is tighter. The mining sector plays the role of a "safety valve" as explained earlier.

Prices move as expected. Urban prices generally go down as a trend with the higher investment (and unchanged other demand structures). Agricultural prices go up because of the relatively lower investment, and higher migration

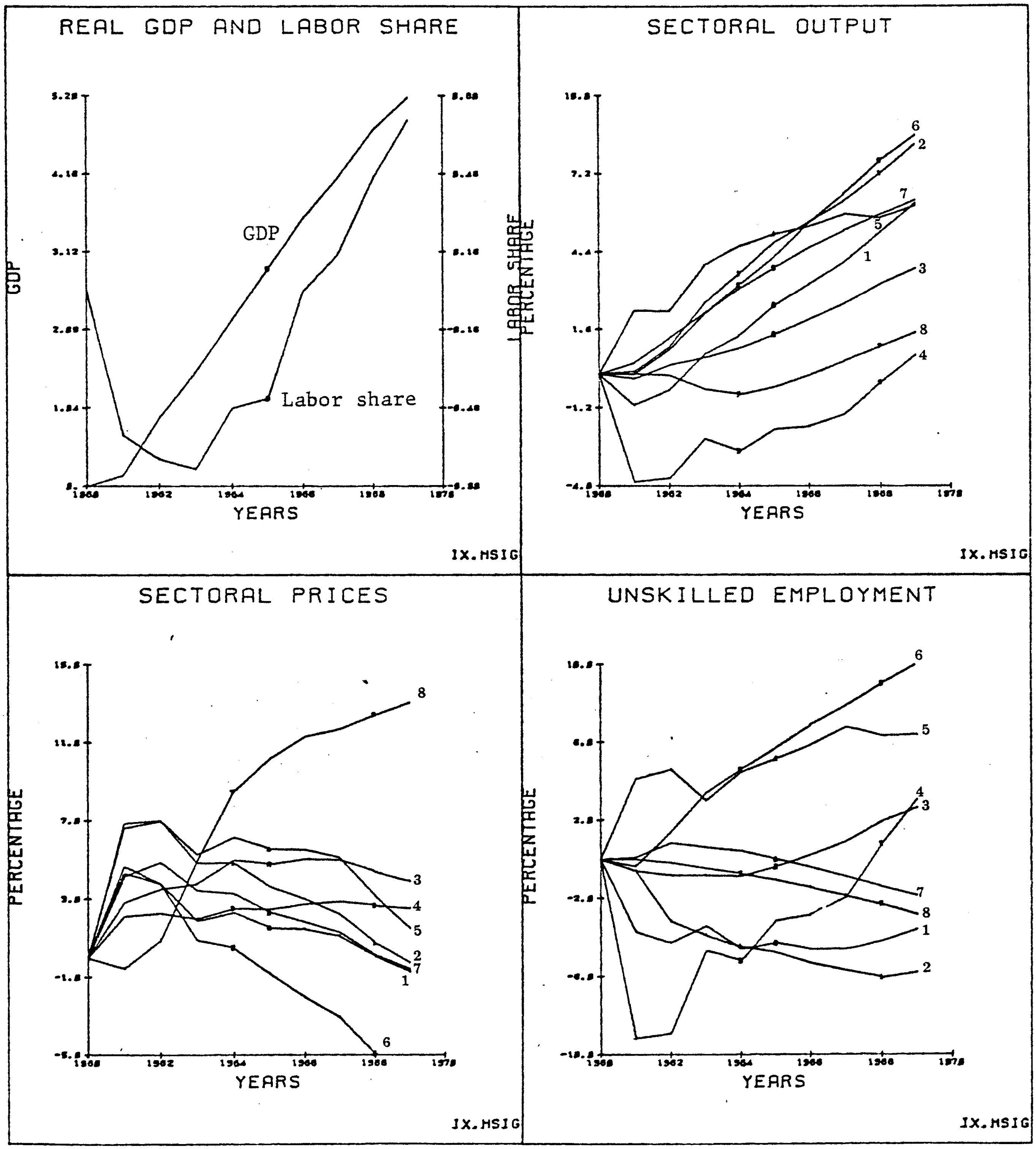

Figure 5.9. Results of a higher elasticity of substitution between unskilled labor and composit capital (HSIG) in the IX framework.

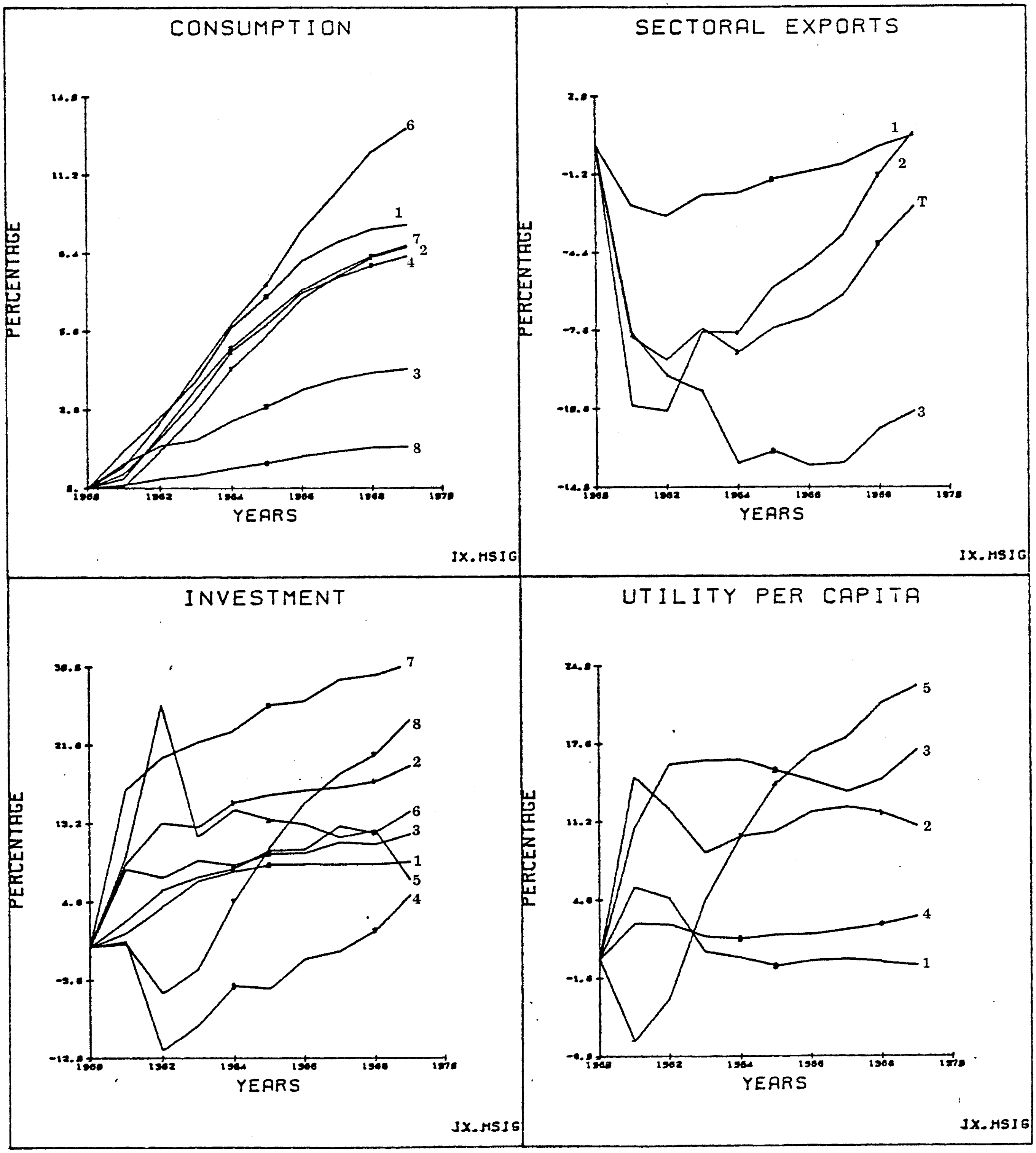

Figure 5.9 continued.

Table 5.9. Results of a higher elasticity of substitution between unskilled labor and compositecapital (HSIG) in the IX framework.

A. Rates of percentage change in distribution measure.

Year	$A(\frac{1}{2})$	A(2)	T	G
	Total population			
5	-2.72	-2.18	-3.01	12.41
10	-6.56	-6.75	-6.45	-2.93
	Urban population			
5	-1.88	-1.32	-2.04	-1.43
10	-2.07	-2.07	-3.32	-3.25

B. Rates of percentage change in dualism measures.

	Year 5	Year 10
M/T	-1.61	- 8.48
T/A	-3.80	-11.88

C. Composition of savings.

	Year 5	Year 10
1	0.08036 (0.09271)	0.06927 (0.08543)
2	0.10107 (0.11661)	0.12049 (0.14860)
3	0.02080 (0.0280)	0.01910 (0.02355)
4	0.58005 (0.66923)	0.53332 (0.65771)
5	0.08447 (0.09745)	0.06870 (0.08472)
TPS	0.86675	0.81089
fs	-0.04624	-0.02455
gs	0.17939	0.21367
TS	7659.5426	17710.0718

cause the supply to go down. The initial low investment is caused by the lower intermediate demand for this sector's goods due to the compositional change of outputs.

Levels of utility per capita move quite similarly to the NC case. The differences are: the skilled workers' utility per capita does not fall because there are proportionate increases in physical capital investment; and the levels of utility per capita for unskilled workers (income classes 1 and 2), no longer improve towards the end, reflecting the very slow overall increase in the unskilled labor share.

The sudden increase of investment in the second year comes as a shock to the economy, which tries to produce more with higher unskilled employment. The unskilled labor, however, is limited in supply. The wage level, therefore, goes up causing inflation. Inflation, however, does not increase the capitalists' income because the aggregate labor-capital ratio is fixed. Increased investment, therefore, is financed mainly by changes in foreign savings, followed at first by government savings. Later on, the rural population, traditional unskilled and skilled workers join to finance the higher investment. Essentially, therefore, the extra investment is at first financed by the general inflation, and later by the structural change and growth of the economy.

Income distribution changes accordingly. First the total population inequality measure goes down slightly because of the agricultural terms of trade deterioration. From then on inequality constantly decreases. The same is true for the dualism.

5.3.4. Overview of Higher Elasticities of Substitution

In general, the more flexibility given to the economy by the increased substitutability among production factors seems to produce positive effects in all three closures. The economy grows faster and income distribution is more equal. The higher growth is financed first, in all closures, by expanded foreign savings and then by skilled workers, traditional unskilled workers, and rural workers. Captialists never really come out as "winners" in these experiments because the unskilled labor shares do not decrease very much at any time in any closures, whereas the skilled labor share increases disporportionately. The rural workers lose at first because the investment increase is the only change that happens in the economy, and agriculture does not supply much intermediate input to the capital producing sectors. As the economy starts to grow in harmony, however, and more workers outmigrate, the agricultural terms of trade shoot up, shifting the distribution of income heavily towards the rural sector.

As far as the growth rates are concerned, NC grows very much more slowly than the other two closures, naturally because increases in animal spirit parameters are not translated directly to investment increases. They are deflated by the available savings in the economy that go up, but slowly.

5.4. HIGHER RATES OF POPULATION GROWTH WITHOUT ADDITIONAL LABOR FORCE

This section and the following two sections examine some of the demographic implications upon the economy. First, we examine a case when the total population is growing twice as rapidly as the base run, but not the labor force, meaning, for example, such a situation as having more children in an economy where compulsory education is well-spread. These children are consumers but they do not participate in the labor force. In this section, the consequences of this are examined, without considering such dynamic effects as human capital accumulation through providing the children with more education. After all, this section deals only with a 10-year simulation, and 10 years is a short enough period not to have to consider such long-run dynamic effects. Consideration of these effects, however, should be done in the future with more elaborate specifications of demographic aspects and government behavior.

5.4.1. FI Framework

As expected, this change has largely negative impacts. Real GDP declines monotonously relative to the base FI run until the eighth year, then it comes up a little closer to the base run, however, it is still 0.16 percent less in the 10th year. The total population is 8.05 percent higher than the base run in the same year, reducing the real GDP per capita in this run to the level of 8.2 percent lower than the base run. Essentially, there are more mouths to feed. The employment in nonagricultural sectors, however, "declines" relative to the base run, i.e., despite the existence of more dependents, the urban unemployed increased in number. This is because having more mouths to feed means higher consumption demand for such income inelastic and essential items as food. The agricultural prices go up, so does the agricultural income per agricultural worker. Urban nominal wages have to go up accordingly. The modern sector prices, however, go up at different speeds from the traditional sector prices. Reflecting the inflexible consumption demand for traditional sector goods per head and investment demand, prices of sectors 3, 5, and 7 go up much more rapidly than the prices of sectors 1, 4, and 6. The price of sector 2, a sector that produces both investment and income elastic consumption goods, behaves somewhere in between. The price increase, however, is not large enough to counteract the nominal wage hike. As a result, the real wages go up for all urban sectors reducing urban unskilled employed as stated above. The decrease in unskilled employment is much larger for modern sectors because their wages go up with the agricultural income but their prices either stay fairly constant or even decrease relative to the base run (Figure 5.10 and Table 5.10).

The unskilled employment of the traditional sectors (sectors 3, 5, and 7) decreases by a small margin during the first four years, after which it starts to increase relatively, and all these sectors have higher unskilled employment in the 10th year than the base run. This comes from the increased consumption and intermediate demand for their goods.

Investment demands also show completely different behavior between the modern and traditional sectors. Sectors 3, 5, 7, and 8 have higher investment than the base run for most years, whereas sectors 1, 2, 4, and 6 have consistently lower amounts of investment throughout the simulation. These differences are the result of the differences in expectation in demand. The animal spirit parameters are similar to the base run values for most sectors, but demand expectation fluctuates very highly.

Levels of utility per capita of all income classes behave similarly. They all decline monotonously relative to the base run values. These levels for capitalists and skilled workers decline least because of their originally high income per capita*. Among the unskilled, the second income class (the traditional sector workers) lose more than class 1 at first. Eventually, however, the former overtakes the latter due to the relatively fast increase in both of the wage levels and unskilled employment in traditional sectors,

*Examining again real income per worker and per consumer, we can see that capitalists and skilled workers actually lose. These two values ryw and ryc respectively, and utility per capita (upc) relative to the base run are shown

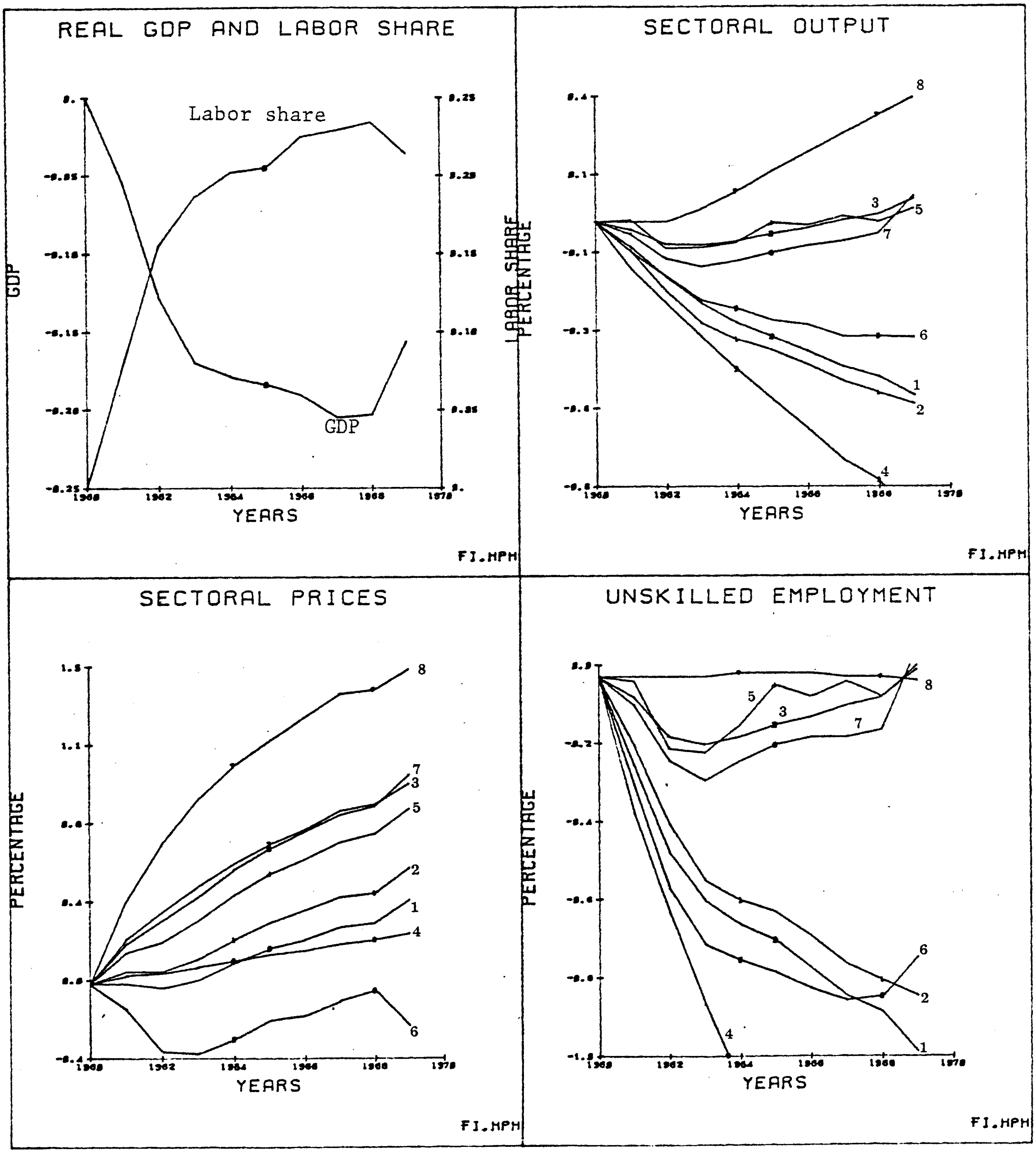

Figure 5.10. Results of higher population growth without proportionate labor force growth (HPOPH).

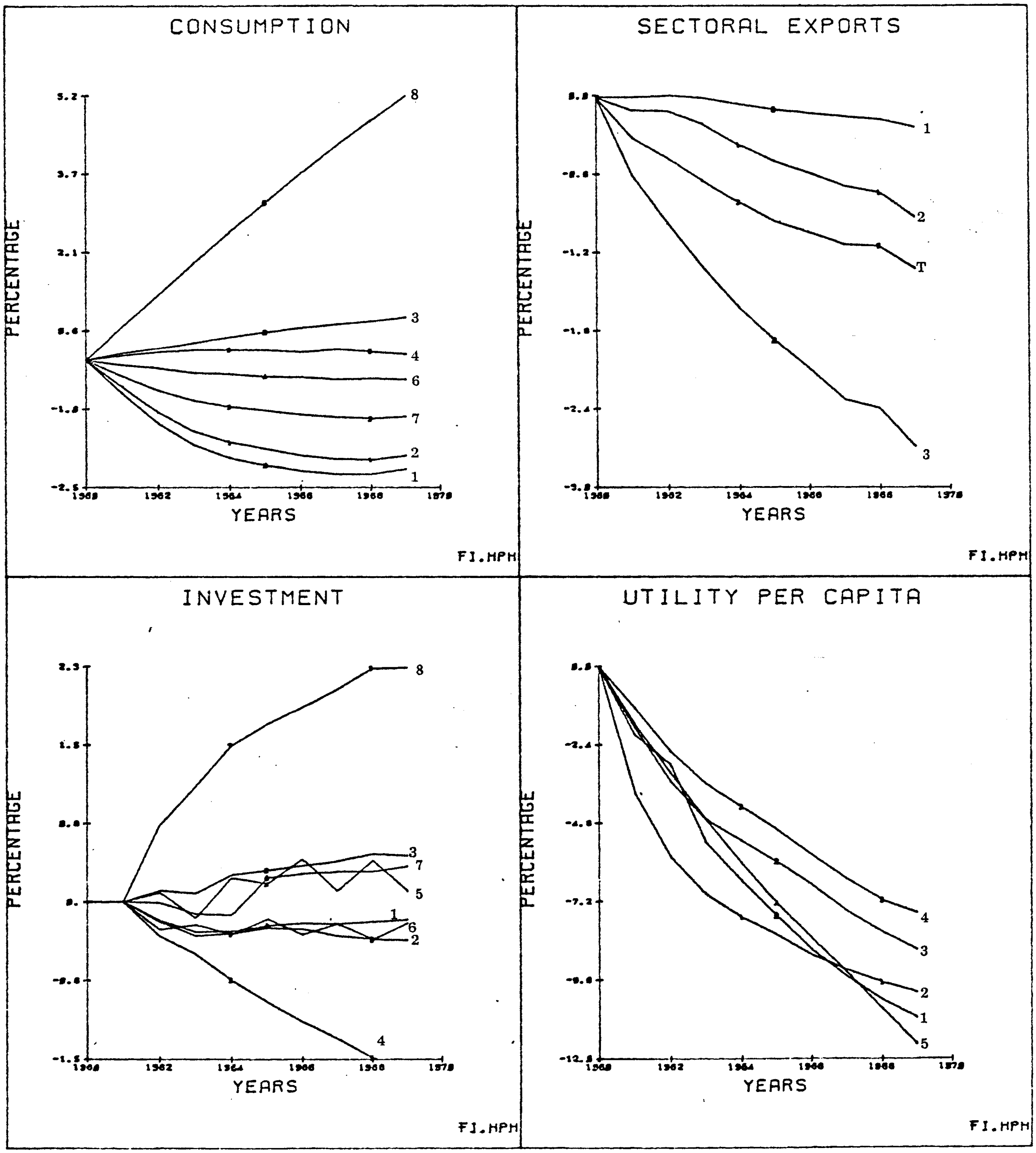

Figure 5.10 continued.

