

GOVERNMENT GROWTH IN A FIXED ECONOMY

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ABSTRACT

Big Government is currently an issue of great concern to many Americans. Numerous legislative initiatives designed to stem government growth have either been introduced or are under consideration at the Federal, state and local level. However, despite widespread concern, there is little understanding of why or how government has come to be what and where it is. Rhetoric far exceeds cogent explanation in the media and popular press. And, no agreed-upon theory of government growth has yet emerged from academe.

Without a clear understanding of the why and how of government growth, it is highly unlikely that any policy designed to moderate this growth will succeed in its intention. The purpose of the research presented here is to take a first step toward the development of such an understanding. A computer simulation model is constructed. The model incorporates both the mechanisms residing within government that generate pressures for expansion and the mechanisms lying outside of government that respond to, and ultimately serve to constrain, this expansion. The model does not attempt to incorporate a theory of the multitude of factors, external to government in the surrounding socioeconomy, which may artifactually contribute to government expansion. However, the model does permit a variety of these external factors to be systematically altered in order to determine the resulting impact on government expansion.

Simulations of the model are used to gain a deeper understanding of the clash of forces that determine any given equilibrium distribution of employment and production between the public and private sectors of a mixed economy. In addition, model simulations are used to examine several alternative theories of government growth. Simulation results indicate that two of the most popular causal explanations for government growth--war and depression--are not capable of causing a permanent increase in the relative stature of government employment and production. Two less popular theories--one relating to productivity, the other to demographic change--are shown to be capable of causing a permanent relative increase in government activity.

The implications of model simulations for an assessment of the future prospects of government growth in the American socioeconomy are discussed.

Thesis Supervisor: Jay W. Forrester
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CHAPTER 1

INTRODUCTION

1.1 GOVERNMENT GROWTH: A Striking Phenomenon of Concern to Many.

Government has been expanding in both absolute terms, and relative to the private sector of the American Economy, for as long as data to measure the phenomenon have existed. Although some of the magnitudes associated with various aspects of government's absolute growth are indeed sensational, it is the relative growth of government that has attracted most attention and that is of some concern to many people.

Kendrick [1] and Fabricant [2] have compiled data which shows that government spending relative to the overall level of economic output has been continuously expanding since 1789. Meltzer and Richard, in a more recent study [3], present data which indicates that the growth of government employment has far outstripped the expansion of the labor force since the beginning of this century. Their data, summarized in Table 1-1, also suggest that the growth of tax revenues has substantially outpaced the growth of total economic output over the same interval.

TABLE 1-1

COMPOUND ANNUAL GROWTH RATES
OF GOVERNMENT AND OTHER VARIABLES

Period	Total Government	Total Labor Force	Tax Revenues (constant \$)	Real GNP
1901-1974	3.46%	1.62%	8.03%	3.17%
1901-1929	3.43	2.06	7.29	3.20
1929-1951	3.40	1.26	9.59	2.92
1951-1974	3.56	1.57	7.58	3.37

Department of Commerce data charting government expenditures as a percent of GNP between 1925 and 1975 are presented in Figure 1-1. Figure 1-2 tracks government employment as a percent of the total labor force between 1940 and 1975. Relative expansion is again clearly evident in both time series.