Table 5.10. Results of higher population growth without proportionate labor force growth (HPOPH) in FI closure.

A. Rates of percentage change in distribution measures.

Year	$A(\frac{1}{2})$	A(2)	T	G
		Total population		
10	-0.43	0.09	-0.25	0.10
		Urban population		
10	-0.48	-0.24	-0.46	-0.64

B. Rates of percentage change in dualism measures.

	Year 10
M/T	-0.31
T/A	-0.92

C. Composition of savings.

	Year 10
1	0.06516 (0.07117)
2	0.12572 (0.13730)
3	0.01706 (0.01863)
4	0.62772 (0.68556)
5	0.07997 (0.08734)
TPS	0.91563
fs	-0.17663
gs	0.26100
TS	16101.8027

caused by the strong demand for the goods of these sectors and increase in agricultural income. The unskilled labor share increases relatively, reflecting the smaller amount of employment in the economy. This is another reason capitalists and skilled workers lose their real income more as noted in the footnote.

5.4.2. NC Framework

The NC run does not give a macro pattern drastically different from the FI (Figure 5.11 and Table 5.11). Real GDP is 0.1 percent below the NC base run by the 10th year. The unskilled labor share is persistently above the base run. The real GDP per capita decreases around 8.14 percent by the 10th year. The levels of utility per capita behave very similarly. Not only are they about the same values as the FI solution in the 10th year, but their pattern of movement over time is so similar that these two are almost indistinguishable. These levels decline consistently and the rural residents' level of utility declines most rapidly, whereas the levels of unskilled workers goes down faster at first and then slows down.

The change is more conspicuous in the traditional sector workers, as their level goes down faster than their modern sector counterparts at the beginning, but later it becomes relatively higher. If we look at the sector breakdown, however, the picture is not similar. The sectors that have outputs

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in the table for the 10th year:

	ryw	ryc	upc
1	-0.27	-7.3	-10.8
2	0.30	-6.9	-10.0
3	-0.70	-7.9	- 8.7
4	-0.53	-7.8	- 7.5
5	0.95	-9.1	-11.6

After all, the utility levels fall quite quickly if expenditure falls the same percentage point, when one is closer to the subsistence minimum than when one is farily well off.

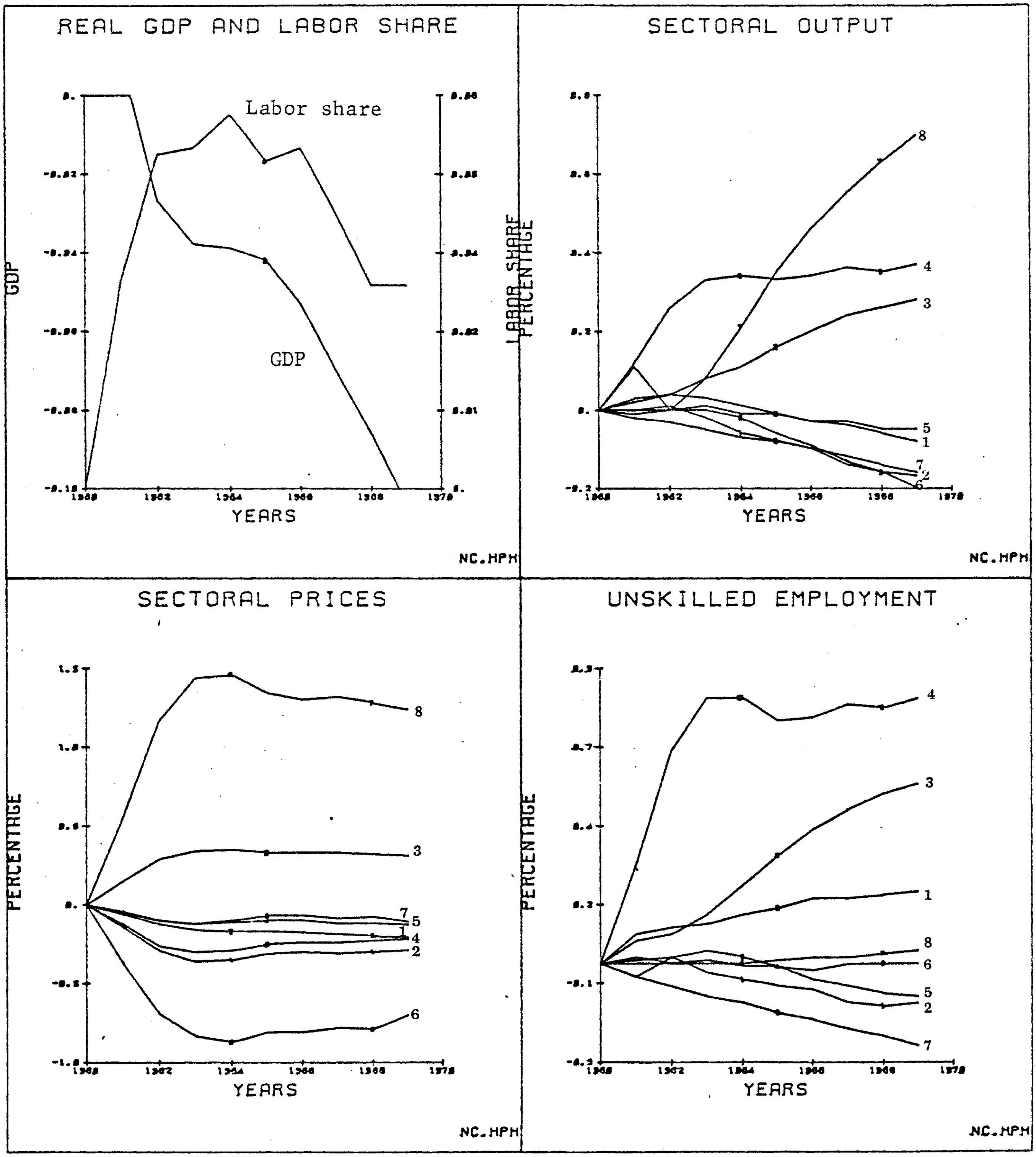


Figure 5.11. Results of higher population growth without proportionate labor force growth (HPOPH) in the NC framework.

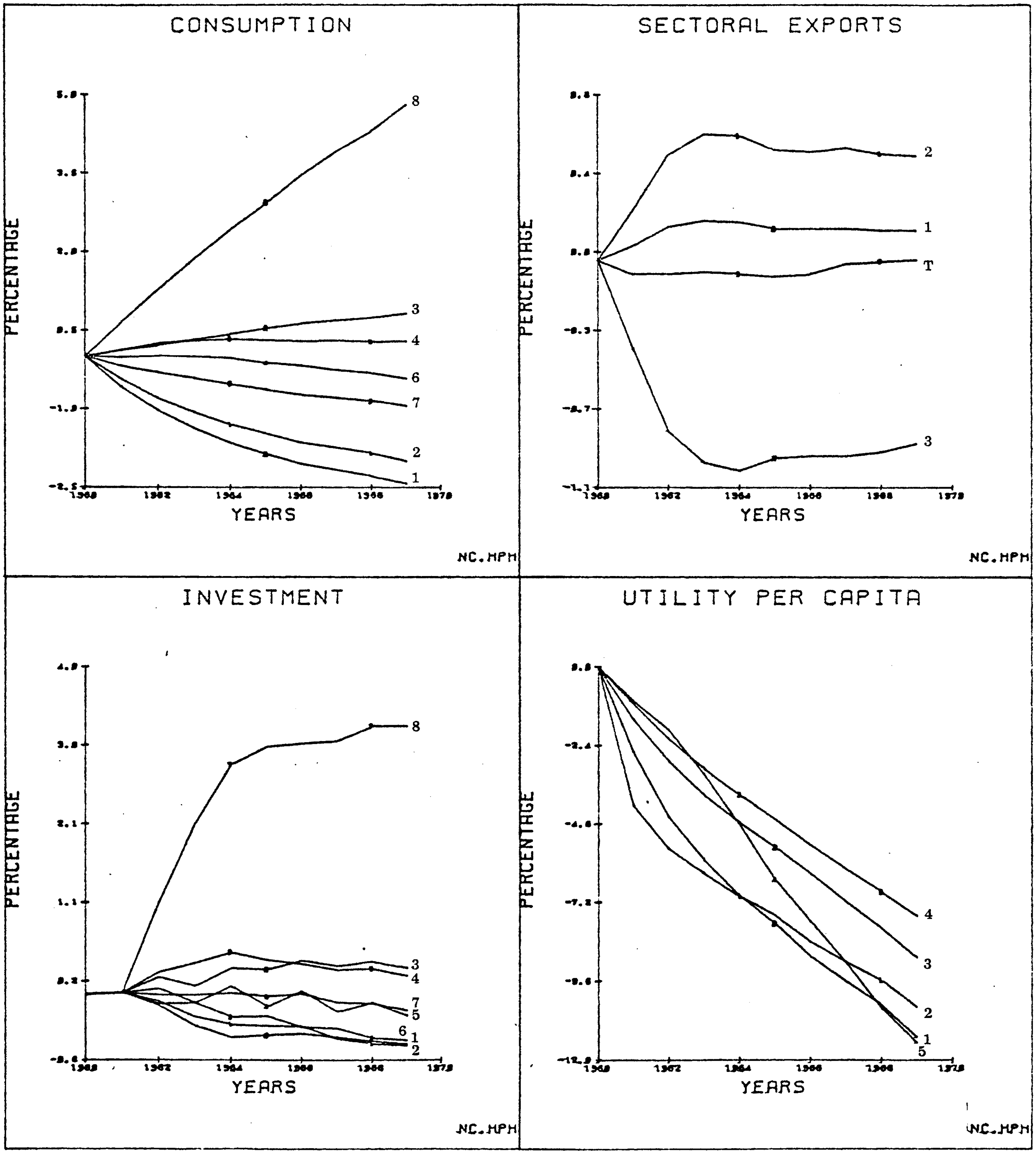


Figure 5.11 continued.

Table 5.11. Results of higher population growth without proportionate labor force growth (HPOPH) in NC closure.

A. Rates of percentage change in distribution measures.

Year	A(½)	A(2)	T	G
		Total population		
10	-0.56	-0.22	-0.15	0.12
		Urban population		
10	-0.45	-0.23	-0.22	-0.26

B. Rates of percentage change in dualism measures.

	Year 10
M/T	-0.85
T/A	-2.15

C. Composition of savings.

	Year 10
1	0.09792 (0.08810)
2	0.14475 (0.13023)
3	0.02203 (0.01982)
4	0.74846 (0.67337)
5	0.09834 (0.08848)
TPS	1.11151
fs	-0.35032
gs	0.23881
TS	9098.4872

higher than the base run are sectors 3, 4, and 8. The reason sector 4 has such a high output can be traced to the fact that in the model this sector behaves very much as the adjusting factor of the unskilled employment. The unskilled labor market is not tight and this sector absorbs more labor than the base run. The increase in output of sectors 3 and 8 is the direct result of the consumption increase caused by the population pressure. They have relatively high minimum subsistence consumption levels. As can be seen, however, the consumption demand is less than 20 percent of the total sector output. Most goes to intermediate input demand. The increase in the output of sector 3, therefore, facilitates a great deal to increasing the output of sector 8.

All other sector outputs behave similarly. Sectors 1 and 5 have a little higher outputs relative to the base run values than do sectors 2, 6, and 7. The movement of sector 5 output is more or less the movement of private construction investment. The output of sector 1 is relatively high despite its highest decrease in household consumption demand. It is, again, because intermediate input demand for this sector dominates this sector's output movement. The same applies to sector 2. On the other hand, sector 7's output is more strongly influenced by the consumption demand than by the intermediate input demand.

The physical investment goes up in those same sectors where output goes up, i.e., 3, 4, and 8. We have higher values of animal spirit parameters than the base run values in sectors 3, 4, 5, 7, and 8. For sectors 5 and 7, however, the decreasing trend in outputs overweighs and investment fails to increase. Again the modern sectors are the biggest losers as far as physical accumulation is concerned. Sectors 1, 2, and 6 have the lowest and consistently declining physical investment relative to the base run, due to the lower animal spirit parameters which in turn, are the result of relatively large decreases in nominal wages in these sectors, plus the declining trend in demand for these sector's goods.

5.4.3. IX Framework

The IX framework has a pattern very similar to NC. Only sectors 3, 4, and 8 have persistently higher output than the IX base run. Reflecting the higher investment, however, sector 5's output oscillates around the level of the base run (Figure 5.12 and Table 5.12).

5.4.4. Overview of Population Growth Without Labor Force Growth

This set of experiments show that it is difficult to get an economy to grow by an increased consumption demand for traditional commodities, at least in the medium term. Income shifts from capitalists to the rural workers and eventually towards the traditional unskilled workers as well. Distribution, therefore, improves despite the decrease in per capita output.

Not everything is as dismal as it looks, however. In FI, the real savings (nominal savings deflated by a capital price) actually are higher than in the base run, and accelerate over time. This increase comes from the higher foreign and rural savings through inflation and shifting terms of trade. The higher animal spirit parameters (in all sectors) coupled with higher expected demand in traditional sectors, produce this result. As agricultural capital stock increases, the favorable agricultural terms of trade cease to exist and the urban wage level will slowly but surely come down increasing employment and output. This is clearly visible in the behavior of real GDP during the last years.

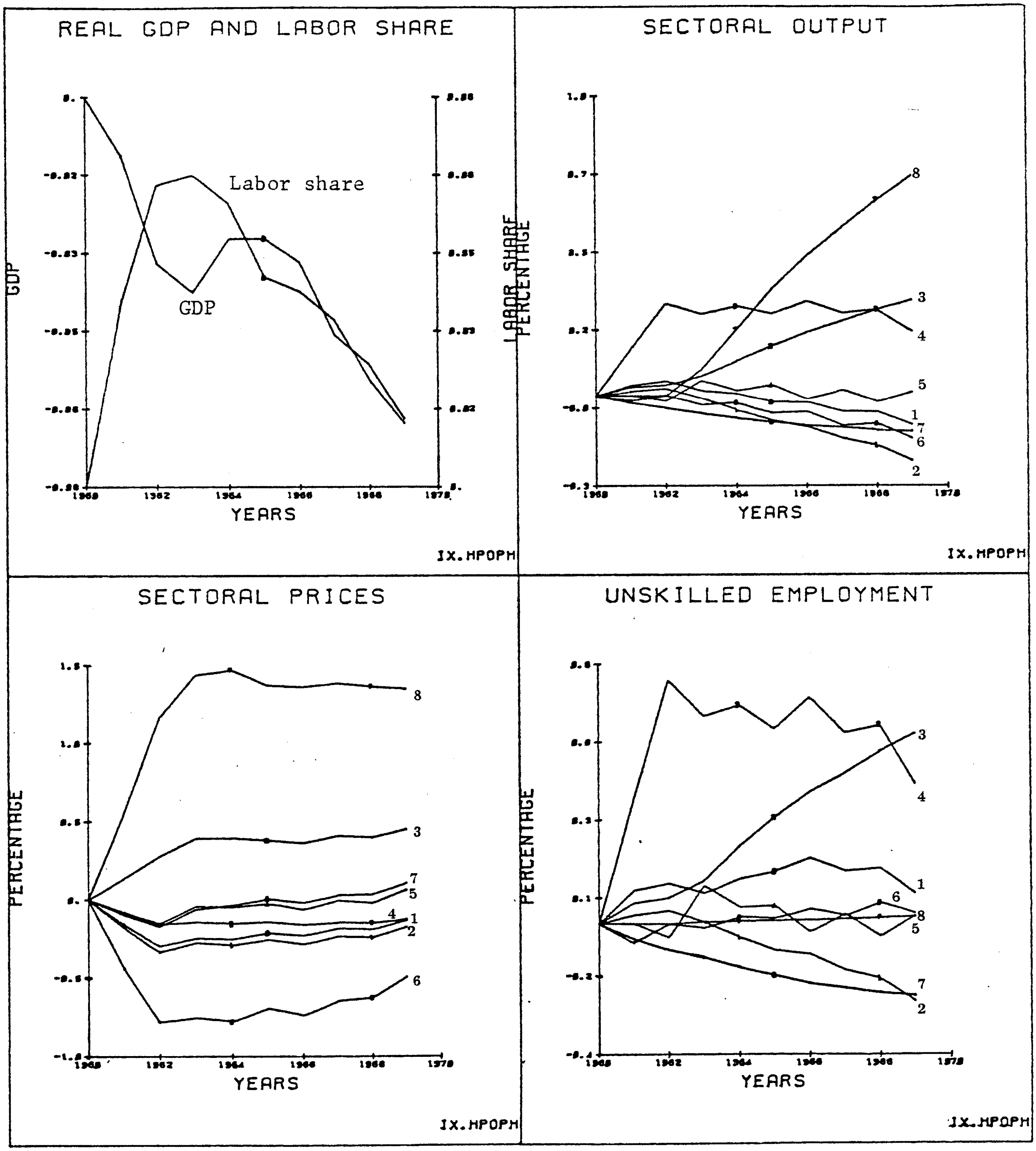


Figure 5.12. Results of higher population growth without proportionate labor force growth (HPOPH) in IX framework.

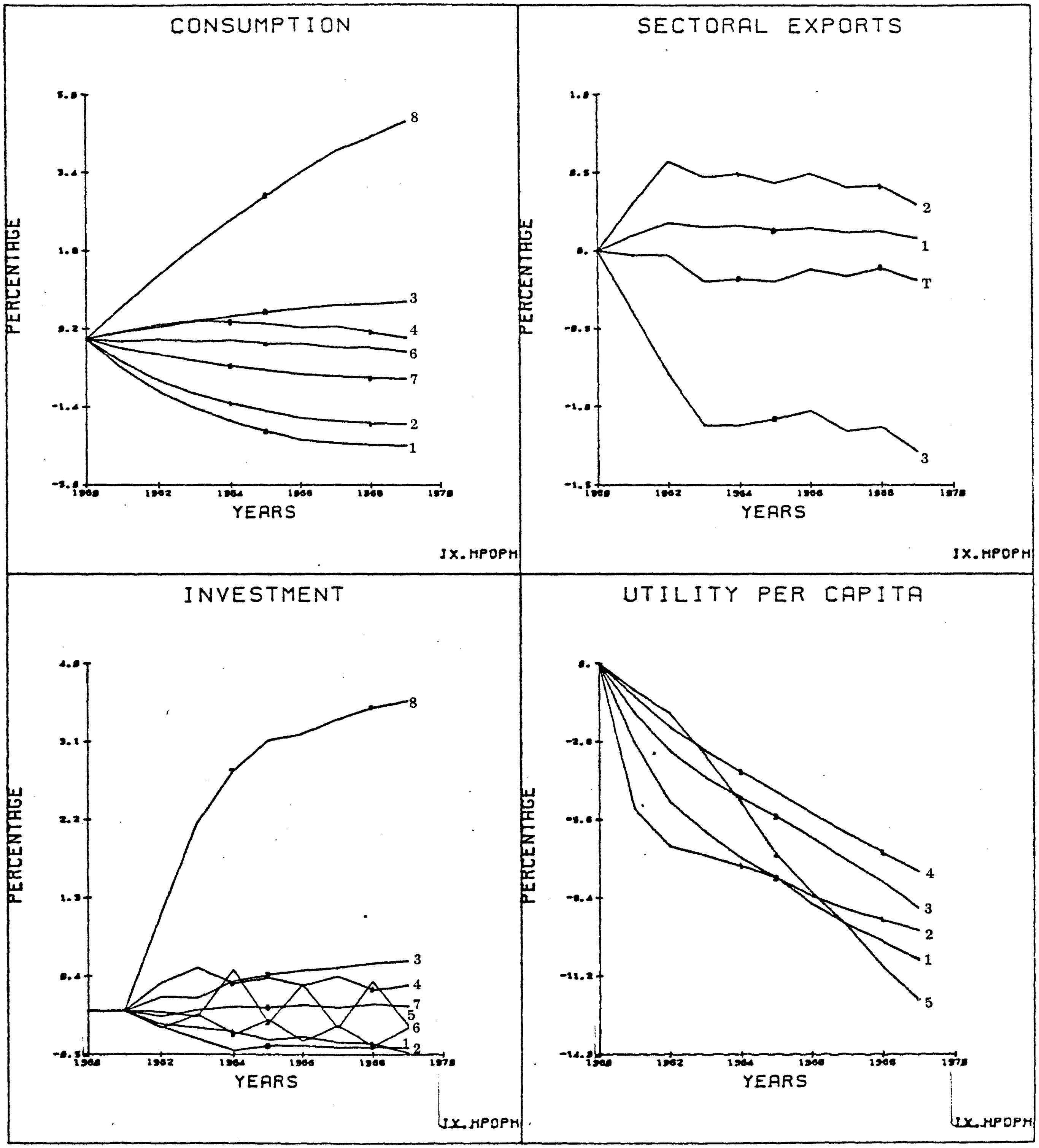


Figure 5.12 continued.

Table 5.12. Results of higher population growth without proportionate labor force growth (HPOPH) in IX closure.

A. Rates of percentage change in distribution measures.

Year	$A(\frac{1}{2})$	A(2)	T	G
		Total population		
10	-0.11	0.42	0.15	0.05
		Urban population		
10	-0.24	-0.08	-0.34	-0.44

B. Rates of percentage change in dualism measures.

	Year 10
M/T	-1.03
T/A	-2.11

C. Composition of savings.

	Year 10
1	0.07444 (0.08712)
2	0.12462 (0.14584)
3	0.01668 (0.01951)
4	0.57170 (0.66906)
5	0.06705 (0.07847)
TPS	0.85448
fs	-0.06271
gs	0.20823
TS	16144.0385

NC, however, is more dismal. The real savings are again higher than in the base run, but the difference is decreasing very rapidly. The major decrease comes from foreign savings: with a tendency for prices of tradeable goods to decline, especially during the second half of the simulation.

In IX, the outcome is mixed. The real savings are less than in the base run, but it increases towards the end of the period. The decrease in real savings is caused by the decline in investment, which, in turn, is the result of the decreased animal spirits in many sectors. Labor demand also starts to go up towards the end, and if this brings up investment then there is hope in this closure as well.

5.5. POPULATION GROWTH WITH PROPORTIONATE LABOR FORCE GROWTH

We now let the urban and rural populations *and* their respective labor forces grow at twice the rates of the base run. This amounts to comparing two steady growth states of population. The difference between this set of runs and the previous set, where only populations increase, can be regarded as warnings to the general equilibrium modelers who only use the labor forces and regard them as populations as well.

5.5.1. FI Framework

This run amounts to increasing the total population and the agricultural labor force, because we assume a perfectly elastic supply of the urban unskilled. More agricultural labor force means higher output from this sector, and despite the fact that household consumption of agricultural goods increase even faster than its output, other demands (exports, intermediate inputs, and investment demands) do not keep up with the output increase and the price of this good falls. This fall appears as a decline in nominal agricultural income per worker, and all the urban nominal wages decline as well. Traditional sector wages decline more than modern sector wages in accordance with the wage determination mechanism assumed (Figure 5.13 and Table 5.13).

This decrease in nominal wage levels would increase the employment of the unskilled workers in each sector provided that the demand is such that the prices do not fall more than the wage levels do. This is what happens and all urban unskilled employment expands relative to the base run. Sector 3 increases its unskilled employment significantly because all household consumption demand, export demand, and intermediate input demand show a strong tendency to expand. Sector 1 expands its unskilled employment and output next to sector 3 due mainly to the increase in intermediate demand. For this sector good, the household consumption demand is actually less than the base run and exports are only nominally larger than the base run values. But these two demands are negligible relative to the intermediate input demands. Similarly with sector 2. Strong intermediate demand and export demand coupled with moderate increase in investment demand keep the sector 2 output relatively high. Service sectors, sectors 6 and 7, increase their outputs only moderately. For sector 6 it is mainly due to the fall in household consumption demand, i.e., with more population in the economy people consume more essentially-needed commodities and less modern and possibly luxury goods. For sector 7, it is the slow increase in the mark-up demand that keeps the output increase relatively moderate. The smallest increase in output occurs in sector 5, construction, reflecting the weak demand for physical capital investment relative to the base run.

Investment in physical capital stocks actually increases for sectors 1, 2, 3, 4, and 6, i.e., the modern sectors and the traditional manufacturing sector, despite the fact that the animal spirit parameters decrease in all

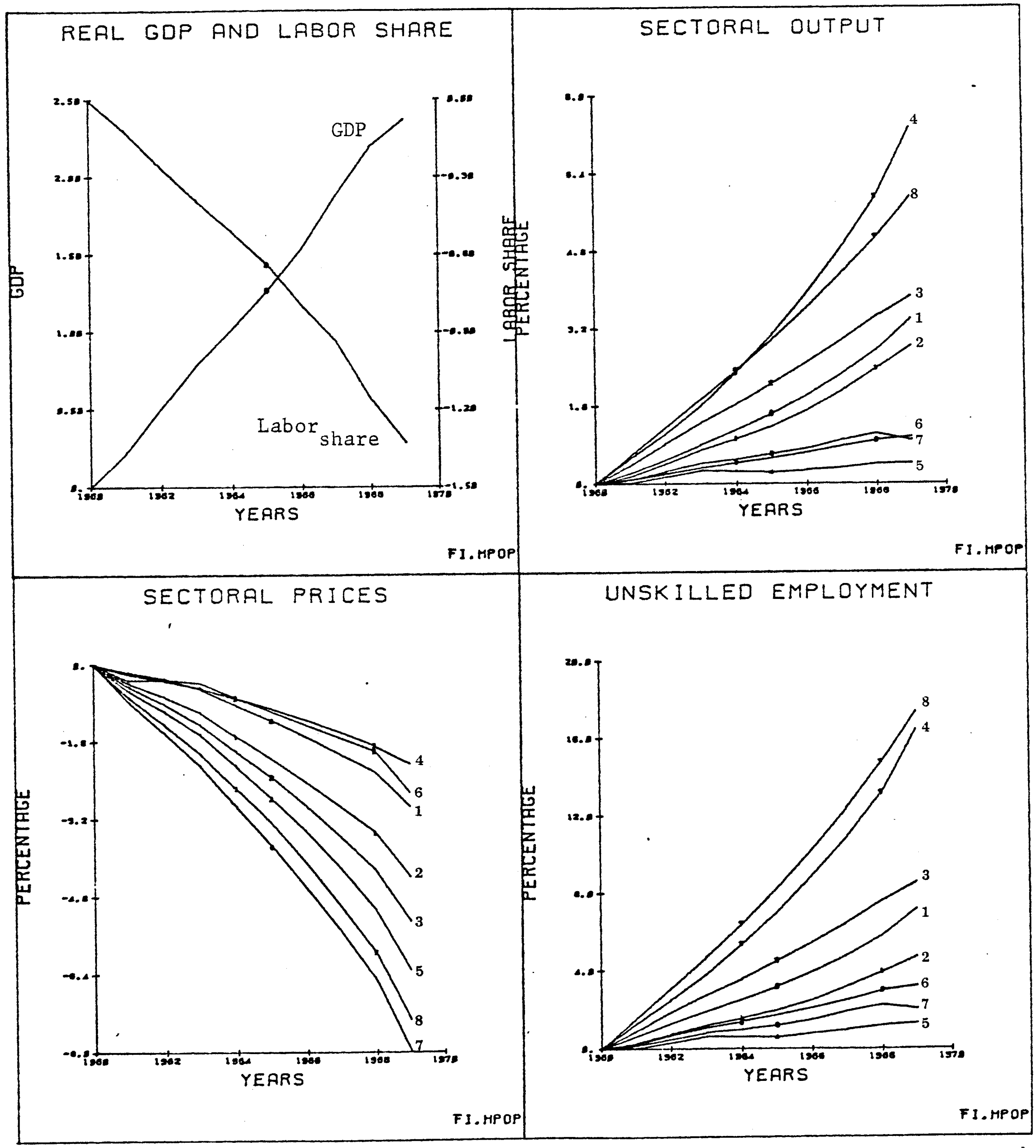
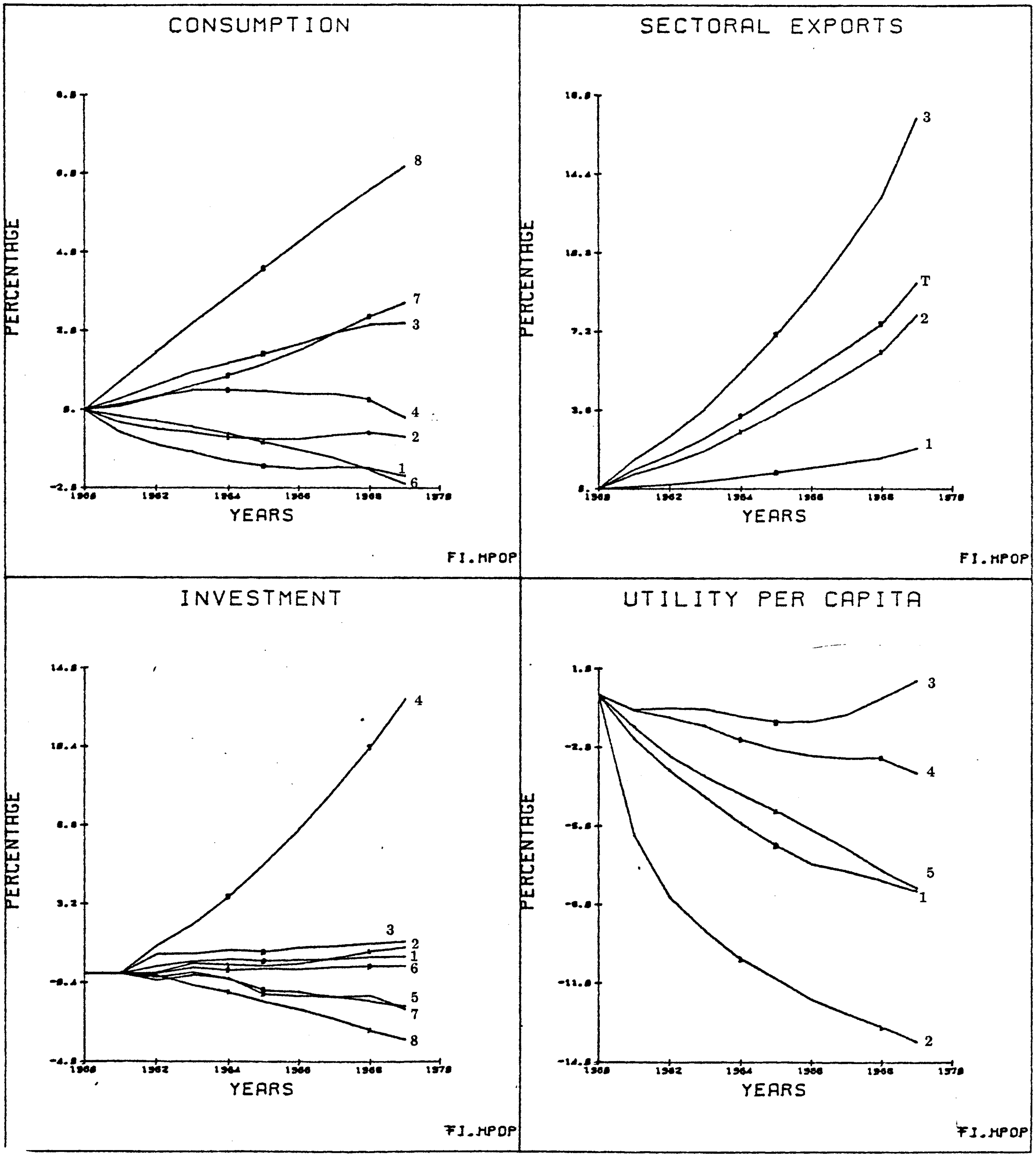


Figure
Figure 5.13. Results of higher population growth with proportionate labor force growth (HPOP) in the FI framework.


CONSUMPTION
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UTILITY PER CAPITA
PERCENTAGE
YEARS
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Figure 5.13.

Table 5.13. Results of higher population growth with proportionate labor force growth (HPOP) in FI closure.

A. Rates of percentage change in distribution measures.

Year	A(½)	A(2)	T	G
		Total population		
5	1.04	0.61	1.24	0.27
10	2.34	1.79	3.14	1.34
		Urban population		
5	1.76	1.26	1.72	1.38
10	3.20	2.77	2.85	3.37

B. Rates of percentage change in dualism measures.

	Year 5	Year 10
M/T	1.59	2.85
T/A	4.01	8.08

C. Composition of savings.

	Year 5	Year 10
1	0.09450 (0.09183)	0.06979 (0.07263)
2	0.11208 (0.10891)	0.12510 (0.13019)
3	0.02179 (0.02118)	0.01882 (0.01958)
4	0.70067 (0.68087)	0.66267 (0.68963)
5	0.10003 (0.09721)	0.08453 (0.08797)
TPS	1.02908	0.96091
fs	-0.23670	-0.23944
gs	0.20762	0.27853
TS	5877.2914	14726.0131

sectors (except sector 4*). The decrease in these parameters is due to a larger decline in nominal wages than in prices of capital. The decrease is, therefore, smaller for modern sectors. The higher demand expectations overcome these smaller declines of the animal spirit parameters, and the capital investment increases. For sector 3, the investment goes up despite the larger decline in the parameter due to the aforementioned strong growth in demands (and therefore output).

Investment goes down for sectors 5, 7, and 8. The animal spirit parameters are significantly below the base run values for all these sectors (-2.3 percent, -3.24 percent, and -4.5 percent, respectively for equipment and machinery investment). In sectors 5 and 7, the weak demand pressure also accelerates the decline of investment. For sector 8, however, the decline in the parameter is so large as to outweigh one of the strongest demand pressures in the economy: because wage goes down with the agricultural price, but the capital user cost is largely determined by a weighted average of urban prices.

Real GDP goes up consistently relative to the base run. This mainly occurs from the increase in the unskilled labor employment. The urban unskilled labor share therefore declines monotonously. The population again increases around 8.05 percent relative to the base run in the 10th year. The same value for real GDP is 2.37 percent. Therefore, the real GDP per capita goes down 5.68 percent relative to the base run 10th year value.

The utility levels per capita tell how this decline in products is distributed over different income classes. The traditional sector workers and their dependents get hurt most severly throughout the simulation. This is due to the larger decline in their nominal wages than modern sector workers. The

*This is because the mining sector's value-added price decreases much more slowly than wages or capital prices. This increases the cost of the natural resource, making more capital *and* labor inputs more desirable.

real inocme per worker delcines for the traditional workers by 3.5 percent, but it increases for modern unskilled by 0.2 percent relative to the base run in the 10th year. The rural residents lose about the same as the modern urban unskilled. The reason they do not lose as much as the urban traditional workers or more, is due to the fact that the labor force is forced to increase proportionately with the population. As a result, the number of dependents increases less rapidly than the number of workers in agriculture, whereas in urban areas, because the unskilled labor has an elastic supply and the amount of the employment is demand-determined, the number of actually employed does not increase as much as the total population, increasing the dependents per worker relatively more than in rural areas.

The measures for income distribution worsen because the agricultural terms of trade deteriorate and the traditional unskilled workers lose. With the lack of an inflation effect, decreased nominal income of agriculture increases both the intraurban and rural-urban wage dualism. Capitalists receive a higher share of national income: another cause of the deterioration in income distribution.

Everybody, including the rural worker, has higher real savings except for the urban traditional unskilled. The number of rural workers increase more than their nominal income per capita decreases. But, the total investment is about the same as in the base run. The decreased foreign savings is the major reason for small capital accumulation. Deflation only increases exports and decreases imports.

5.5.2. NC Framework

Higher rates of growth of both population and labor force have extremely large positive effects to the macro economy in general in NC. The real GDP grows very rapidly and is as much as 10.6 percent higher than the NC base run in the 10th year. The unskilled labor share has a distinctive U-shape. The first decline is caused by the faster growth of the unskilled employment than any of the components of the capital stocks. The second half is due to the higher rates of physical capital accumulation plus the higher rates of growth of unskilled employment in such high labor share sectors as sectors 2, 4, and 5, and consequently the lower rates for such low labor share sectors as sectors 1 and 6 (Figure 5.14 and Table 5.14).

The outputs go up for all sectors. The increase is faster for the more traditional goods at first due to the strong consumption demands for these sector goods. As the economy grows and investments picks up, however, the demand for more modern goods goes up because of the higher income elasticities of consumption for these commodities and because of more intermediate input demand for these commodities.

Higher domestic demand pressure for exportables keep their prices relatively high, and exports in general are less than those of the base run, whereas the rapid increase in domestic demand pushes up imports significiantly. The foreign savings therefore increase 20 percent relative to the base run by the 10th year, This accounts for 31 percent of the increase of the total savings. The government savings also increase because of higher tax and tariff revenues. With all these together, the physical investment is around 40 percent higher in the 10th year than the base run.

When we look at the utility per capita, it can be found that the urban skilled labor class benefits most from the higher growth of population and labor force. This run has much higher levels of unskilled urban employment and physical capital stocks, but the amount of the skilled does not go up proportionately. The per capita income for this income class therefore increases

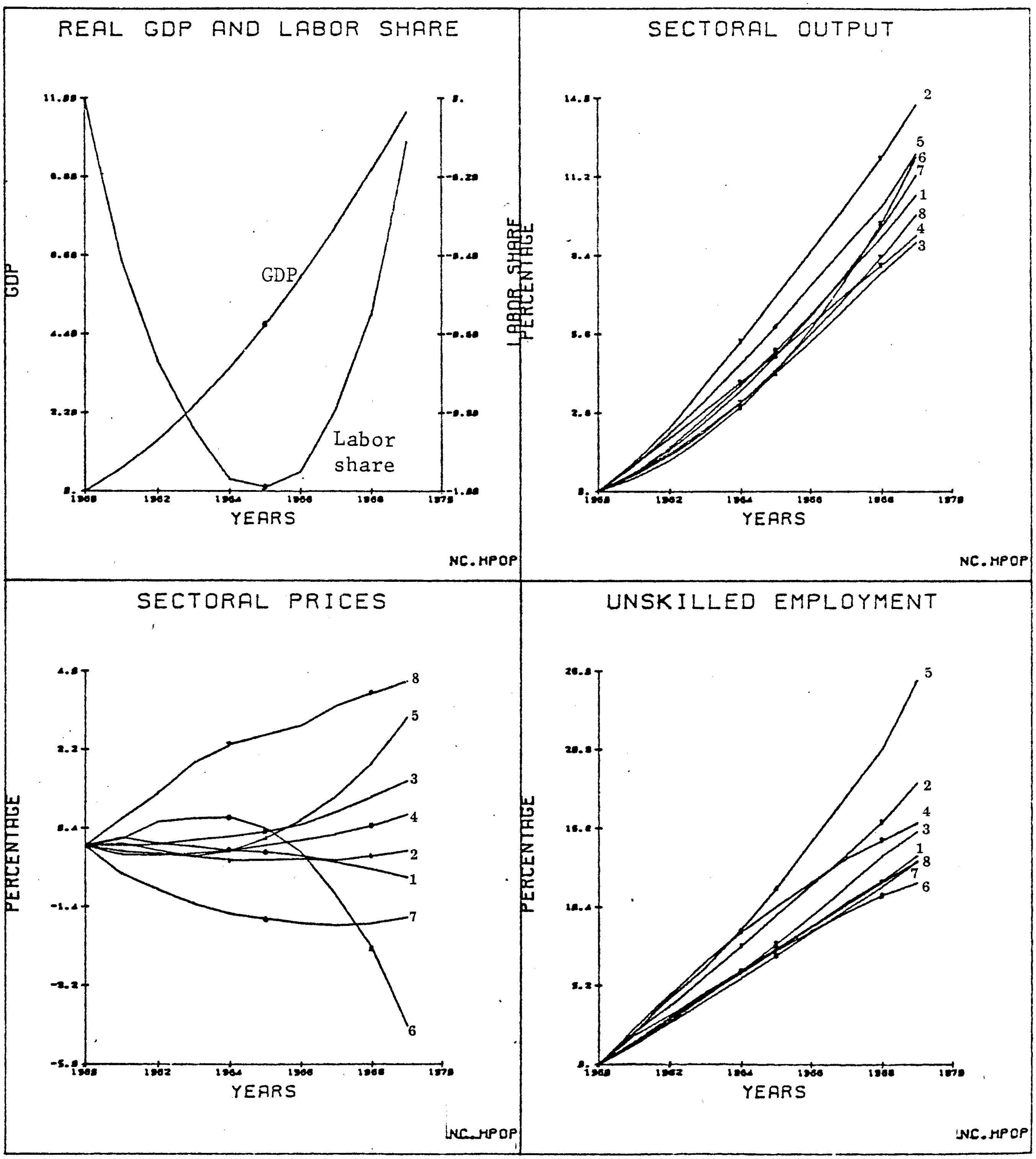


Figure 5.14. Results of higher population growth with proportionate labor force growth (HPOP) in the NC closure.