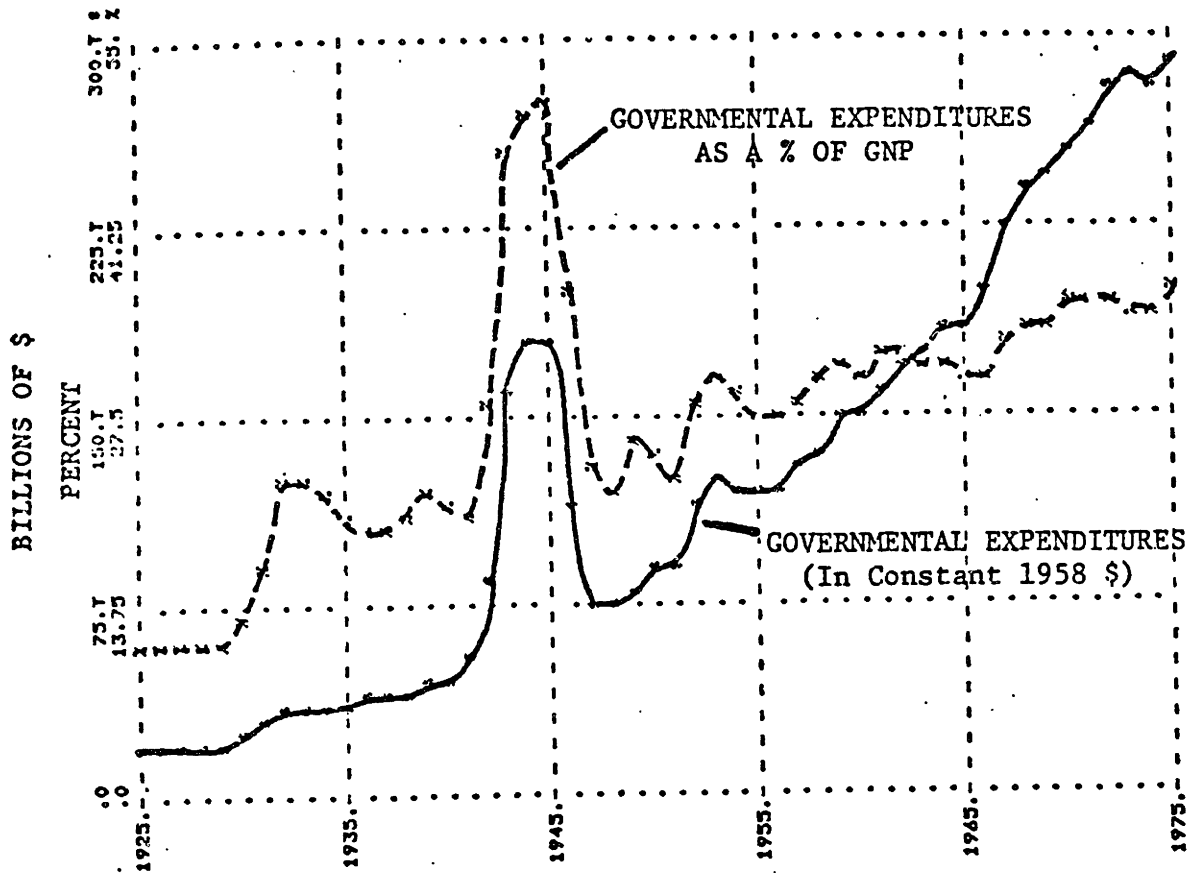


FIGURE 1-1. Total Government Spending in Constant (1958) Dollars and as a Percent of GNP, 1925-1975.

Source: Historical Statistics of the United States, p.1123 and p. 224.

Statistical Abstract, 1976, p. 273 and p. 394.

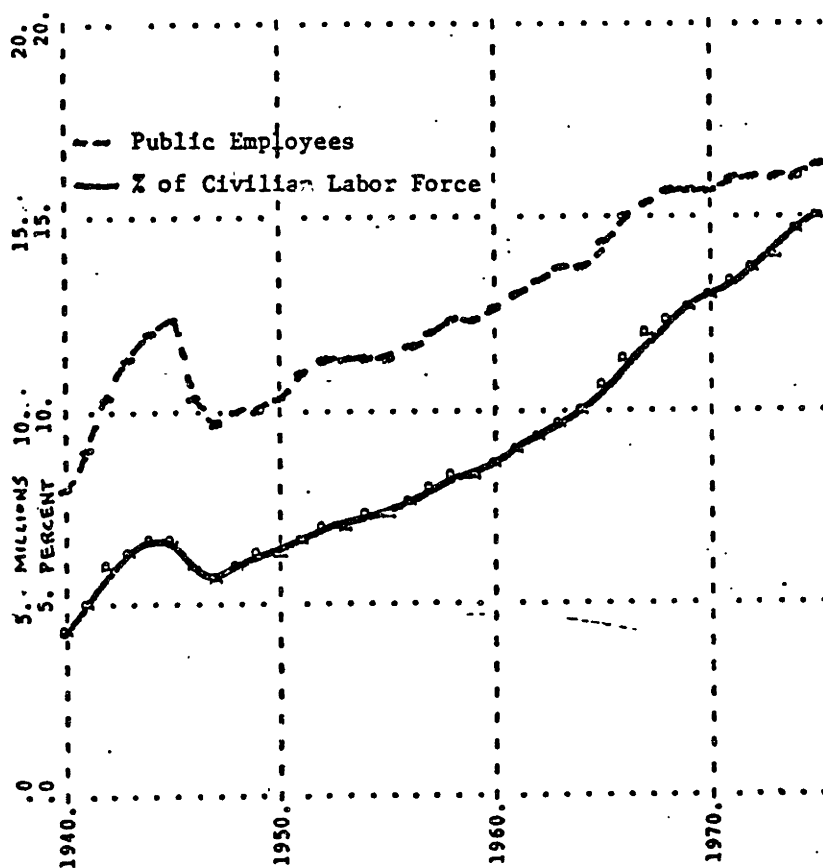


FIGURE 1-2. Total Public Employees and as a Percent of the Civilian Labor Force, 1940-1975.

Source: Historical Statistics of the United States, p.1100 and p.126-7.

Statistical Abstract, 1976, p. 284 and p. 355.

Of concern to at least a segment of the American population is the possibility that government's relative expansion may ultimately squeeze the private economy out of existence, replacing it with an inefficient, stagnant welfare state. Although this vision is perhaps somewhat extreme, a sizeable number of Americans have apparently come to feel that government is indeed overgrown. A wave of conservatism

has swept the country, literally obliterating the liberal groundswell of the mid and late 60's. California's Proposition 13 was the first substantial mass expression of the new conservative sentiment. The California initiative has since spawned numerous other state and local government growth-cap measures. And, the idea of a Constitutional amendment to fix a ceiling on Federal spending, a notion first entertained in the 30's, has again resurfaced for public consideration.

1.2 PURPOSE OF THE RESEARCH

Despite widespread concern about the relative stature of government in the U.S. economy, there is precious little understanding of why or how government has come to be what and where it is today. As is often the case when understanding is lacking, rhetoric abounds. Highly sensational, allegational accounts of insatiable and inefficient bureaucrats stuffing tax coffers with the hard-earned wages and salaries of American workers pepper the popular press and media. Whatever modicum of truth may lie in such highly-seasoned accounts, they do not explain how or why such a situation has been able to come to pass. Nor do they offer any insight into what might be done to throttle the long-standing relative expansion of government; if, indeed, the society at large desires such a throttling.

In the absence of a real understanding of the forces underlying the relative expansion of American government, the design

of policies that are capable of effectively moderating the course of this expansion is impossible. Early returns from Proposition 13 suggest what can happen when a policy is designed and implemented without first gaining an understanding of the underlying causes of the problem that the policy is designed to mitigate:

"California's Proposition 13 has done more than cut taxes. According to worried mayors and county supervisors, it has also cut the throat of local government.