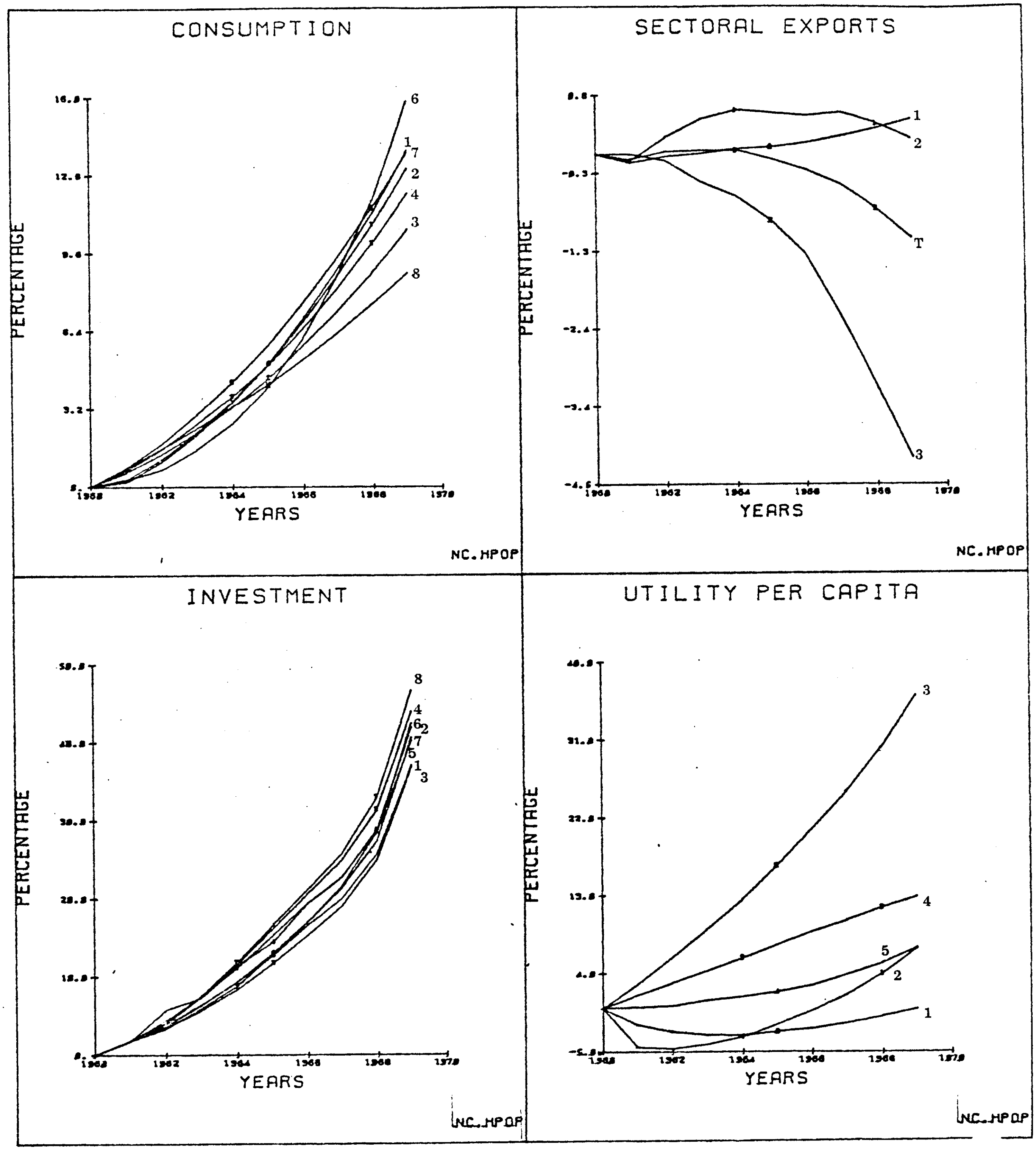


Figure 5.14 continued.

Table 5.14. Results of higher population growth with proportionate labor force growth (HPOP) in NC closure.

A. Rates of percentage change in distribution measures.

Year	A(½)	A(2)	T	G
		Total population		
5	2.84	1.29	3.56	0.28
10	0.0	-1.28	1.50	-1.67
		Urban population		
5	3.40	2.43	4.59	1.95
10	1.44	0.0	2.90	-0.72

B. Rates of percentage change in dualism measures.

	Year 5	Year 10
M/T	-0.25	-4.43
T/A	-1.41	-5.25

C. Composition of savings.

	Year 5	Year 10
1	0.08188 (0.09325)	0.08538 (0.08628)
2	0.10275 (0.11701)	0.13503 (0.13646)
3	0.02094 (0.02385)	0.02292 (0.02317)
4	0.58487 (0.66608)	0.65631 (0.66324)
5	0.08764 (0.09981)	0.08990 (0.09085)
TPS	0.87809 (1.0000)	0.98955
fs	-0.06410	-0.23742
gs	0.18601	0.24787
TS	7464.1883	11103.7843

quite rapidly. Both of the largely unskilled labor classes have U-shaped patterns: they first decrease and then increase. For the traditional sector workers the decline is sharper and the increase even more drastic than the modern unskilled workers. This is caused by the slower increase in unskilled employment in traditional sectors due to the higher elasticities of substitution assumed in these sectors. Wages are decreasing equally across the urban sectors in the earlier period because agricultural nominal income is not so different from the base run level. But the total population in urban areas is increasing, the burden of which largely falls on the unskilled classes. Thus these classes suffer. The class 2 suffers more than class 1 because of the smaller increase in unskilled employment in traditional sectors, plus the large decrease in the relative price of sector 7 goods which form the bulk of class 2's income. A good part of the value-added from this sector is included in income class 2. The increasing part of the utility per capita level of the unskilled classes comes from a higher increase in labor force than in population, the increased labor share of the value-added, and the relative slowing down of the decline of the general wage level. The last is due to the higher economic growth absorbing more and more unskilled labor, eventually attenuating the effects of the population pressure. Finally, more drastic increase in the utility per capita of the traditional worker class comes from the fact that, as the agricultural income increases, the urban traditional wages go up relatively more than the modern unskilled workers' wages.

The composition of savings shows the extent to which foreign savings contributed to the capital accumulation in this run. The more unskilled employed means higher output that, in turn, increases imports. The higher demand for sector 3 goods from the expanded population increases its price, decreasing its exports. Because sector 3 goods are the major export commodity of this economy, the total exports go down as well as increasing foreign savings.

Captialists, however, contribute more to the higher saving than do foreigners during the first years of the simulation. This comes from the higher share of the total value-added they get with increased unskilled labor but unchanged physical capital stocks.

The distribution of income becomes more unequal at first, but gradually becomes less unequal. Urban income distributions becomes worse than overall distribution because the agricultural terms of trade improve throughout the simulation whereas within the urban sectors capitalists and skilled workers get higher shares of income. As the labor share increases and intra-urban dualism disappears (through higher agricultural income), the distribution becomes more equal. All dualism measures naturally decrease.

5.5.3. IX Framework

IX has a more disconcerting result than NC. The real GDP grows at a higher speed than the IX base run, and it is around 6 percent higher than the base run in the 10th year. However, the unskilled labor share is down to a level 3.5 percent below the base run in the same year. Reflecting this and other factors, the utility levels per capita of unskilled urban workers fall substantially from the base run values. Owners of capital stocks have consistently higher and annually increasing levels of utility per capita. This outcome is essentially necessary because the higher labor supply produces more output and (with population growing more slowly than the labor force), prices tend to fall, increasing exports. This increase in exports, without a large expansion of imports, brings down the amount of foreign savings substantially requiring an increase in domestic savings. As a result, the economy works to benefit the high savers and let the low-saving classes suffer. This is done by letting the nominal wage levels fall drastically as there are more unskilled to be hired in the economy (Figure 5.15 and Table 5.15).

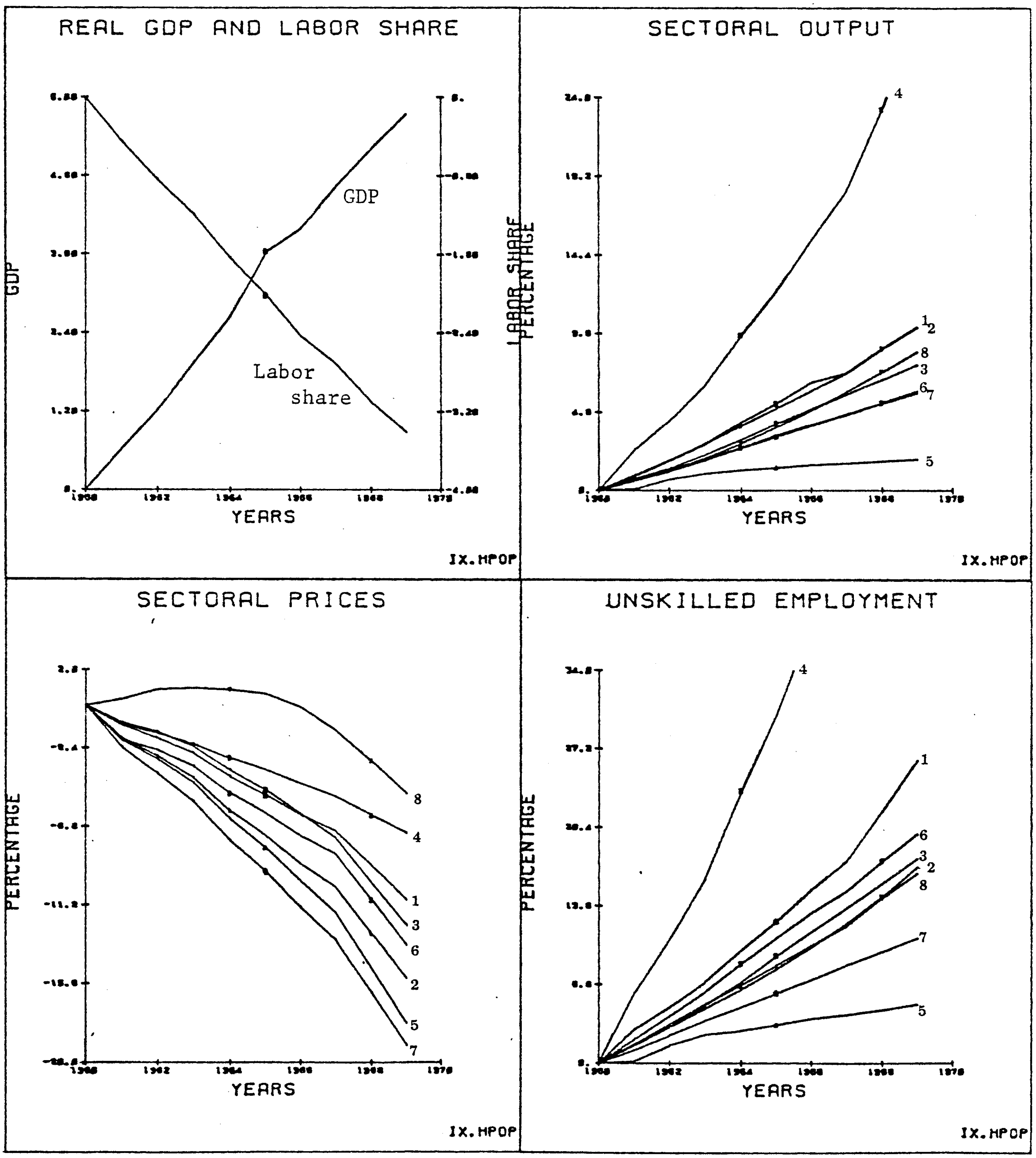


Figure 5.15. Results of a higher population growth with proportionate labor force growth (HPOP) in the IX framework.

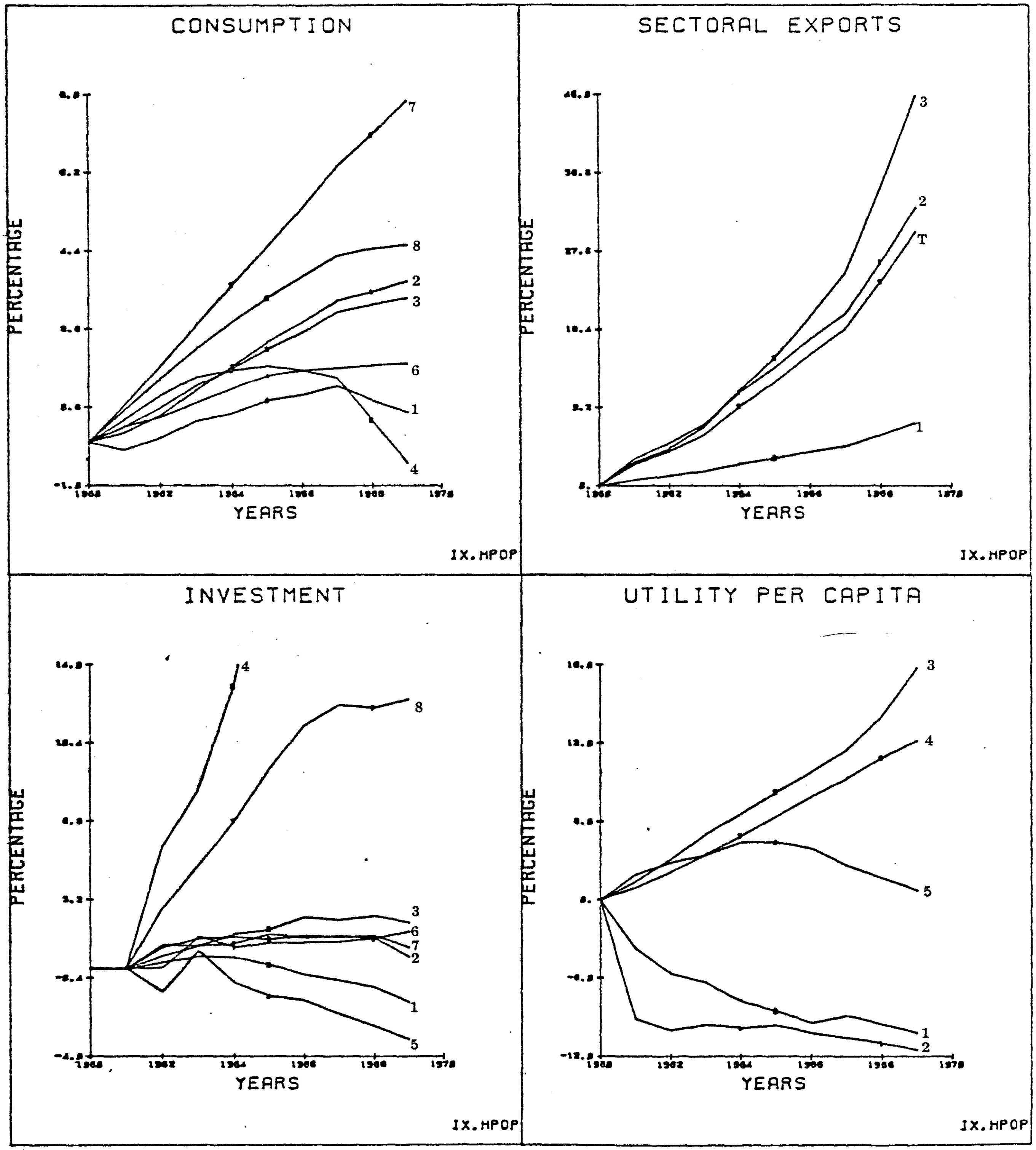


Figure 5.15 continued.

Table 5.15. Results of higher population growth with proportionate labor force growth (HPOP) in IX closure.

A. Rates of percentage change in distribution measures.

Year	$A(\frac{1}{2})$	A(2)	T	G
		Total population		
5	2.17	0.0	3.39	-1.34
10	7.65	2.45	10.82	1.60
		Urban population		
5	5.16	3.42	6.28	2.38
10	11.92	8.26	14.58	7.05

B. Rates of percentage change in dualism measures.

	Year 5	Year 10
M/T	-3.49	- 7.27
T/A	-9.83	-15.98

C. Composition of savings.

	Year 5	Year 10
1	0.08709 (0.09250)	0.0776 (0.08497)
2	0.10426 (0.11073)	0.12415 (0.13595)
3	0.02023 (0.02149)	0.01888 (0.02017)
4	0.63700 (0.67656)	0.61881 (0.67553)
5	0.09294 (0.09871)	0.07388 (0.08089)
TPS	0.94152	0.91333
fs	-0.12920	-0.14535
gs	0.18768	0.23201
TS	6500.8293	13642.1571

The wage decline stalls or reduces the level of investments in many sectors because of the large fall in the animal spirit parameters, i.e., the wage levels go down much more than the user cost of capital. The relatively small amount of output increase of sector 5 signifies the degree of investment increase. Instead, the exportable sectors have largely expanded outputs, not to mention the mining sector whose original domestic output is so small. Sectors 1 and 2 have 13 and 10 percent higher outputs than the base run in the 10th year, and sectors 3 and 8 enjoy around an 8 percent increase in outputs, Sectors 6 and 7 enjoy similar expansion—6 percent, for sector 7 due mainly to the increase in consumption, and for sector 6 due to the increase in the export and intermediate goods.

Agriculture enjoys improved terms of trade, especially during the first half of the simulation when its nominal commodity price is actually higher than the base run, whereas all urban nominal prices decline rapidly. This price rise comes not only from the increased consumption demand but also from the large increase in intermediate input demands due to the rapid increase of *inter alia* sector 3 production. A larger increase in the sector 3 production than, say, the FI solution, comes from increased exports, as well as increased intermediate demands through the general expansion of the economic activities than FI. The improved terms of trade of agriculture, however, erode away in the second half, because the high demand pressure pushes up the investment in this sector substantially for the first five years of the simulation, increasing disporportionately the supply capacity of agriculture.

The distributional measures show a major deterioration. The cause lies in the urban sector: the increased income shares of capitalists and skilled workers, and the decreased share of unskilled worker classes. Ironically, the dualism measures all show an improvement because of the increased nominal agricultural income with no inflation.

5.5.4. Overview of Higher Population Growth with Labor Force Growth

Unlike the case of higher population growth without labor force growth, this set of experiments shows completely varied results in the different closures. First of all, the NC closures grows very fast and real GDP is 11 percent higher than the NC base run by the 10th year. The higher income share of capitalists and increased foreign savings finance the growth.

In IX, the real GDP is 5.8 percent higher in the 10th year. Essentially this is because the investment is stalled by lower nominal wages due to higher urban unskilled labor supply. The same mechanism of increased supply of savings as in NC exists in the earlier phase of the simulation, but the investment is predetermined by the previous year's conditions. The potentially higher savings are brought down to equal the value of investments by deflation which mainly decreases the foreign savings. Insufficient capital accumulation with ever increasing urban unskilled labor supply severly deteriorates the distribution of income.