The proposition, which has been seen nationwide as a statement of public anger with state and federal government, has given state government increased financial control and decision-making powers over traditionally local issues.

For conservatives, who strongly backed Proposition 13, the inadvertent growth of centralized power in Sacramento has been especially galling.

The decline of local control in California is a result of the "bail-out" legislation approved by the state legislature to save cities and counties floundering under the Proposition 13 loss of \$7 billion in property tax revenues.

Through the quick distribution of \$4 billion from the state's surplus funds, legislators and Gov. Jerry Brown were able to minimize the effects of Proposition 13's passage.

The dire predictions of massive layoffs and reduced city services did not come true. With the bail-out funds and the imposition of heavy user fees for formerly free local services, more than half of California's 417 cities plan to spend more money in the year after Proposition 13 than they did the year before.

A few communities are even expanding services, hiring employees and building parks and libraries.

But the key to California's life-after-Jarvis - the bail-out funds - did not come without strings attached. The gift-giving legislators in Sacramento required numerous restrictions on use of the money.

It was a carrot-and-stick approach hungry local governments could not turn down. But today, many city and county officials are beginning to view the bailout as a buy-out of local powers and fiscal independence.

"By voting in Proposition 13, the electorate has voted out local government...There has been a real shift of power from local government to the state," editorialized "Cry California," a magazine published by California Tomorrow, a non-profit environmental foundation.

Don Benninghoven, executive director of the League of California Cities, says, "Proposition 13 is one of the most severe blows to representative government in the history of the state."

"Unfortunately, the bail-out system probably hurt more than it helped." [4]

Thus, not only has Proposition 13 failed to stem the growth of government spending and employment, as it was designed to do, the measure has also produced an unanticipated centralization of governmental decision making power at the expense of a loss of local autonomy.

To arrive at the depth of understanding that is needed to design policies that do not produce such inadvertant consequences, would necessitate the development of a complete theory of government growth. The development of such a theory is not trivial. Government growth has not taken place in a vacuum. The relative expansion of the public sector is but one of the overall constellation of behaviors that, taken together, define a socioeconomy's life-cycle of development. In short, government growth can not be understood as separate from the economic, demographic, technological and physical changes that have characterized the overall evolution of the American socioeconomy.

The development of a full theory of socioeconomic evolution is an extremely ambitious undertaking; far too ambitious for the restricted scope of the research discussed here. Such a theory is, however, currently being constructed by the System Dynamics Group at

M.I.T. under the direction of Jay W. Forrester. The theory is being incorporated piecemeal into a large computer simulation model of a generic socioeconomy, the System Dynamics National Model SDNM [5]. The SDNM is divided into a number of sectors. Each sector constitutes a self-contained theory of a particular aspect of socioeconomic reality. When fully assembled, the sectors will interact to generate the evolution of any particular socioeconomy under study.

The research described here underlies development of the government sector of the SDNM. The research is aimed at developing a computer simulation model of government which can, in particular, be used to investigate the phenomenon of relative expansion. Because the sector is self-contained, it only represents the growth-promoting mechanisms that lie within government. The environment in which government growth takes place is assumed to be "fixed". This means that any potential growth-promoting mechanisms lying outside of government exert a constant influence. It does not, however, mean that the environment surrounding government is passive. For example, government actively competes for a fixed supply of labor with the private sector. In addition, the public responds to the tax and debt burden imposed by government, and government conducts regulatory activities which influence the productivity of private sector employees. It is, in fact, the interaction of government with its "fixed" environment that generates the pressures that ultimately halt government's relative expansion.

Because the model employed in the analysis focuses only on growth-promoting mechanisms lying within government, it is not an

adequate vehicle for the conduct of policy design. The purpose of the model is, rather, to take a first step toward the development of a full theory of government growth; a theory which can then be used as a basis for the design of effective policy. In particular, the model is designed to illuminate both the forces, internally-generated by government, that produce relative expansion, and the forces, external to government, that ultimately serve to constrain this expansion.

1.3 CHAPTER OVERVIEW

The remainder of the text is divided into four chapters and two technical appendices.

Chapter 2 describes the model that has been developed for use in analyzing government growth. The description is, for the most part, non-technical. A technical, equation-by-equation description of the model (with detailed DYNAMO flow diagrams) appears as Appendix I. A complete documented, undocumented and analyzer listing of the model is presented in Appendix II.

In Chapter 3, the model is disturbed from its reference equilibrium state by reducing the size of government. The behavior of the system as model variables "retrace" their steps back to the reference equilibrium state is then recorded and analyzed. The return trajectories of variables internal and external to government illuminate the clash of forces which determines the particular balance of production and employment that is ultimately struck between the public and private sectors of an economy.

In Chapter 4, a number of alternative theories of government growth are examined. Each of the theories deals with a different aspect of the "fixed" environment which surrounds government. In order to test a given theory, the relevant aspect of the environment is "un-fixed" in a one-time, step-change fashion. The response of the system to the particular disequilibrating environmental change is then noted to determine whether the alteration in fact causes government production and employment to settle at higher levels, or whether these variables return to their initial reference equilibrium position. If government production and employment return to their initial positions, the theory represented by the particular disturbance is not supported. However, if the particular alteration does result in a permanent change in the stature of government production and employment, the associated theory can be entertained as a cause of government expansion.

Chapter 5 concludes the text by assessing what light model simulation results can shed on the possible future course of government expansion in the American socio-economy. The Chapter also contains a discussion of the features of the present model which limit its usefulness as a vehicle for examining the future course of government expansion, and suggests ways in which the model should be extended to make it more useful in this capacity.

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CHAPTER 2

A MODEL OF GOVERNMENT GROWTH IN A FIXED ECONOMY

This Chapter describes the model that has been developed to examine government growth. The model has been conceptualized and constructed using the System Dynamics approach and associated methodology [1] [2] [3].

The Chapter contains four sections. The first couches the purpose of the undertaking in terms of model behavior in order to provide a context for the discussion of model structure that follows. The second discusses the major substantive assumptions on which the model is based. The third overviews model structure. The final section indentifies the principal feedback loops that constitute the detailed structure of the model.

2.1 THE BASIC CLASH OF FORCES

The model is designed to take a first step toward achievement of a full understanding of the relative expansion of the public sector. In particular, it seeks to illuminate the clash of forces that cause a balance of production and employment to be struck between the public and private sectors of a mixed economy. In order to generate this clash of forces, the model contains an explicit portrayal of the major stocks and flows within government that are assumed to provide government with the wherewithal to expand. In

addition, the model generates the major pressures, emanating from the environment surrounding government, that are hypothesized to restrict government expansion.

The principal stocks within government, as represented in the model, are: employment, money balance, outstanding government securities and tax rate. Employees produce government output. In order to acquire employees government must have money. Government's money comes from two sources: tax revenues and sale of government securities. Thus, in the model government growth occurs as a result of using money resources to acquire labor in order to expand production.

In the limited representation of the environment surrounding government, the pressures that throttle government growth derive from the degree of public tolerance for government's tax rate and debt burden. In the model, public tolerance declines with falling levels of private output and increases as private output expands. Private output varies directly with the level of private employment, expressed demand for private output, and productivity, each of which is influenced by the level of government activity in the model. When government expands employment, it ultimately does so at the expense of private employment because the two sectors compete for a fixed supply of labor in the model. If government levies too great a tax burden, disposable income, and hence expressed demand for private output, is reduced. Conversely, if government expands transfer payments, it can stimulate demand for private output by augmenting disposable income. Finally, private output can be depressed through declines in the

productivity of private sector employees. High levels of government regulation, which result in the model from high levels of government employment relative to private employment, can foster such declines.

Thus, as government expands, pressures for continued expansion clash with declining public tolerance for government's tax and debt burdens. Ultimately the growth of government's financial resources is limited, which brings expansion of government employment and production to a halt.

2.2 SUBSTANTIVE ASSUMPTIONS

In order to capture the clash of growth-promoting and growth limiting forces between the public and private sectors, the model contains an explicit portrayal of the interface between the two sectors. However, in reflection of the limited purpose of the model, a number of substantive assumptions have been made in order to properly restrict the scope of this interface.

2.2.1 The "Fixed Socioeconomy" Assumption

Government is assumed to exist in a socioeconomy whose major physical features are "fixed". Population size, age distribution, labor force size and composition, and the level of technology are all constants in the model. In addition, the socioeconomy is not plagued by war or economic depression. Freezing the major physical characteristics of the socioeconomy enables the clash of forces between government and its environment to be viewed against a fixed

backdrop. In particular, by fixing the environment surrounding government, government's own contribution to government growth can be isolated from the artifactual contributions to government expansion occasioned by evolutionary changes in the underlying physical features of the socioeconomy. Moreover, the forces that restrict government growth can be isolated to see how an equilibrium size of government is reached.

Once the equilibrium-determining clash of forces between the public and private sectors is well understood, each of the formerly "fixed" elements of the socioeconomic backdrop can be altered (one at a time) in order to determine the resulting impact on the particular balance of production and employment that is struck between the two sectors. These experiments provide the background for a future investigation that can develop a full theory of government growth. In the full theory, important physical features of the socioeconomy that have been identified would be generated as actual model variables to provide an overall causal explanation for government growth in the context of an evolving socioeconomy.

2.2.2 The "Mixed Economy" Assumption

The model assumes that there is an indelible distinction between government and the private sector. Only the private sector can produce material goods; i.e., food clothing and shelter. Government to produces only services that have traditionally been

provided publicly. Examples of such services, none of which are explicitly represented in the model (i.e., the model generates an aggregation called "Government Services"), are: police and fire protection, primary and secondary education, sanitation, bus and subway service, and National defense. Government, in the model, also produces transfer payments; these are explicitly represented in the model.

Theoretical support for recognizing a fundamental distinction between public and private output comes from the economics literature on social goods:

"To begin with, we return to the features which distinguish social from private goods. This distinction arises from certain technical characteristics of such goods which in turn have important bearing on the mechanism by which they can be provided. It is generally recognized that under certain conditions the market is an efficient mechanism for the provision of private goods. This is the case (1) because such goods permit application of the "exclusion principle" which renders them marketable and (2) because consumption is "rival" so that exclusion may be applied without efficiency loss. In the case of social goods these conditions are not met and a different form of provision is needed. The market mechanism can function only if the "exclusion principle" applies, i.e., if A's consumption is made contingent on his paying the price, while B who does not pay is excluded. Exchange cannot occur without property rights, and property rights require exclusion. Given such exclusion, the market can function as an auction system. The consumer must bid for the product, thereby revealing his preferences to the producer, and the producer under the pressures of competition is guided by these signals to produce what consumers want. Such at least is the case with a well-functioning market. Moreover, the nature of private goods-such as food, clothing, housing, automobiles, and millions of other marketable private goods-is such that the benefits derived therefrom flow to a particular consumer. Thus, benefits are internalized and consumption is

rival. A hamburger eaten by A cannot be eaten by B. At the same time, the nature of the goods is such that exclusion is readily feasible. The goods are handed over when the price is paid and the market mechanism is well equipped to handle their provision. We refer to them as marketable private goods.