FI has the lowest growth of the three closures: around 2.4 percent increase in the 10th year. The agricultural income levels determine the wage structures that, in turn, determine the levels of employment for unskilled labor. This mechanism does not produce the employment growth of unskilled labor as fast as the unskilled labor force is growing. Unlike the full employment scenarios of IX and NC, therefore, the unskilled employment does not grow as fast. As a result, total investment stays around the same level as in the base run, whereas in IX it declines because of lower animal spirit parameters. The labor share decrease is, naturally, much less here than in IX.

Using their general equilibrium model, Kelley and Williamson experiment with almost a tripling of population growth in 19th century Japan and report various positive outcomes of high population growth. It should be reminded, however, that they use the NC closure with the labor force growing at the same rate as the population. Population pressures in contemporary developing countries may very well be the type experimented in the previous section. Thus, the optimism of Kelley and Williamson may be difficult to share.

5.6. HIGHER RURAL-URBAN MIGRATION

The last of these demographic comparative dynamics is to raise the migration parameter by 20 percent (HMIG). That is, the α shift of

$$\text{shift} = \alpha_{\text{shift}} \cdot \sum (I_i \cdot \frac{L_i}{K_i}) \cdot L_A$$

is raised from 0.055192 to 0.066230.

This usually means a higher output in total and per capita because rural to urban migration is, in general, a shift of the labor force from less productive to more productive sectors (Yap 1976). In this section it is discussed that this result depends on the assumptions of full employment in urban sectors. As long as unemployment and under-employment exist in urban areas, the result needs qualification. The same is true if the urban labor market is dualistic, i.e., a modern sector (enclave) exists that does not have much to do with either the agricultural labor market, or the labor market of the urban traditional sectors.

5.6.1. FI Framework

A greater shift of the labor force out of agriculture works to lessen agricultural production, improving the agricultural terms of trade. This would increase agricultural income, which in turn, would raise the nominal wages of the urban unskilled. The rise in traditional sector workers' wages is larger than that of the modern sector workers. The higher wage level decreases urban employment and reduces the total output. Real GDP goes down to a level 1.2 percent below the base run by the 10th year. The unskilled labor share increases by 8 percent. This is due to the fact that less unskilled labor is employment in urban areas with relatively constant capital stocks. (Figure 5.16 and Table 5.16.)

Except for the primary sectors, the decrease in output is largest in the manufacturing sectors because the decrease in demand is quite large for all factors, consumption, exports, and intermediate inputs. Other urban sectors (sectors 5, 6, and 7) lose less because they have less intermediate input ratios than manufacturing, and the output declines in the rest of the sectors does not affect them very much and, partly, because the overall investment demand for the construction sector shows a stability.

In this run, all urban classes lose in terms of utility per capita. The skilled workers' class loses most because their share of valued-added goes down while the number of their dependents increases. Similarly for the physical capital owner's class. The traditional workers lose least because their dependents do not increase in number so much and, because their wages go up more than the modern sector wages due to the high rate of increase in nominal agricultural income. This is one of the few results where both capitalists and skilled workers lose in terms of utility per capita. This result, however, seems to depend very much on how we allocate the dependents, and we employed an extreme assumption: that dependents are proportionate to the working population. To see how much this assumption determines the outcome, we look again at the real income per worker for each income class. The following table shows the percentage change from the base run in the 10th year. For compari-

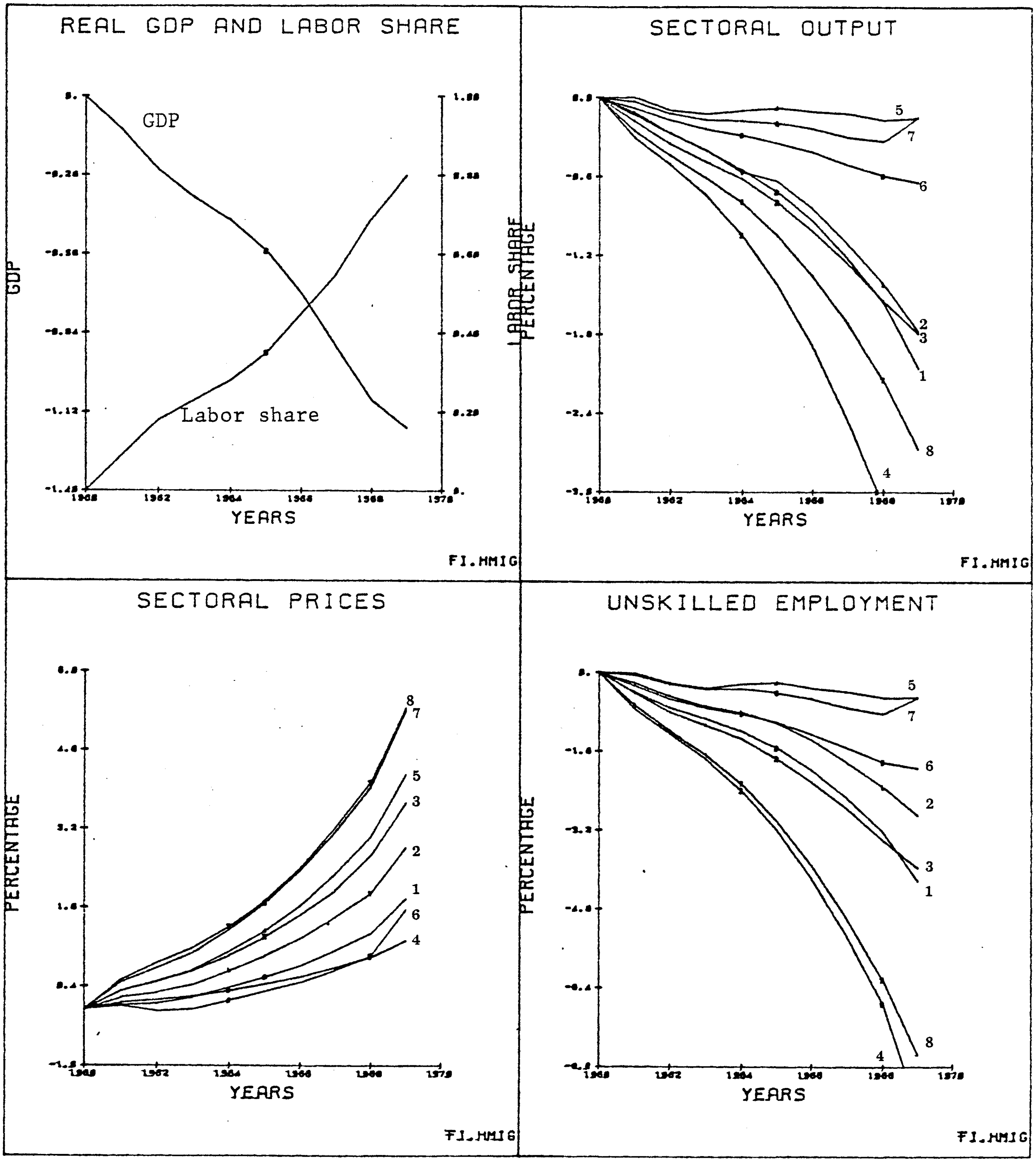


Figure 5.16. Results of a higher propensity to migrate from rural to urban areas (HMIG) in the FI framework.

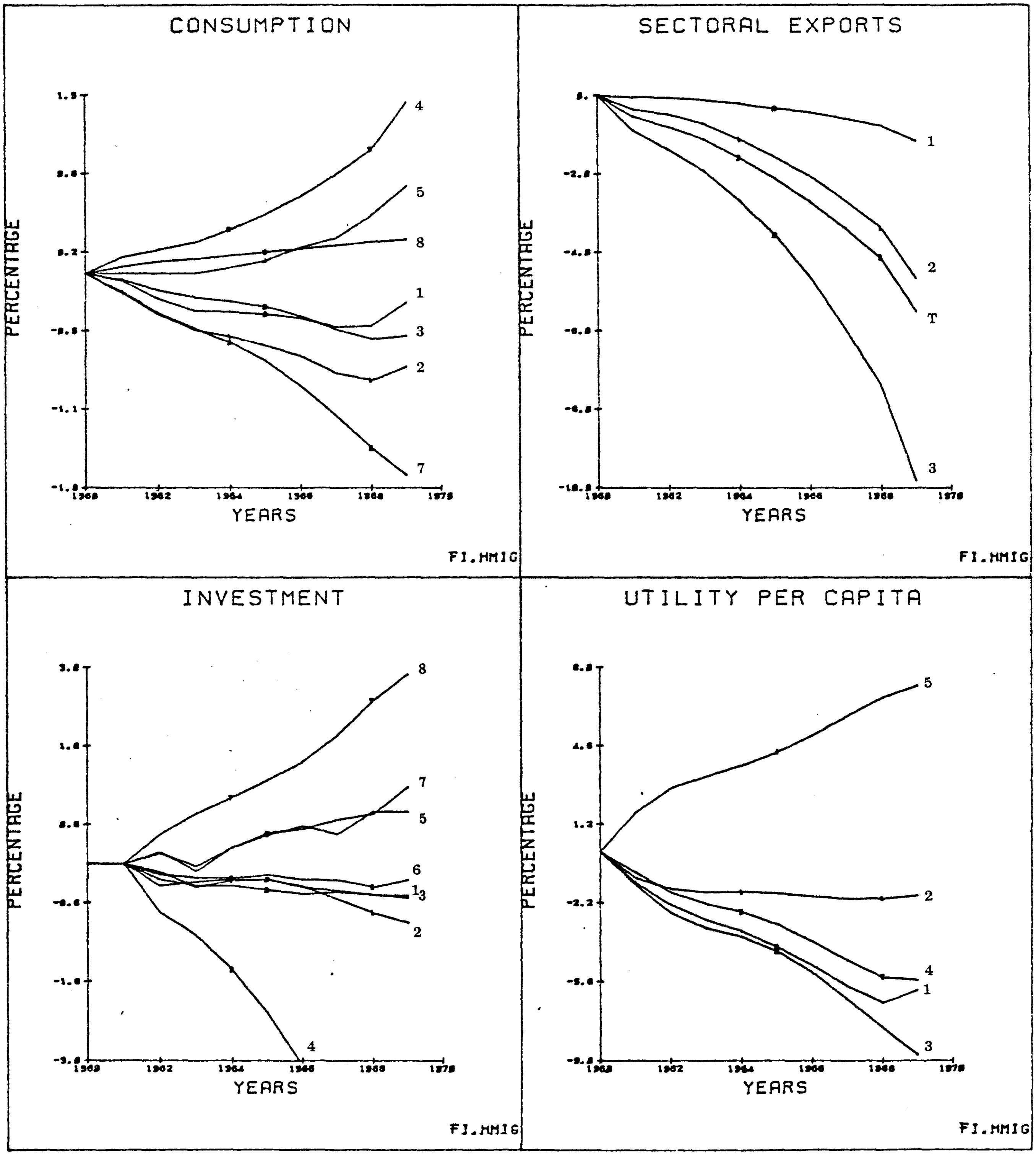


Figure 5.16 continued.

Table 5.16. Results of a higher propensity to migrate from rural to urban areas (HMIG) in the FI framework.

A. Rates of percentage change in distribution measures.

Year	$A(\frac{1}{2})$	A(2)	T	G
		Total population		
5	-1.56	-1.53	-1.77	-1.86
10	-2.80	-2.98	-3.74	-4.55
		Urban population		
5	-0.44	-0.51	-0.78	-0.46
10	-1.12	-0.76	-1.73	-1.44

B. Rates of percentage change in dualism measures.

	Year 5	Year 10
M/T	-3.77	-10.62
T/A	-8.92	-21.22

C. Composition of savings.

	Year 5	Year 10
1	0.09214 (0.09132)	0.06350 (0.07052)
2	0.11222 (0.1112)	0.12365 (0.13732)
3	0.02101 (0.02082)	0.01638 (0.01819)
4	0.68497 (0.67886)	0.61668 (0.68485)
5	0.09866 (0.9778)	0.08024 (0.08921)
TPS	1.0090	0.90045
fs	-0.20758	-0.15475
gs	0.19858	0.25430
TS	6075.487	16715.9571

son, columns 2 and 3 show the real income per consumer and utility per capita (as they came out from the run).

Class	Real income/worker	Real income/consumer	Utility per capita
1	-0.544	-4.868	-6.948
2	+2.782	-1.307	-1.864
3	-3.774	-7.985	-8.774
4	-1.496	-5.723	-5.565
5	+4.575	+5.117	+7.231

This table shows that the relative position of changes in income per capita does not differ whether we deflate the income by the number of employed or by the number of assumed consuming population. Of course, if we assume that all additional unemployed are family members of unskilled workers, the relative position of income classes 1 and 2 will become worse. But, the fact that capitalists and skilled workers also lose remains unchanged.

In this run, real savings are very close to the base run. Those groups whose real savings increase are rural works and foreigners. The losers, of course, are the high income earners, capitalists, skilled workers, and even modern unskilled workers. The reduced capital share with reduced outputs hits the capital owners hard.

The agricultural sector enjoys the improved terms of trade, and increases all urban wages and therefore the prices, i.e., a situation of stagnation occurs. Almost everybody is poorer, but the resulting income distribution is more equal because the richer get poorer whereas the rural residents get richer.

5.6.2. NC Framework

The picture becomes less bleak with the NC solution than in FI because all the urban unskilled labor is forced to be employed through adjustments in the general wage level. Real GDP goes up to the level of 1 percent higher than the base run by the 10th year. The unskilled labor share declines because there exists more employed unskilled labor in the urban economy relative to capital stocks, plus the fact that such low labor share sectors as sector 6 increase their employment share steadily. As investment picks up, the decline of the labor share slows down and starts to increase by the end of the 10 years. (Figure 5.17 and Table 5.17.)

Output and employment increase most in sector 4 for the same reason, it has higher flexibilities and substitutabilities. When the labor market is loose, this sector can absorb more labor due to the high elasticities of factor substitution, as well as high trade elasticities.

Sectors 1, 2, and 6, the modern sectors, have the next highest levels of output and unskilled employment. Sector 6 has the highest employment growth relative to the base run, but sector 2 which has higher accumulation of capital stock and much higher marginal productivity of capital stocks has the highest output growth. The growth of these sectors enforces one another through the interaction with intermediate input demand.

Despite the fact that the wage decrease makes the animal spirit parameters lower, the higher supply (and therefore demand) heightens the demand expectation, increasing investment. The outputs of sectors 2 and 5 are, therefore, enforced.

Utility levels also behave somewhat differently from FI. True, the rural residents' utility per capita shoots up, reflecting higher agricultural prices and a smaller agricultural labor force. Class 1's utility falls

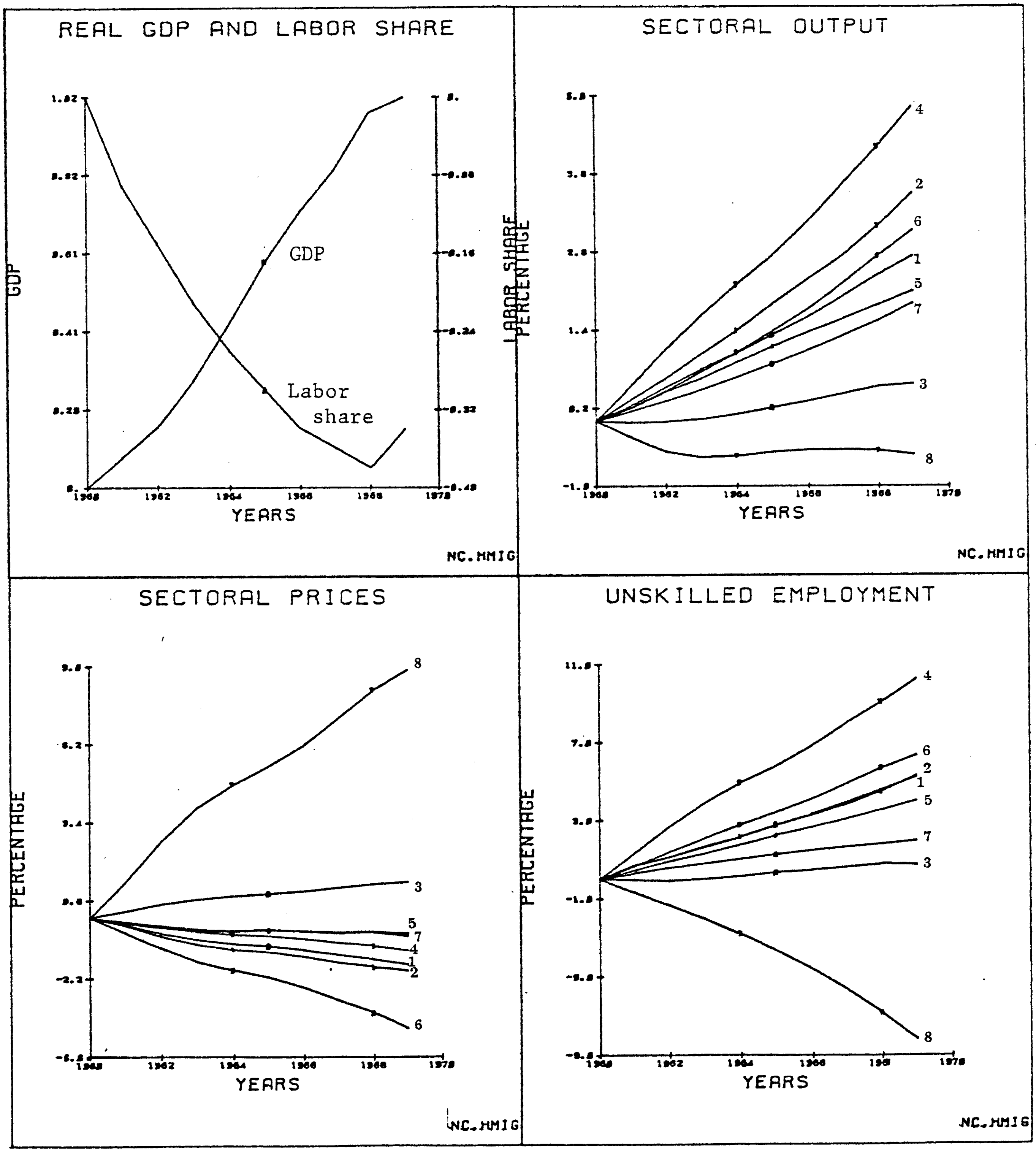


Figure 5.17. Results of a higher propensity to migrate from rural to urban areas (HMIG) in the NC framework.

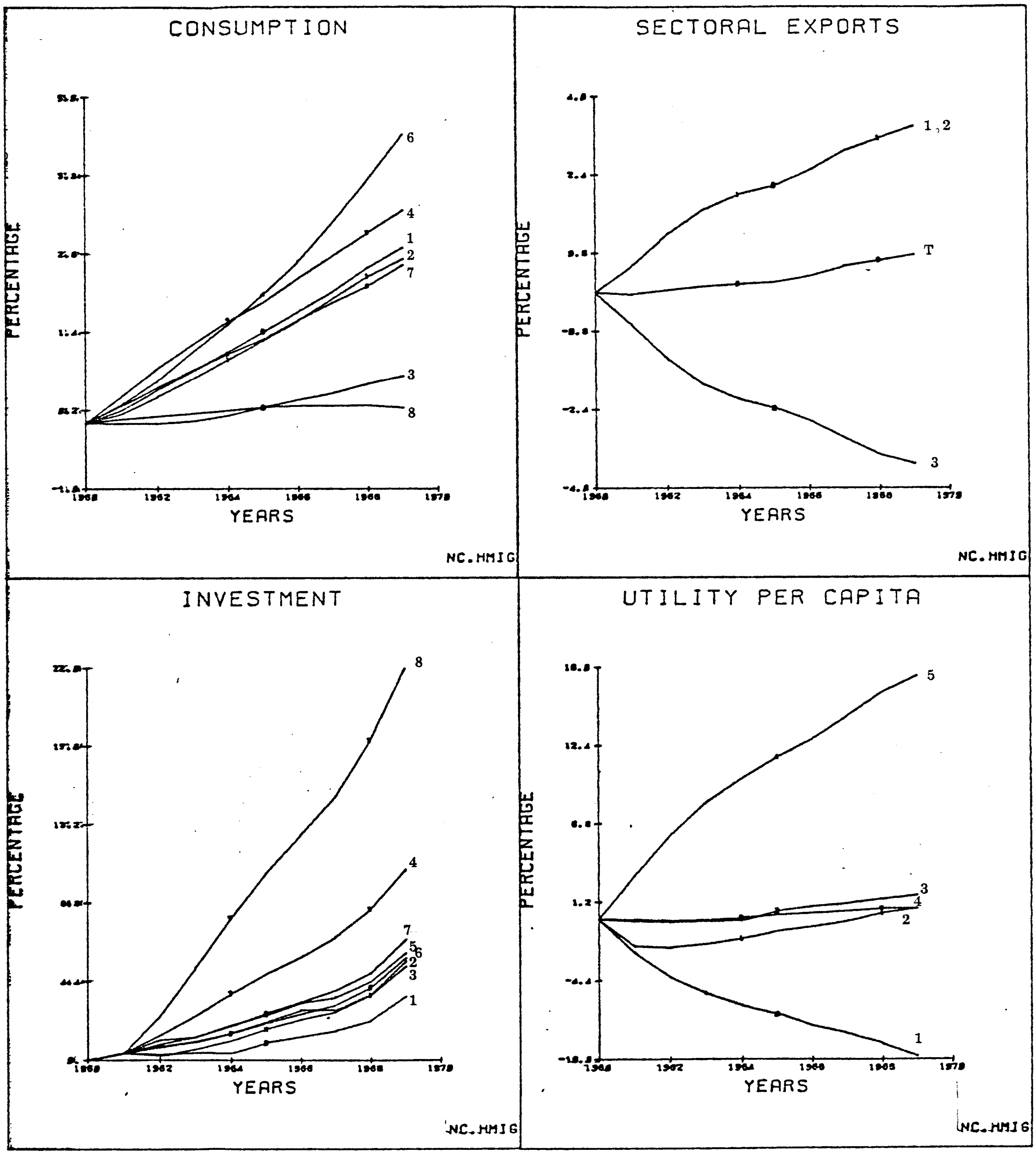


Figure 5.17 continued.