A first instance of market failure arises where exclusion is not applicable. While most goods which are rival in consumption also lend themselves to exclusion, this is not always the case. Consider for instance travel on a crowded cross-Manhattan street during rush time. The use of the available space is distinctly rival and exclusion (the auctioning off, or sale of the available space) would be efficient and should be applied. Use of crowded space would then go to those who value it most and who are willing to offer the highest price. But such exclusion would be impossible, or is too costly at this time. We have here a situation where exclusion should but cannot be applied. Here the difficulty of applying exclusion is the cause of market failure. Public provision is required until techniques can be found to apply exclusion.

A second instance of market failure arises where consumption of certain goods is nonrival. Such goods are here referred to as "social goods." These are goods where A's partaking in the consumption benefits does not reduce the benefits derived by all others. Because of this it would be inefficient to apply exclusion even if this could be readily done. Since A's partaking in the consumption benefits does not hurt B, the exclusion of A would be inefficient. Consider for instance, the case of a bridge which is not crowded. A's crossing, therefore, will not interfere with B's. Charging a toll would be quite feasible, but so long as the bridge is not crowded, it would be inefficient to do since it would curtail use of the bridge.[4]

It is important not to overstate the meaning of the assumption that there is a fundamental distinction between public and private goods. Maintaining such a distinction means only that the private sector does not produce social (or public) goods and that the public sector does not generate material goods; i.e., that the economy

remains "mixed". On the other hand, the assumption, by itself, says nothing about the relative quantity of public versus private goods that the society will want. It says only that if people want a given quantity of material goods, they can only get them from the private sector. And, if they want a given quantity of public goods, they can only obtain them from government.

Even without overstating the meaning of the distinction between public and private goods the assumption is nonetheless very restrictive. In particular, adhering to the assumption, means that the phenomenon of nationalization can not be investigated by the model. Assuming that material output is only available from the private sector, completely begs the question of why and how government comes to assume control of production in a given private company or industry. Such a question is, extremely important. The inability of the model to address the question of nationalization constitutes one of its principal limitations. The limitation is discussed further in Chapter 5.

2.2.3 The Assumption That Economic Transactions are Conducted in "Real" Terms.

The model is greatly simplified by assuming that economic transactions are conducted in "real" terms. Because of this assumption, it is not necessary to keep track of a money supply, or to generate prices, wages or inflation.

The importance of the "real" assumption for the investigation of government growth is two-fold.

First, money creation, which is one of the important ways that government (at the Federal level) can finance its expansion, is eliminated. The Federal government creates money in two ways. Money is created directly, simply by printing it. Wartime often occasions the need for direct money creation through printing. Money is also created indirectly. Indirect money creation--a process known as "monetizing the debt"--occurs when the Treasury borrows money from the Federal Reserve, and then spends the money.* As Figure 2-1 indicates, in recent years, debt monetization has become an increasingly important financing channel at the Federal level.

* Because there is no compensating reduction in Fed reserves--as there is when, say, a commercial bank borrows from the Fed--money is created when the Treasury spends the borrowed money. See [5] [6] for a discussion of "monetizing the debt."

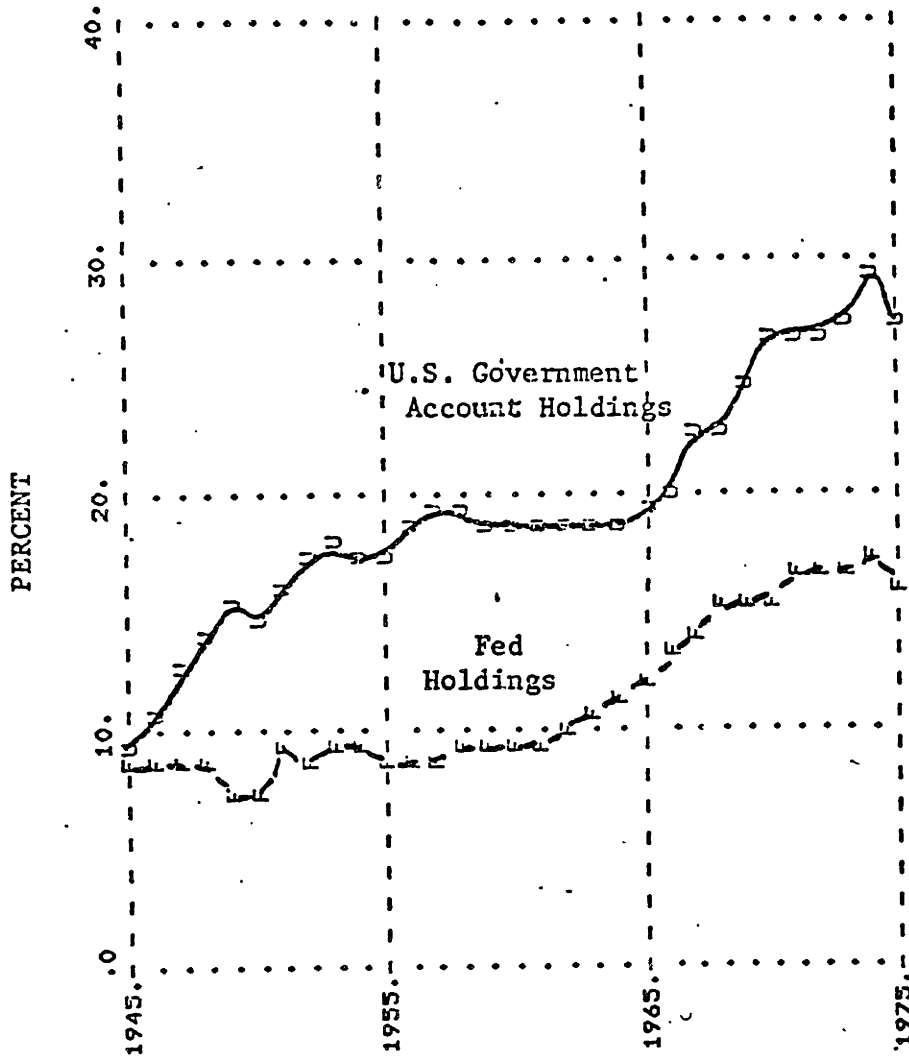


FIGURE 2-1. Holdings of Federal Securities by U.S. Government Accounts and the Fed as a Percent of Federal Debt Outstanding, 1945-75. [7] [8].

In addition to eliminating money creation as a financing option, restricting the model to dealing in only "real" quantities also eliminates government's so-called "fiscal dividend." The "dividend" results when inflation moves wage and salary earners into higher marginal tax brackets. The higher marginal tax rates cause tax revenues to rise by more than the nominal increase in incomes. This extra margin of tax revenues is the so-called "fiscal dividend." Inflation thus effectively provides government with unlegislated tax increases.

When the two effects are combined, it is evident that a potentially important relationship underlying government's ability to grow is ignored by assuming that the economy functions in a "real" mode. "Monetizing the debt" creates money which, other things equal, increases inflation. Inflation, in turn, awards government a "fiscal dividend". Government therefore has some potential for bootstrapping its own expansion through the exercise of its financing options.

Such a ponzi scheme can not, however, go on forever. In the not-too-long-run, a currency is only as strong as the real output of goods and services that it represents. Thus, although the model does ignore an important effect which can influence government growth in the short to intermediate term, dealing only in "real" quantities should not distort the ultimate balance that will be struck between the public and private sector. And, it is the forces that determine this ultimate balance that the model is designed to illuminate.

2.1.4 Labor is the Only Factor of Production

The model assumes that labor is the only factor of production. Government and the private sector compete for the fixed supply of labor in the model. Any members of the labor force who are not employed by one or the other, enter the pool of unemployed.

Capital is not explicitly represented in the model. However, its effect enters implicitly through the effect of technology on the productivity of labor. An increase in the level of technology in the model is assumed to increase the productivity of labor. One of the justifications for this assumption is the implicit assumption that a sophistication of the capital stock occurs with rising levels of technology.

Excluding capital, and all other factors of production (except labor), reflects the fact that the model is not concerned with issues of economic instability, per se. However, the model can be used to examine the impact of an exogenously-imposed depression on government's ultimate stature in the socioeconomy.

2.2.5 Private Output is "Demanded," Government Output is "Supplied".

In reality, the demand for privately-produced goods and services is, at least in principle, a quantity that can be measured in dollar terms. Private producers price their output and then register sales revenues. Under normal conditions, aggregate sales revenues serve as a reasonable dollar estimate of demand for private output. Private employers use this estimate to adjust their employment levels. Thus, in the private sector, there is an approximately direct connection between the demand for, and resulting supply of, output.

The directness of the connection between supply and demand, evident in the private sector, breaks down in the public sector.

First of all, it is not possible to measure the demand for government output in dollar terms. This is due to the fact that most government output is not divisible into priceable units, nor is it "sold" on an exclusive basis. As Von Mises notes:

"Bureaus specialize in the supply of those services the value of which cannot be exchanged for money at a per-unit rate. As a consequence, bureaus can not be managed by profit goals. "[9]

Secondly, the payment for, and receipt of, government output are not temporally coincident. What is more, the party paying for a particular government output is often not the party who receives it.

For all of these reasons, it is difficult to speak of there being a demand for government output in the same sense as there is a demand for private output. And, because government does not receive direct sales revenue feedback from the market (nor is it guided by profitability considerations) government does not, like the private sector, adjust its output and employment levels in response to a perception of demand.

In light of these considerations, the model assumes that government operates in a mode that is supply, rather than demand, driven. In particular, it is assumed that government is continuously attempting to supply as much output as it is financially and physically able to.

The assumption that government institutions will seek to supply as much output as they can, and that they have an inherent advantage over private sector institutions in seeking to do so, has considerable support in the literature. For example, Downs states:

"In fact, all organizations have inherent tendencies to expand. What sets bureaus apart is that they do not have as many restraints upon expansion, nor do their restraints function as automatically. The major reasons why bureaus inherently seek to expand are as follows: The expansion of any organization normally provides its leaders with increased power, income, and prestige; hence they encourage its growth ... Growth tends to reduce internal conflicts in an organization by allowing some (or all) of its members to increase their personal status without lowering that of others. Therefore, organizational leaders encourage expansion to maximize morale and minimize internal conflicts...Increasing the size of an organization may also improve the quality of its performance (per unit of output) and its chances for survival...Finally because there is no inherent quid pro quo in bureau activity enabling officials to weigh the marginal cost, the incentive structure

facing most officials provides much greater rewards for increasing expenditures than for reducing them. Hence officials are encouraged to expand their organizations through greater spending...Unlike the other sources of growth pressure described above, this one is not found in most market-oriented organizations." [10]

To this, Niskanen adds:

"Among the several variables that may enter the bureaucrat's utility function are the following: salary, perquisites of the office, public reputation, power patronage, output of the bureau, ease of making the changes, and ease of managing the bureau. All of these variables, except the last two, I contend, are a positive monotonic function of the total budget of the bureau during the bureaucrat's tenure in office." [11]

Financial constraints to government's ability to supply increasing amounts of output come in the form of public reactions to tax and debt burdens. And, physical constraints arise from the fact that government must compete with the private sector for a fixed supply of labor. For example, any reduction in the stock of private labor that generates a decline in material output will draw a strong reaction from the public.