Table 5.17. Results of a higher propensity to migrate from rural to urban areas (HMIG) in the NC framework.

A. Rates of percentage change in distribution measures.

Year	A(½)	A(2)	T	G
		Total population		
5	-1.71	-2.59	-1,58	-3.60
10	-3,28	-4.47	-3.00	-7,22
		Urban population		
5	0,49	0,27	0,88	-0.24
10	0,96	0,56	1,54	-1,29

B, Rates of percentage change in dualism measures,

	Year 5	Year 10
M/T	-6.02	- 8,50
T/A	-2,19	-17.74

C. Composition of savings,

	Year 5		Year 10	
1	0,08383	(0,09337)	0.09335	(0,08588)
2	0,10531	(0,11730)	0,14084	(0,12957)
3	0,02046	(0,02279)	0,02172	(0,01998)
4	0,59600	(0.66383)	0,72897	(0.67064)
5	0,09221	(0,10271)	0,10209	(0.09392)
TPS	0,98782		1.08698	
fs	-0,07592		-0,32585	
gs	0,18710		0,23888	
TS	7074.7555		9362.0744	

consistently, again because, with the nominal agricultural income expanding rapidly and urban wage levels going down, the rate of decrease is faster for the modern sector wages than the others.

The high consumption and intermediate input demand also keep the modern outputs high, keeping the employment levels of unskilled workers high in these sectors. The wage levels of unskilled workers in traditional sectors decrease marginally, however, and demands for their outputs do not increase as much. The traditional unskilled employment, therefore, only increases slightly. With more workers (and dependents), but with sharply decreased wage levels, the modern unskilled workers can only lose, whereas the marginal wage decrease in a slightly deflationary economy (plus the fact that some traditional capital income is included in this group's income) enables the traditional unskilled income class to enjoy much better welfare levels.

The levels of utility per capita for capital owners and skilled workers also shows a small dip at first but then improves. The first dip occurs because the rural sector takes away so much of the income quickly. But the increased share of capitalists and skilled workers quickly put their levels of utility per capita back to the base run levels.

Overall distribution improves mainly because of the change in the agricultural terms of trade, but urban distribution in general deteriorates, reflecting the worsening position of income class 1. Gini coefficients, however, show an improvement even among the urban population. This is because Gini coefficients emphasize the relatively lower end of distribution and, in fact, pick up the improving position of the lowest urban income class, i.e., the traditional unskilled.

The higher investment is financed by all groups except the modern unskilled, but the initial "push" to the economy comes from increased foreign savings in the second year, 26.5 percent higher than in the base run.

5.6.3. IX Framework

The solution with the IX closure gives similar results as NC. The only differences are that growth in physical capital investment is rather limited. Investment generally falls because of lower animal spirit parameters that result from the rapid decline in unskilled wage levels. Unlike the NC case, however, the decline in desired investment is realized next year, even when the economy is capable of collecting more savings. This forced disavings are, once again, realized by lower prices that decrease the foreign savings relative to what is potentially possible (i.e., as in NC).

Because there is less capital accumulation in the economy, the capital share increases much higher than in, say, NC. The unskilled labor class also lose more, which is clearly shown in the utility per capita levels. The distribution measures also show this. Urban distribution is even worse than in NC. (Figure 5.18 and Table 5.18).

5.6.4. Overview of High Migration Propensity

A higher propensity for the population to shift from agricultural to non-agricultural activities gives two largely different results depending on whether we assume full employment of urban unskilled workers or not. If we do, the economy naturally grows faster. There are more workers to be employed. The real wage goes down and capitalists, as well as the (remaining) rural workers, tend to benefit. In NC, the initial boost of savings because of an increase in foreign savings would results in a continuous growth. A higher GDP produces more savings, and therefore, higher investment. Here a continued higher relative price of sector 3 goods, the major exporting goods, supports the high savings, otherwise the economy could easily lose the

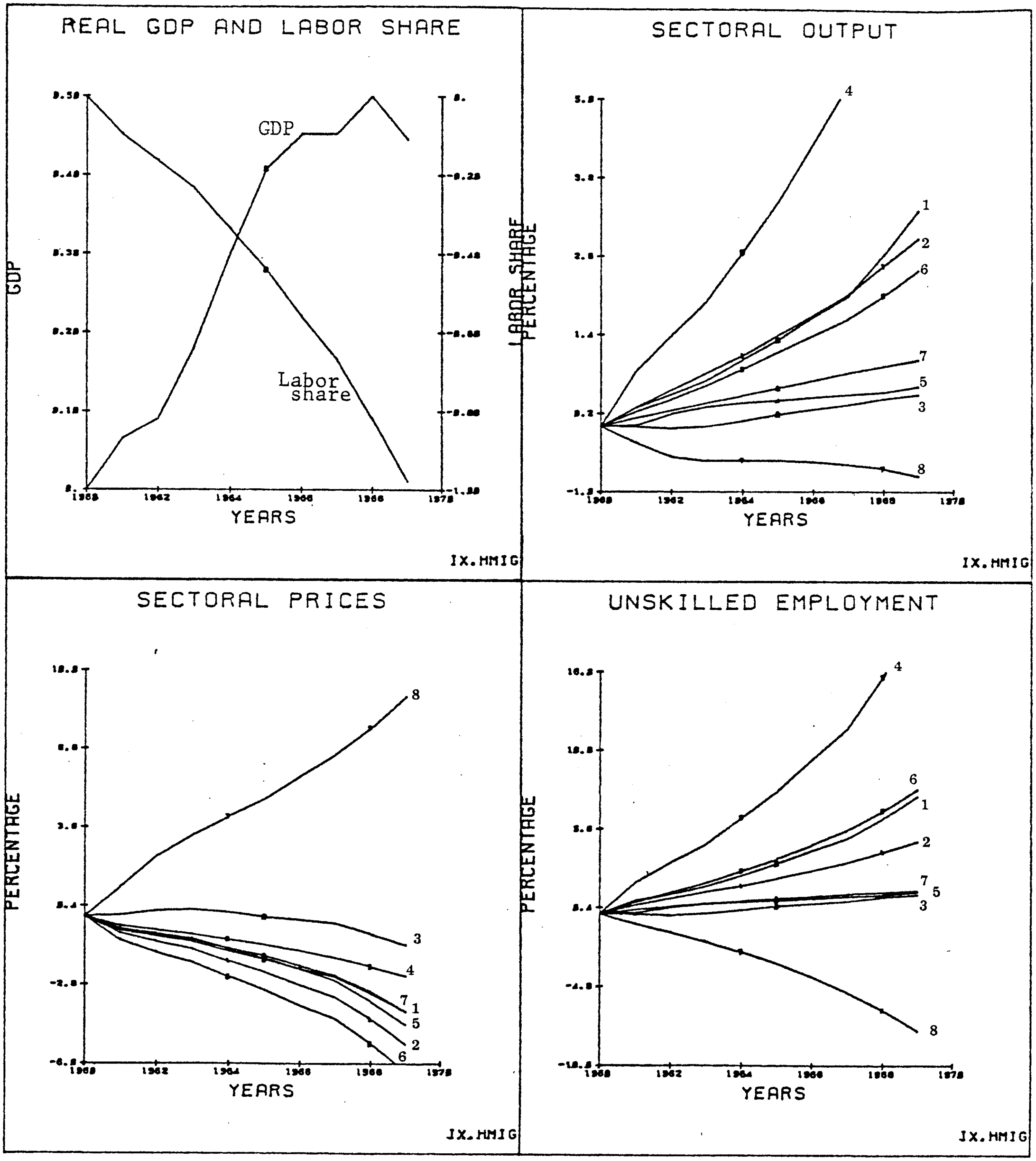


Figure 5.18. Results of a higher propensity to migrate from rural to urban areas (HMIG) in the IX framework.

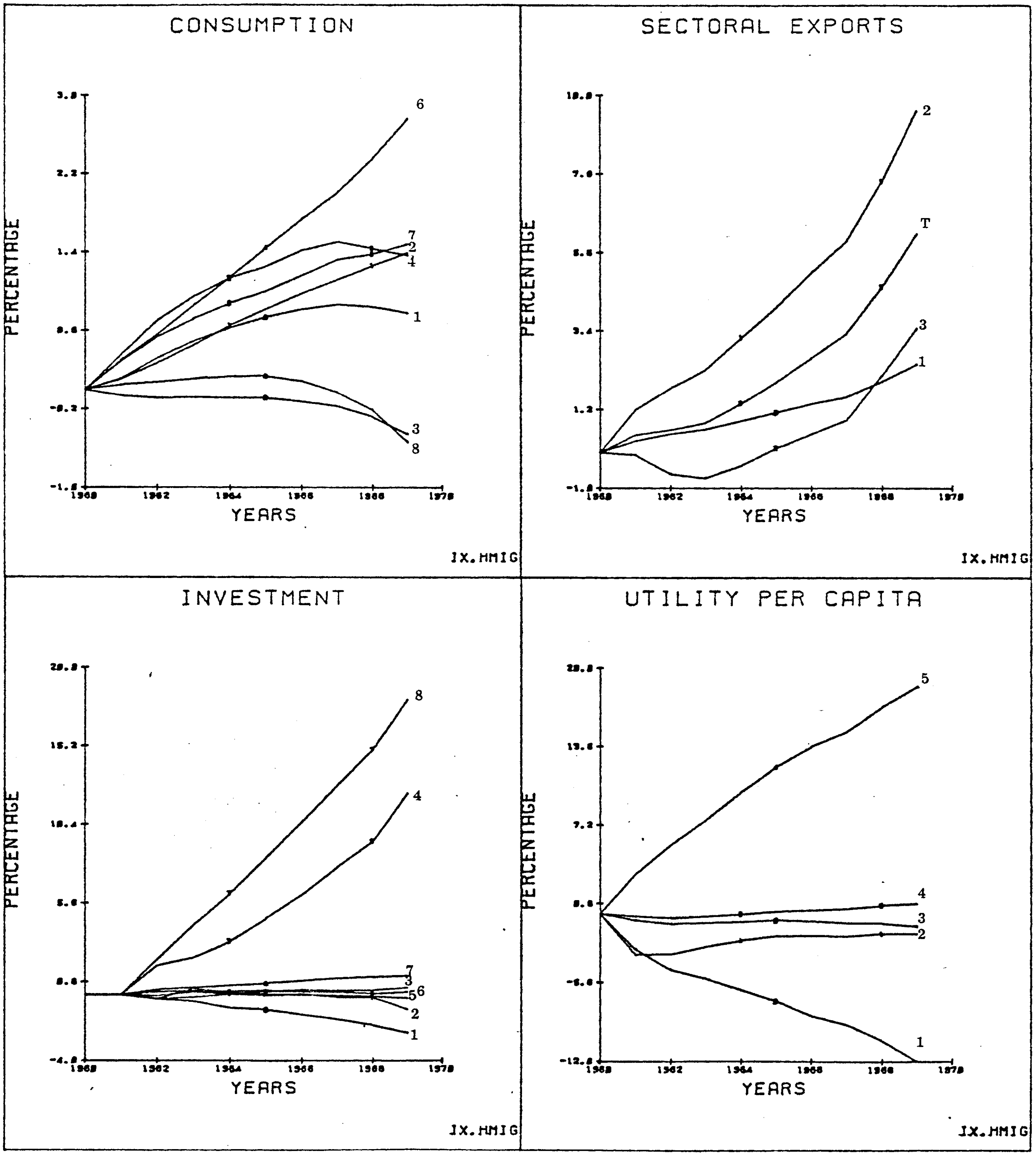


Figure 5.18 continued.

Table 5.18. Results of a higher propensity to migrate from rural to urban areas (HMIG) in the IX framework.

A. Rates of percentage change in distribution measures.

Year	A(½)	A(2)	T	G
		Total population		
5	-1.63	-2.49	-1.51	-3.48
10	-3.28	-6.14	-1.90	-6.65
		Urban population		
5	0.94	0.26	1.02	-0.24
10	3.11	2.07	3.57	-0.27

B. Rates of percentage change in dualism measures.

	Year 5	Year 10
M/T	-3.77	-10.62
A/T	-8.92	-21.22

C. Composition of savings

	Year 5	Year 10
1	0.08600 (0.09302)	0.07261 (0.08421)
2	0.10463 (0.11317)	0.12313 (0.14281)
3	0.01957 (0.02117)	0.01664 (0.01930)
4	0.62302 (0.67388)	0.57712 (0.66938)
5	0.09131 (0.09878)	0.07267 (0.08429)
TPS	0.92452	0.86217
fs	-0.10204	-0.07284
gs	0.17752	0.21067
TS	6760.299	15561.8888

foreign savings. But the high price of this sector's goods is a natural outcome because the growth is essentially investment led. This sector does not contribute to the physical capital. A weaker demand keeps the investment in this sector low and at the same time high wages keep the unskilled employed and output low, but the prices high.

In IX, however, the lower wages work to decrease the level of investment. This is more or less forced disavings and is carried out by lower general price levels. The economy, therefore, cannot grow at its potential speed.

The picture becomes totally different when we assume the unemployed urban unskilled but a rigid wage structure. The agricultural income hike increases the wages and prices, but keep employment and, consequently, outputs low. A very unpleasant stagflation results in FI.

5.7. HIGHER TARIFF RATES

In this section, the effects of increasing the tariff rates are considered. No government action for redistributing the increased tariff revenue is considered, partly to keep it simple and analytically tractable, but mainly because such redistribution mechanisms would be much too arbitrary. For example, to whom should the government transfer the extra money, and how much? The experiments, therefore, are mostly contractionary in a static sense—the government savings increase.

There are two sets of experiments: the first considers an across-the-borad 20 percent increase in tariff rates of *all* importables (sectors 1, 2, 3, 4, and 8); the second is to increase the tariff rate by sector (20 percent each).

5.7.1. Across-the-Board Increase in Tariff Rates

In a static setting, an across-the-board tariff increase slightly expands the total GDP in all three closures (around 0.01 percent). NC, however, gains most in terms of GDP. For NC and IX, the only way the total products can differ in the first year from the base run first year is by reallocation of unskilled labor. Sectors 1, 2, and 4 increase their unskilled employment because of their high import elasticities, but this shift of labor to sector 1 is the highest in NC due to the fact that the total (real) savings decrease in NC (mainly due to the decline in foreign savings that overwhelm government savings). This decrease contracts the demand for sector 2 and sector 5 goods, thereby releasing more unskilled labor for employment in sector 1, the higher labor productivity sector relative to sectors 2 and 5; thus the high first year GDP of NC.

In FI, the higher tariff rates increase the urban prices more than in IX or NC because despite the slight decrease in the average agricultural income (i.e., a decline in the agricultural value-added price), the consumer's price indices are kept high and urban wages are, consequently, still high. Of course, this is a simultaneous process, high urban prices and high consumer's prices are almost synonymous. In IX, however, the contractionary effects would be translated to lower wage levels, bringing both price vectors down, whereas this mechanism does not exist in FI. Agricultural price is almost constant because the higher intermediate input demand from the higher urban output and the cross-price effect on consumption, almost completely cancel out. With less decrease in imports and more increase in exports, there are simply more goods available for domestic consumption in FI. The decline in total utility in FI, therefore, is the least among the three closures. Total utility declines most for NC despites its best standing in real GDP. The curtailment of imports in this closure is highest, whereas the curtailment of exports is lowest, leaving the least available for domestic uses.

Despite the tariff increase that can be called protective, the outputs and, therefore, unskilled employment, decline in sectors 2 and 3 in FI. This happens even if the urban labor supply is not limited as in other closures. For these sectors, import substitution effects are limited due to the low import elasticities, and high export elasticities reduce their export demand significantly. The decline in household consumption for sector 3, and in intermediate input demand for sector 2, also contribute to the decrease in the demand for these sectors. Similar things happen in NC and IX, but this time the general wage level has to come down to keep all the urban labor employed. This lowers the urban price somewhat increasing the consumption and export demands. In IX, the sector 2 output even increases because of the continued investment pressure in addition to the above two factors.

Distribution measures suggest that, in FI, inequality increase in any measure in both urban areas and in the total economy. There is a worsening of agricultural terms of trade and a decrease in the urban unskilled labor share accompanied by a widening gap between the modern unskilled wages and the traditional unskilled wages. The mechanism must by now be familiar.

In IX and NC, on the other hand, the total inequality decreases due to the improved agricultural terms of trade, but the urban inequality increases; the same as in FI.

The overtime path depends, in the cases of IX and FI, on the specification of the fixed capital formation. With the specification elected here, real GDP slides down relative to the base run continuously to the level 0.1 percent below the base run in the 10th year for both closures. NC fares a little better: -0.02 percent in the 10th year, because the loss of foreign savings is partially compensated for by the increased government savings in this closure. In FI and IX, the investors' decision predetermines the investment for the next period. Investors see that wages are getting relatively cheaper, making the perceived wage-rental ratio decline. The capital cost is more of a function of the urban prices, and the rate of return on capital influences the user cost of capital only partially. Investors then decide to invest less because capital seems more expensive.

Experiments with the investment specification that respond more quickly to the change in the profitability of capital stocks show that the infant industry arguments may indeed hold, provided that the import elasticities are high for these sectors (as in sectors 1 and 4 in our model). If the capital formation in these sectors are substantial, the overall labor share will increase because the aggregate capital-labor ratio rises. The utility level would go up first from that of capitalists and skilled workers, then eventually to the unskilled. But this specification* contradicts the fact that in Japan, the faster growing sectors had lower rates of return on capital, and yet they were investing more heavily than the rest of the economy. We, therefore, do not take this new specification seriously here. It should surfice to note that *if* we would like to believe in protection, we might use a specification that combines the differential capital market and profit-rate incentives in capital formation.

5.7.2. Sectoral Tariff Hikes

We now experiment with the 20 percent tariff rate increase by sector. First, the manufacturing sectors. Figure 5.19 shows the real GDP changes relative to the respective base runs of the three closures. We can see that the tariff increase on sectors 1 and 2 have results that are not drastically

*A variant of such a specification has been used by Melo and Dervis (1977) with similar interests.

A. Sector 1

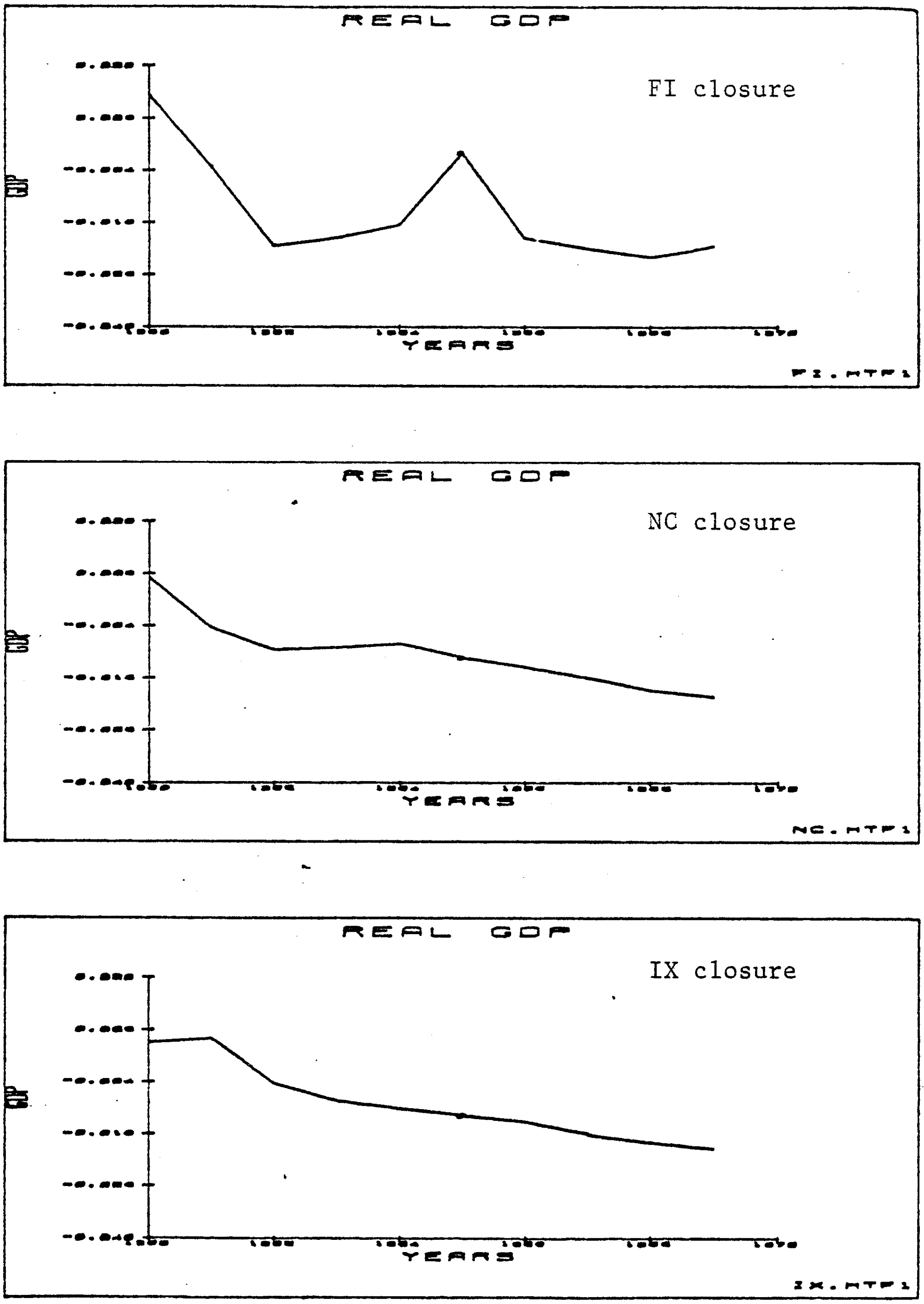


Figure 5.19. Real GDP changes relative to the respective base runs of the three closures using a 20 percent tariff rate increase in the manufacturing sectors.

B. Sector 2

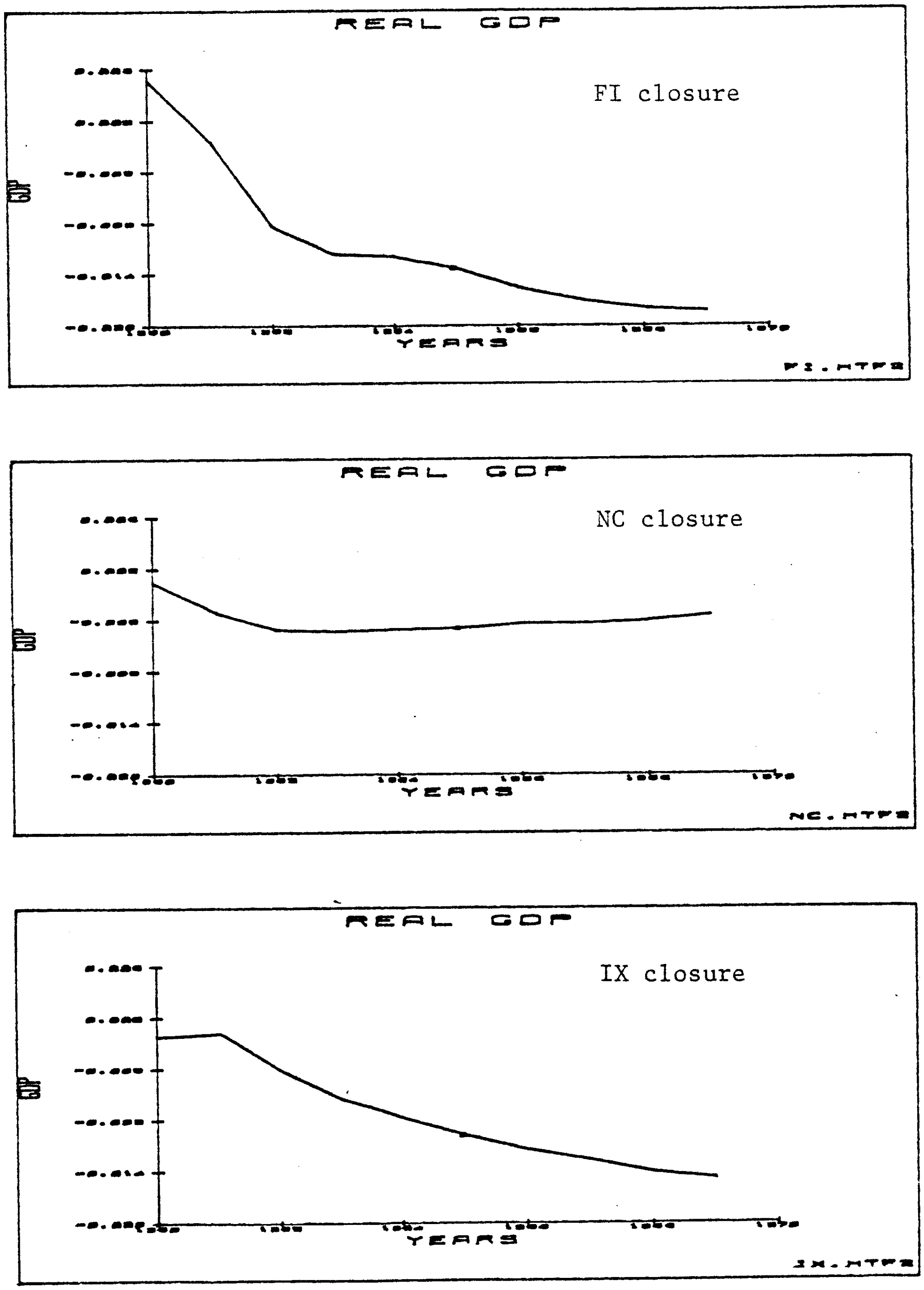
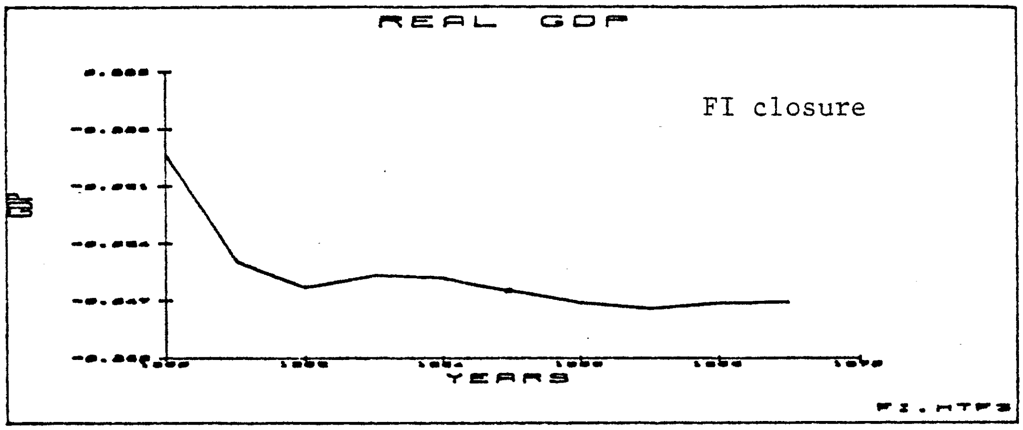
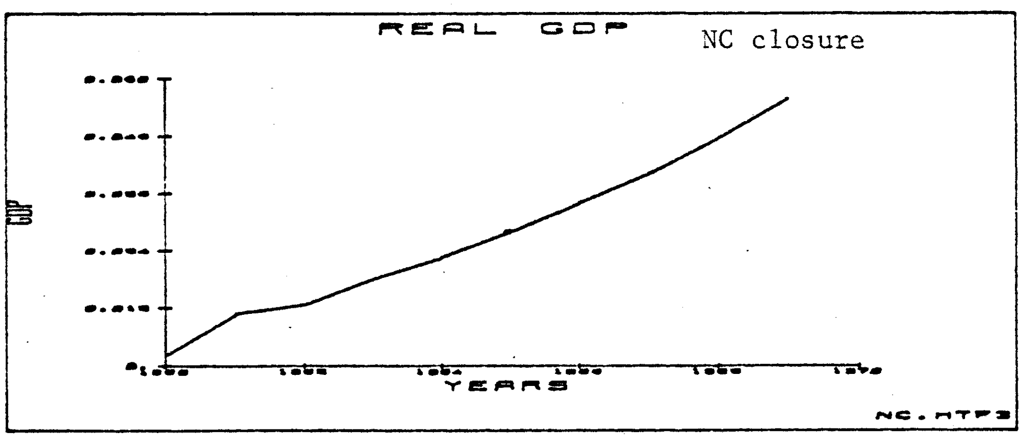


Figure 5.19 continued.

C. Sector 3





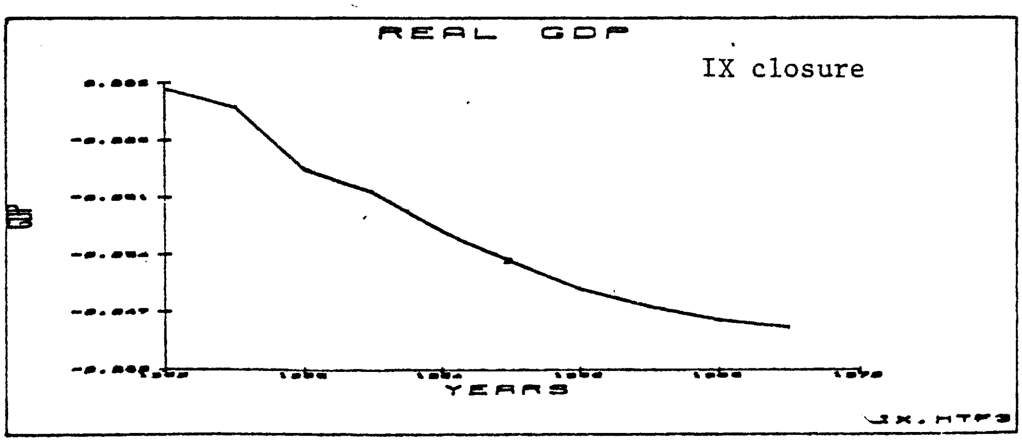


Figure 5.19 continued.

different from one closure to another. This fact is also confirmed by looking at sectoral disaggregated outputs (Figure 5.20) for the tariff increase of sector 1 goods. At least the import substitution mechanism seems to be working as one can observe from the relatively high outputs of sector 1. When we look at the rest of the results of the tariff increase for sector 3 goods, however, they differ surprisingly. The consistent (and fast) decrease of real GDP for FI and IX, versus the rapid growth of NC. In examining the sectoral outputs for the sector 3 experiment (Figure 5.21) we notice that import subsitution does not seem to have occurred at all (not even in NC). This differences comes from the magnitudes of trade elasticities.

Sector 1 goods are "importables" or "import substitutables" in a sense that the import elasticity is relatively high. Sector 3, on the other hand, has limited import elasticity but a very high export elasticity: this sector's goods are exportables (at least during the 1960s).

When tariff rates go up, the domestic demand for importables shifts from imports to domestically produced goods, raising both the domestic output level and the domestic price for goods of the sector concerned. This, the argument for protection goes, increases the profit of the sector's capitalists and increases investment and, consequently, allows for further expansion of the sector's output. It does not quite happen that way in any of the closures in our model. First, for sector 1, animal spirit parameters do not increase. Sector 1 is a capital intensive sector, and shifting domestic production towards this sector means less demand pressure for unskilled labor in IX. Thus, the urban wage level comes down, lowing the animal spirit parameters. The expectation on demand does not increase very much either because the expansion of domestic demand through import substitution is somewhat nullified by the decline in exports, even for sector 1. Thus, investment *declines* for sector 1 after the tariff increase for this sector.

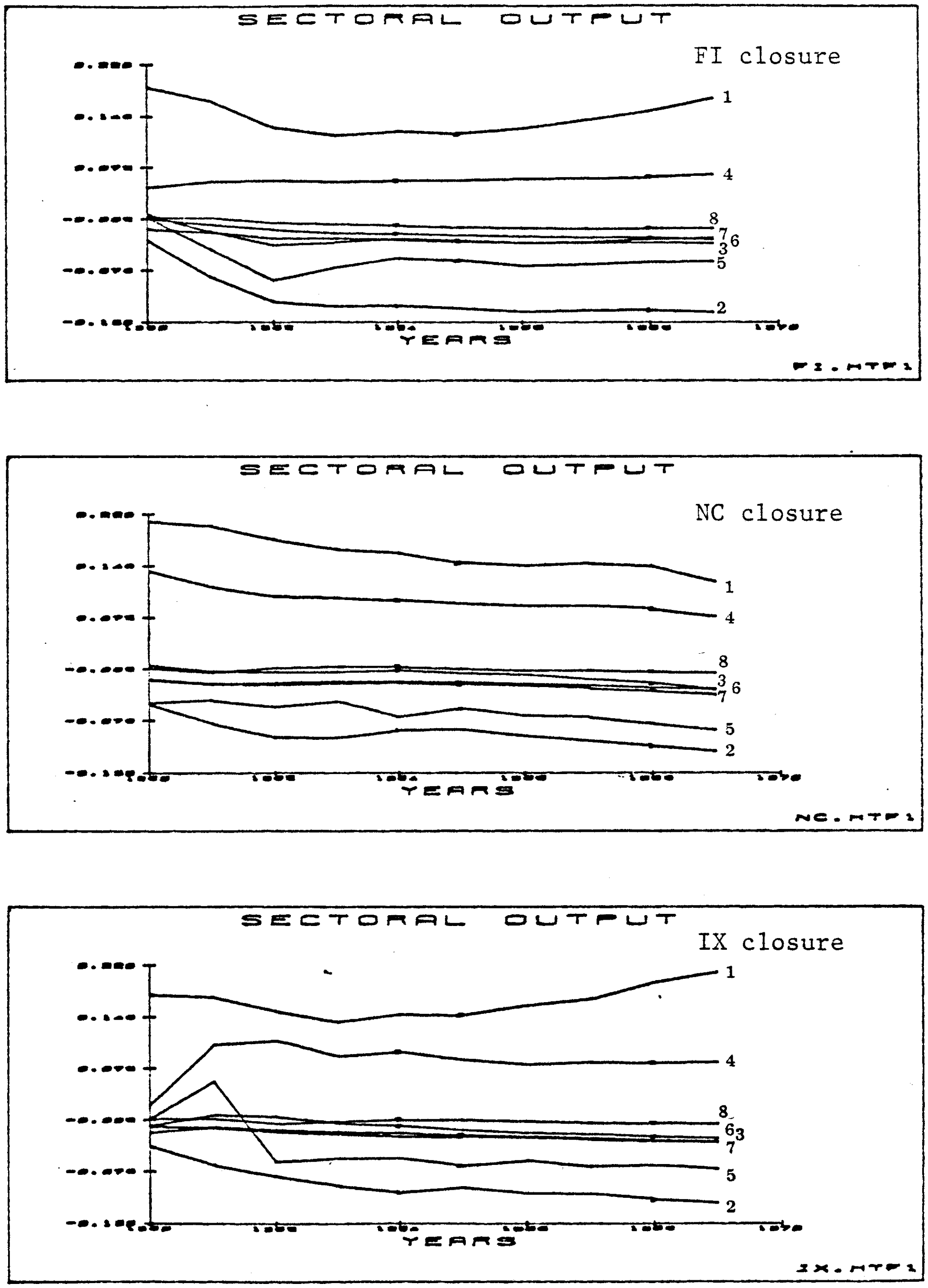


Figure 5.20. Sectoral outputs for 20 percent tariff increase sector 1 goods.

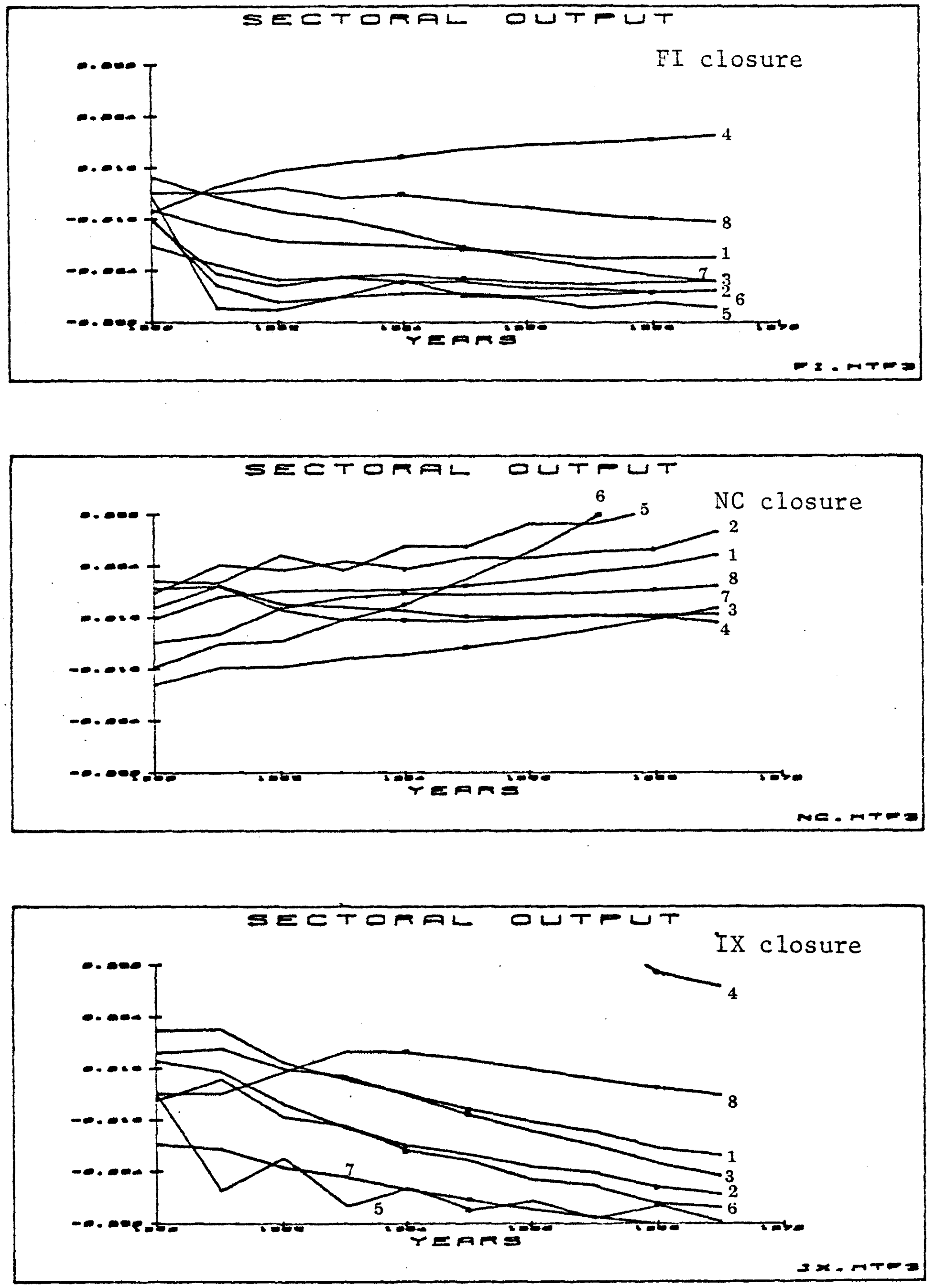


Figure 5.21. Sectoral outputs for 20 percent tariff increase for sector 3 goods.