Thus, rather than demanding a particular level of government output--as they do for private output--the public, in the model, is supplied with as much as they will tolerate. The public responds to the "price" that is being exacted, although it perceives this "price" only indirectly. For a given "price", it is assumed that the public will accept as much government output as it can get. When the public says "too much", it is not responding to the level of output, but

rather to the cost (in terms of tax and debt burden) that is associated with the particular level of output.

The operational significance of the assumption that government is supply, rather than demand, driven, is the resulting implication that government will respond asymmetrically to its money adequacy position. For example, it is assumed that, given a budget surplus, government will seek to absorb the excess into expanded spending commitments rather than to return it to the public by cutting taxes or reducing its debt burden. On the other hand, if government faces a money shortfall, it is assumed that government will seek to increase tax rate and sale of securities, rather than cut back its spending obligations. This assumed asymmetry is described in greater detail in subsequent discussion.

2.3 OVERVIEW OF MODEL STRUCTURE

The preceding two sections indicated the general nature and form of the model by describing the methodological and substantive assumptions upon which it is based. The next two sections provide a more refined picture of the model by moving to the level of detailed assumptions. This section provides an overview of the detailed structure of the model. The final section then describes the major feedback loops that go to make up the detailed structure of the model. Again, Appendix I should be read in conjunction with these sections in order to obtain a complete picture of the detailed structure of the model.

2.3.1 Major Stocks and Flows Within the Government Sector.

Figure 2-2 depicts the major stocks and flows in the government sector of the model. The Figure also indicates the nature of the interrelationships between the major stocks and flows within the sector. The Figure is not a complete DYNAMO flow diagram of the sector. It does not include any of the intervening auxiliary variables or constants; nor does it indicate any of the inputs to, or outputs from, the sector. The Figure is only intended to provide a visual feel for the basic structure of the sector.

As Figure 2-2 indicates, the government sector of the model consists of four major accumulations, or stocks. In this version of the model, only one level of government is represented. Thus, each major stock, and its associated flows, aggregate the activity of the three levels of government. However, model equations are written in generic form, with subscripts, so that the model can be easily disaggregated to depict two or more levels of government as well as a variety of different tax types.

Of the stocks depicted in Figure 2-2, Government Employees GE, Government Money Balance GMB, and Outstanding Government Securities OGSY are physical accumulations. Tax Rate TR is an accumulation of information.

The Tax Rate TR that prevails at any point in time is an accumulation of all past changes in TR. Furthermore, TR, like the other stocks, is physically observable and serves as a basis for decisions. Therefore, TR, although superficially different, is both conceptually and functionally analogous to the other stocks.

As the layout of Figure 2-2 suggests, GMB is central to the functioning of the sector. Government must have an adequate stock of money in order to expand its employment and output, which government is assumed to be continuously seeking to do. Thus, GMB influences every flow within the government sector.*

Government's money stock moderates the hiring and firing of employees. When money is abundant, government can offer financial incentives which attract employees into the sector and discourage

* As subsequent discussion details, it is not the absolute level of Government Money Balance GMB that regulates activity in the sector. Rather, it is Government Money Adequacy GMA. GMA is a relative concept. It relates GMB to the amount of money that government needs to cover its desired volume of spending commitments. In providing a general overview of the relationships operating in the sector, GMB, rather than GMA, can be used in the interest of simplicity without distorting the sense of any relationships.

employees from leaving the sector. When money is in short supply, government will be compelled to enact hiring freezes and perhaps even to discharge employees, in order to reduce spending commitments. Abundant money also means that government can expand transfer payment program eligibility and benefits, while tight money reverses these effects. When money is in short supply, government defaults rise. Conversely, budgetary excesses reduce the volume of government defaults.

Because of the important influence that government's money stock exerts on the level of its activities, government seeks to maintain its money balance at desired levels. As Figure 2-3 indicates, government has two sets of options for restoring its money balance to desired levels. The model assumes that one set of options is preferred when government money balance is below desired levels, and that the other set is preferred when money excesses have built up.