In the FI closure, the decline in the animal spirit parameter comes from the worsening of agricultural terms of trade. The rest of the story is the same.

In NC, savings do not expand and the economy contracts over time. The decrease in imports, especially in sector 1, lowers the foreign savings, overwhelming the marginal increase in government savings. The further decline in real GDP accelerates the decline in foreign savings. Sector 1, again with low animal spirit parameter and low demand expectation, has the lowest rate of investement relative to the base run.

Now we turn our attention to sector 3 (the result of a tariff hike in sector 2 are somewhere in between sectors 1 and 3). The situation looks miserable in FI and IX in this case, because sector 3 produces exportables. The tariff hike does not increase output because, according to our assumption, they are not close substitutes to foreign goods. However, it increases the price to some extent reducing export disporportionately. To the extent, therefore, that there is a positive level of substitutability with imports, the output goes up, but the decline in exports is so overwhelming that the investment in this sector falls way down (through the decreased expectation of demand for the next period). This also decreases the unskilled employment (in FI) or the wage level of the unskilled (in IX and NC). In NC, however, the economy expands over time when the tariff is increased for sector 3 goods. This is, as mentioned above, *not* because import substitution has occurred, but because sector 3 is the main export sector with a high export elasticity. The decline in export in this sector has such a large positive impact on foreign savings. The total savings in the economy, together with the higher government savings, go up continuously. Thus this result.

Because sector 3 is more labor intensive, the labor market impact is much larger than in the case of sector 1 tariff increases. More unemployment for the FI closure and much lower wages for IX. We are far from the putty-putty world of the pure trade theory, but all this certainly shows that whether or not we are dealing with a labor-intensive sector or whether we are dealing with exportables or importables, does matter a lot, as implied by Brechner (1971)*, on the future welfare of the population in the economy.

We shall now look at the situation when the agricultural tariff is raised. Real GDP declines in each closure, more so in FI than in IX or NC. The tariff definitely improves the agricultural terms of trade pushing up the urban wage level and urban prices. The consumption in general declines, despite the wage hike, because of a counteracting decrease in employment and higher prices. Export, of course, also declines. Overall, the GDP goes down even from the first year of the tariff increase. The higher wage raises the animal spirits of investors and the decline in investment is not as serious as the decline in demand expectations. Consequently, the capital-labor ratio goes up, increasing the labor share significantly (Figure 22).

In IX and NC, the need for full employment initially keeps the output high. But, the full employment is maintained by lower wages that push the animal spirits down. Investment, therefore, gradually declines for IX. In NC the increase in foreign savings, mainly from the decline of exports of sector 3 and from the higher rural sector savings, keep the initial investment quite high. However, the failure of either foreign savings or government savings to further contribute to relative increases in investment, and the rapid decline of rural savings (from deteriorating terms of trade) push down the

*In FI, the fact that the wage level is determined by agricultural income is equivalent to having a (shifting) minimum wage level for each solution.

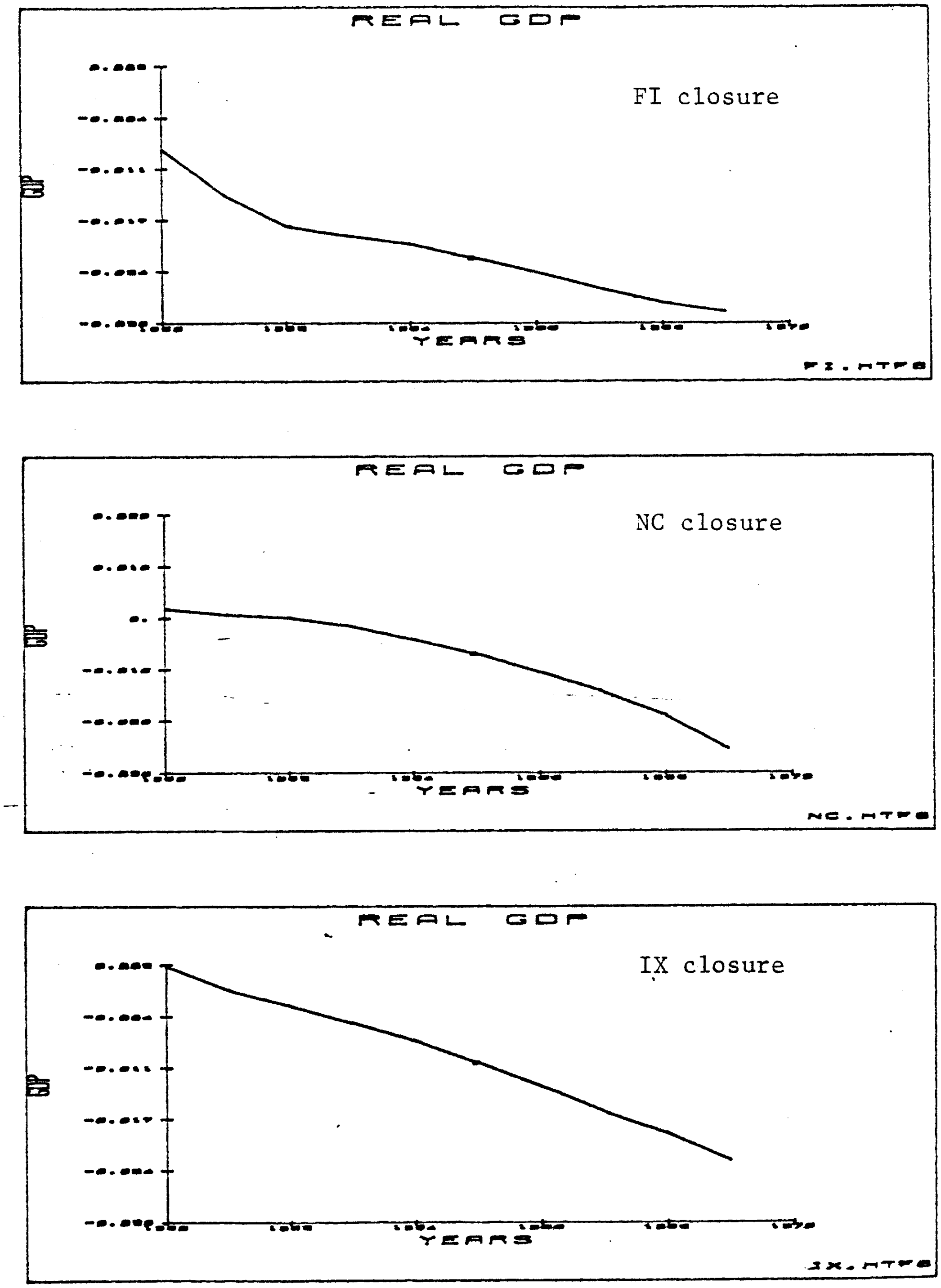


Figure 5.22. Real GDP changes relative to the respective base runs of the three closures using a 20 percent tariff rate increase in the agricultural sector.

total investments, slowing down economic growth. Sector 3 suffers in all closures because of its high agricultural intermediate inputs and close relations in the labor market with the agricultural sector. They both contribute to raising sector 3's prices relatively more than the other sectors. The export and consumption declines really hurt this sector.

The distributional factors are shown in Table 5.19. Essentially, a tariff hike on modern manufacturing sectors is unequalizing, it deteriorates agricultural terms of trade and worsens the urban wage dualism. Tariffs on sector 3 are equalizing at first, due to the higher intermediate input demand from agricultural goods from sector 3. As sector 3 outputs decline, through lower export, however, it quickly turns to the unequalizing factor in IX and FI. An agricultural tariff raise is equalizing because of the terms of trade effects, but the impacts on intraurban distribution are rather limited.

Table 5.19. Distributional impacts of higher tariff rates (shown in percentage differences of Gini coefficients from the base run values).

	Year 1		Year 10	
	Total	Urban	Total	Urban
Sector 1				
FI	0.114	0.083	0.044	0.035
NC	0.098	0.066	0.066	0.027
IX	0.120	0.077	0.039	0.030
Sector 3				
FI	-0.042	-0.023	0.036	0.020
NC	-0.055	-0.010	-0.116	-0.106
IX	-0.125	-0.019	0.041	0.019
Sector 8				
FI	-0.054	-0.018	-0.025	-0.014
NC	-0.090	-0.014	0.012	-0.007
IX	-0.095	-0.014	-0.022	-0.004

CHAPTER 6: SUMMARY AND CONCLUDING REMARKS

The exercises so far have had dual purposes. One is to examine the patterns of economic growth and distribution in Japan in a historical setting, and the other is, by doing so, to learn some lessons of the general characteristics of economic development, or at least a subset of them, for contemporary developing countries. The latter purpose is based on the belief that, even if each country is different in its socio-cultural and institutional settings, there should be some aspects of one country's experience that can, with sufficiently careful abstraction, be of relevance to another country's experiences. We are, therefore, taking a similar viewpoint as that of Fei, Ohkawa and Ranis (1982):

> Our approach... represents something of a half-way house between the unacceptable proposition that there is a general fixed evolutionary model that is followed by all developing countries, and the equally unacceptable proposition that every country is *sui generis* and that its transition growth defies any efforts at generalization and transferability (II-1,2).

The tool chosen for such abstraction and examination is a general equilibrium model with different closing rules. It has been found that the FI closure of the model performs quite well, not only in replicating the history of various real variables during the concerned period of Japanese economic history, but also in reproducing the qualitative relationships between growth and the functional and size distribution of income. In this FI clousre, urban labor is assumed to have a perfectly elastic supply curve, and investment is determined by investors' decisions alone. Urban wage structures are "determined" by reference to the agricultural per capita income and the levels of consumers price indices. It is by now almost a textbook orthodoxy that the distribution of income becomes more unequal in the short run when an economy grows faster. Such has been the case in Japan: changes in functional distribution of income (and for most years size distribution as well), and the real GDP growth rates moved completely against each other. FI behaves this way, but the other two closures, NC and IX, fail to do so.

To the extent that the FI closure replicates the Japanese economic history moderately well, the sensitivity analyses in Chapter 5 can be considered as counterfactual experiments.

It is worthwhile noting that, in the short run, a higher amount of investment deteriorates distribution of income much more than a higher amount of export in FI. The overall distribution of income depends heavily on the agricultural terms of trade, and a higher general export demand, e.g., through devaluation, improves them because the export-oriented sector (sector 3), has a large agricultural intermediate input coefficient. An increase in export pressure, therefore, increases the demand pressure for agricultural commodities, which improves the terms of trade. The exogenous expansion of investment, however, raises the demand for urban goods that do not require many agricultural intermediate inputs (sectors 2 and 5). Urban prices increase in this case relatively more than the agricultural price does, worsening the terms of trade and income distribution. Indeed, the magnitudes of intermediate input coefficients are very important in determining patterns of growth and distribution. In an earlier work (Shishido 1982), it has been shown that the real wage of urban traditional sector workers grows much more slowly if agriculture supplies no intermediate input to modern manufacturing.

In both cases of export expansion and investment increase, the urban labor share declines in the short run, simply because there are more unskilled workers employed in urban sectors. The intra-urban distribution of income (and intra-urban wage dualism) depends on all of the labor share, consumers' price indices, average agricultural income, and the level of unskilled employment. In the experiments in Chapter 5, devaluation increases intra-urban wage dualism by 1.25 percent, but decreases rural-urban dualsim by 7 percent in the first year. If investment is increased (not shown in Chapter 5), intra-urban dualism decreases slightly, and the rural-urban dualism stays almost constant. When only the export of sector 1 goods, whose intermediate demand for agriculture is also limited, is raised, the situation is similar: a slight increase in both intra-urban dualism and rural-urban dualism results.

It should also be noted, as the other side of the same coin, that when the model economy does have smaller total output than the base run, it is because unemployed skilled workers increased in the urban sector in a static setting. The unemployed can increase due to higher wages caused by improved agricultural terms of trade (e.g., in the case of a higher tariff rate on agricultural goods), or due to decreased investment. The former is akin to the classical unemployment in the sense that real wage levels are too high for full employment. The latter, of course, is similar to the Keynesian unemployment.* Of course, with no rationing in the goods market**, even in the pseudo-classical unemployment case, the aggregate demand for goods have to come into equality with the supply. This is done by decreased exports and

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*These definitions of classical and Keynesian unemployment are close to those used by Bruno (1979) and Lluch (1979).

**See Malinvand (1977) for a case where there is a rationing scheme in the goods market.

consumption through higher price, i.e., a good part of the wage increase is passed on to the commodity price levels.

This last aspect is important because a higher level of urban wages *per se* does not prompt capitalists to substitute labor for capital as much as would be expected. The capital user price is a weighted average of urban prices that are positively correlated with wages. The change in the animal spirit parameters, therefore, is very limited. Consequently, a significant investment increase has to come from higher expectation on demand. Therefore, measures to lower agricultural income and, consequently, lower the urban wage levels, usually serve to accelerate the growth rate of the economy in FI. All cheaper agricultural imports, lower agricultural tariff rates, and lower rural-urban migration serve this purpose. The last, lower migration, implies that the longer the period of agricultural labor surplus continues *á la* Lewis, the higher will be the growth rate an economy is able to achieve, provided factor substitution is fairly limited. This result is naturally consistent with that of Minami and Ono (1978c) who postulate a subsistent sector that can supply labor to a capitalist sector with infinite elasticity.

Of course, all these measures keep the distribution of income quite unequal, increasing both the rural-urban dualism and the intra-urban dualism, and decreasing the urban labor share. Whether such a policy is possible or not, therefore, depends very much on the country's political situation.

Devaluation also increases output through export expansion and import substitution, but the effects are limited by the very fact that the prices go up almost as much as the devaluation amount. Devaluation increases the export of sector 3 goods especially, which, in turn, increases the intermediate input demand from agriculture. Wages and prices of the urban sector therefore go up. The rate of increase of urban prices is around 9 percent when devaluation is 10 percent. This improves the agricultural terms of trade, decreasing the measure of rural-urban dualism. However, the aggregate distribution gets more unequal because of the drastic shift of income to the capital owners, and the increase in intra-urban wage dualism through inflation, i.e., the modern sector unskilled wages go up more rapidly than the traditional unskilled wages.

The rural sector would not be so lucky when, naturally, only urban exports are increased as in experiment HWT1. The rural-urban dualism decreases but only around 1 percent (as compared with 7 percent in HEX), and intra-urban dualism increases all the same, deteriorating the distribution of income severely during the export boom.

In these two experiments on the trade aspects of the economy, the devaluation and the export boom, we obtained some higher total output (real GDP) than in the base run. The third experiment on trade, higher tariff rates, does not give this result. Investment declines because of the lower demand expectation, mainly through the decreased export demand, and partly through the contractionary effects of increased government savings. Whether the import substitution effect, the usual argument for protection, occurs or not, depends therefore on the degree of import- and export-orientation of the concerned commodity. A higher tariff on sector 1 goods, for example, would at least have this substitution effect (although the total GDP declines over time), whereas it does not work at all on sector 3 goods, the exportables. Among the importables, however, the tariff increase on agricultural goods would only give a negative outcome because of the aforementioned classical unemployment effect.

The same classical unemployment effect* is at work on two of the three demographic experiments, namely HPOPH and HMIG. The higher population growth without a proportionate increase in the labor force, increases the demand for agricultural goods disporportionately and not the supply, whereas the higher rate of migration reduces the supply capacity of agriculture. The investment in agriculture does not increase sufficiently to overcome the difficulty. HPOPH is, however, a mirror image of what actually happened in Japan. The birth rate decreased continuously after the baby boom that occurred right after World War II. During the 1960s and 1970s, those young people born in the baby boom started to enter the labor market as well-educated, quality labor, in both urban and rural areas while the relative size of dependents decreased. This clearly boosted the economy quite positively**.

HMIG gives a result that is strongly negative in terms of growth. The high tariff rate on agriculture slows down rural-urban migration. Both affect the economy adversely by the classical unemployment effect, but the high migration case is more serious in terms of the loss of output and urban jobs. The Japanese government's persistence on a high agricultural tariff may largely be a result of political considerations, but it may very well have been a wiser choise even from a straightforward economic point of view—given, of course, all the rigidities in the economy.

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*We should emphasize that the classical unemployment usually defined (Bruno 1979, Lluch 1979), is that the (institutional) subsistence minimum wage level, which is exogenous to the economy, is too high for full employment. Here rural income is endogenous and increases due to the relative scarcity of rural workers. For such a case the Lewisian case easily reappears with assumptions of an endogenous and elastic labor supply function, or just by having an extremely higher amount of labor in the rural sector initially. Assuming a higher factor substitutability in the rural sector should also help (Bell 1979).

**This effect is naturally built into the present model as higher growth rates of labor force than population. This is one reason for the growth performance of the model economy.

As discussed in detail in Chapters 4 and 5, NC gives a solution that is unrealistic. This actually corroborates the results of Cardoso and Taylor (1979)*. In NC, not only does the distribution of income move counter to the historical facts, but it also fails to produce export-led growth: a result that is not only quite inconsistent with the experience of Japan, but also of many contemporary developing countries. The only way for an economy with an NC framework to grow faster is to have higher output (e.g., as in the HPOP experiment), or to have more savings (Shishido 1982a). Thrift and productivity are the only measures by which a neoclassical economy can be successful.

The IX framework produces results that are more rigid than the solutions of the other two. This is, of course, expected because we assume animal spirit investment and full employment of all factors. In this closure all that can change in the short run are the sectoral allocation of unskilled workers within nonagricultural sectors, and the amount of international trade.

The urban wage level in IX is endogenous and this makes the aspects of dualism and distribution vis-a-vis growth less straightforward than those in FI. In a situation where the pseudo-classical unemployment is the outcome of FI, the wage level goes down in IX decreasing both measures of wage dualism drastically. In cases where the Keynesian unemployment is the expected outcome in FI, the rural-urban dualism increases in FI**, whereas it decreases in IX. On the other hand, the magnitude of the changes in measures of size distribution, especially those of the urban sectors, is rather limited in most sensitivity analyses. This is naturally the result of the rigidities of the full employment assumption.

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*Although their "Cambridge" closure is IX, it is all the same in that a neoclassical closure does not work.

**The classical contraction involves the wage hike that narrows the gap at least between rural income and traditional urban wages, but the Keynesian contraction means less aggregate demand, resulting in deflation. All nominal wages then go down increasing the rural-urban dualism.

Adelman and Robinson (1978) and Lysy and Taylor (1980) also obtain similar results of stability in the size distribution measures. The assumption of both models, i.e., full employment, may very well explain at least a part of the stability. In IX, the functional distribution measure (the unskilled labor share) moves fairly together with the real GDP growth rate, as it does in NC. This is also counter to history. Given, however, the break down of the similar relationship between real GDP and the size-distribution of income towards the end of the 1960s, it may just be conjectured that the FI framework of infinitely elastic labor supply ceases to work around that time, and that the IX framework may take over. There is, of course, no readily available statistical test for such a conjecture and we will have to depend on future research and the further accumulation of real world as well as academic experiences.

Finally, several words can be said about the wage dualism observed in Japan. First, given a large enough labor force in the agricultural sector, the only way the intra-urban wage dualism can be born is through increasing the training-and-hiring costs of certain sectors (Shishido 1982a). In other words, higher technical progress in some sectors compared to others can definitely cause wage differentials even if the workers, before they are employed, are homogenous. Second, the close relationship between the agricultural and traditional sectors' female wages shows that these two labor markets, urban traditional and rural, were closely tied to each other until quite recently. The use of NC or IX, which use endogenous urban wage levels that effectively separate the two markets, cannot really trace the history of the wage dualism. Thirdly, the use of FI also means that the very highly elastic supply of nonagricultural labor is essential for the continued existence of wage dualism, and the exhaustion of such surplus labor means that the wage dualism at large has to disappear. All these corroborate with the findings of Yasuba (1976) and Tan (1980).

Naturally, it can be argued that the wage determination mechanism and the FI closure have these properties built in. True. But the important point is that the other closures fail to work or fail to replicate history qualitatively. The wage determination mechanism and the existence of surplus labor are among the essential differences of the three closures, and, from the limited experiments performed, they matter.

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