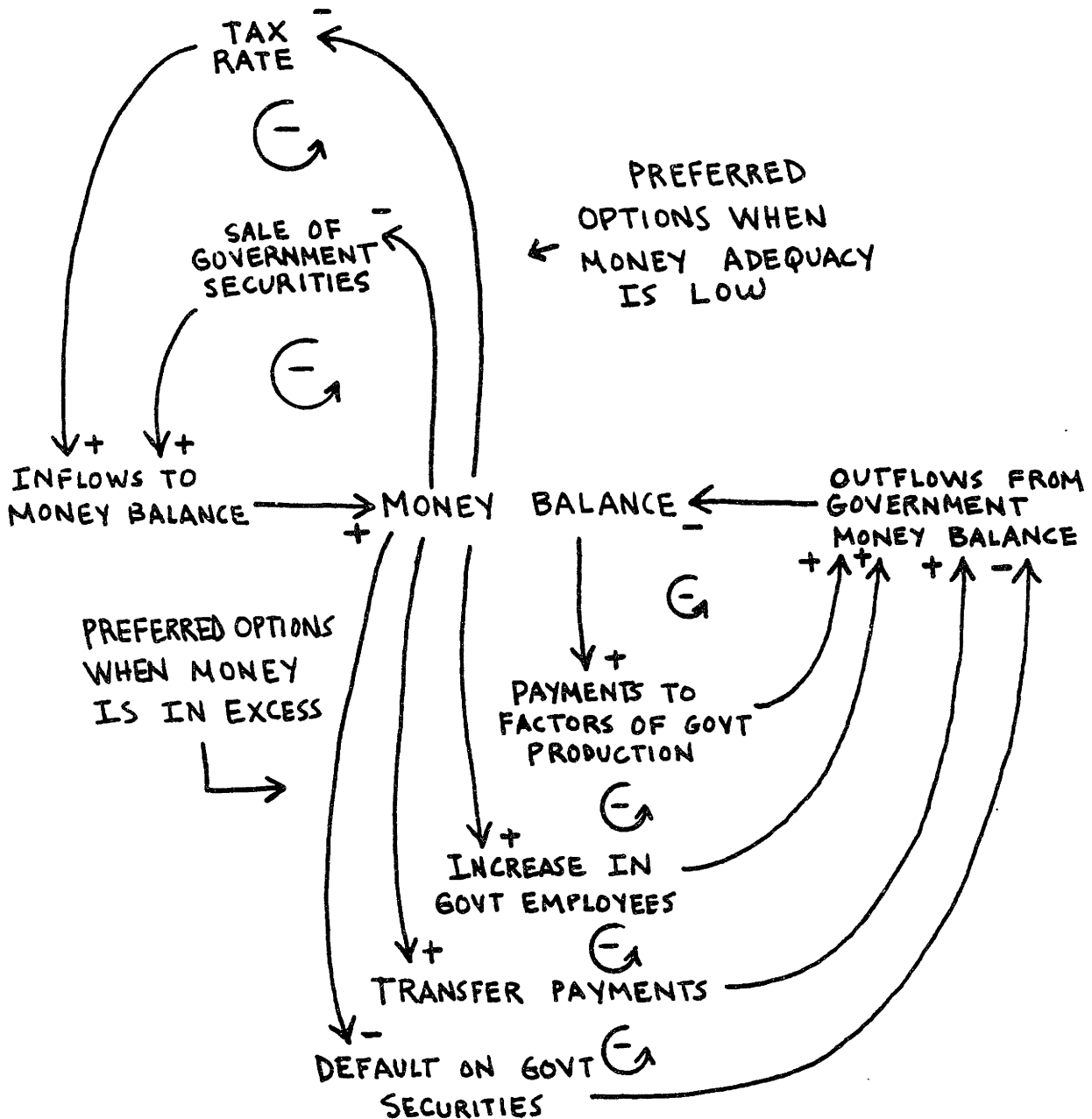


FIGURE 2-3. Government's Options for Restoring Money Balance to Desired Levels.

As Figure 2-3 shows, when government wishes to correct money balance shortfalls, it can increase inflows to its money stock by increasing Tax Rate TR (which increases tax revenues) and/or Sale of Government Securities SGS. Alternatively, government can decrease outflows from its money balance by reducing Payments to Factors of Government Production PFGP, Increase in Government Employees IGE, and Transfer Payments TP, or by increasing Default on Government Securities DGS and Decrease in Government Employees DGE. The model is parameterized so that government prefers to exercise the first set of options (i.e., augmenting money balance inflows) when faced with money shortfalls.

Similarly, when government wishes to reduce money balance excesses, it has two sets of options. Government can elect to reduce inflows to its money stock by cutting TR or decreasing SGS. Alternatively, government can choose to increase outflows from its money stock by increasing PFGP, TP and IGE, or by depressing DGS and DGE. The model is parameterized so that government prefers to exercise the latter set of options (i.e., augmenting money balance outflows) when faced with a budget surplus.

Taken together, the four major stocks and ten policies in the government sector form a system. The system, in the absence of constraints, will grow. Growth can continue, however, only as long as government has the financial wherewithal to maintain ever-increasing levels of employment and spending. Government generates this financial wherewithal from two sources: tax revenues and sale of government securities. As the next section indicates, government's

capacity to raise tax revenues and sell securities, as well as its ability to acquire employees, is limited by the level of activity in the private economy.

2.3.2 An Overview of the Interface Between the Government Sector and the Rest-of-the-Socioeconomy Sector.

Figure 2-4 provides an overview of the interface between the Government Sector and the Rest-of-the-Socioeconomy Sector of the model. Like Figure 2-2, Figure 2-4 is not a complete DYNAMO flow diagram. Most intervening variables, all constants and many feedback loops are omitted. In particular, the diagram does not attempt to accurately depict, even in overview form, the internal structure of the Government sector. Figure 2-2 did this. Figure 2-4 is intended only to summarize, in graphic form, the interface between the Government Sector and The Rest-of-the-Socioeconomy Sector of the model.

First, notice that, as previously discussed, the Rest-of-the-Socioeconomy Sector is divided into a fixed and a variable component. All of the parameters in the fixed component remain constant except during testing when each may be modified in a step-change fashion.

Space did not permit a graphic elaboration of the interface between the fixed and variable components of the Rest-of-the-Socioeconomy sector. Therefore, the interface is briefly described here in verbal terms.

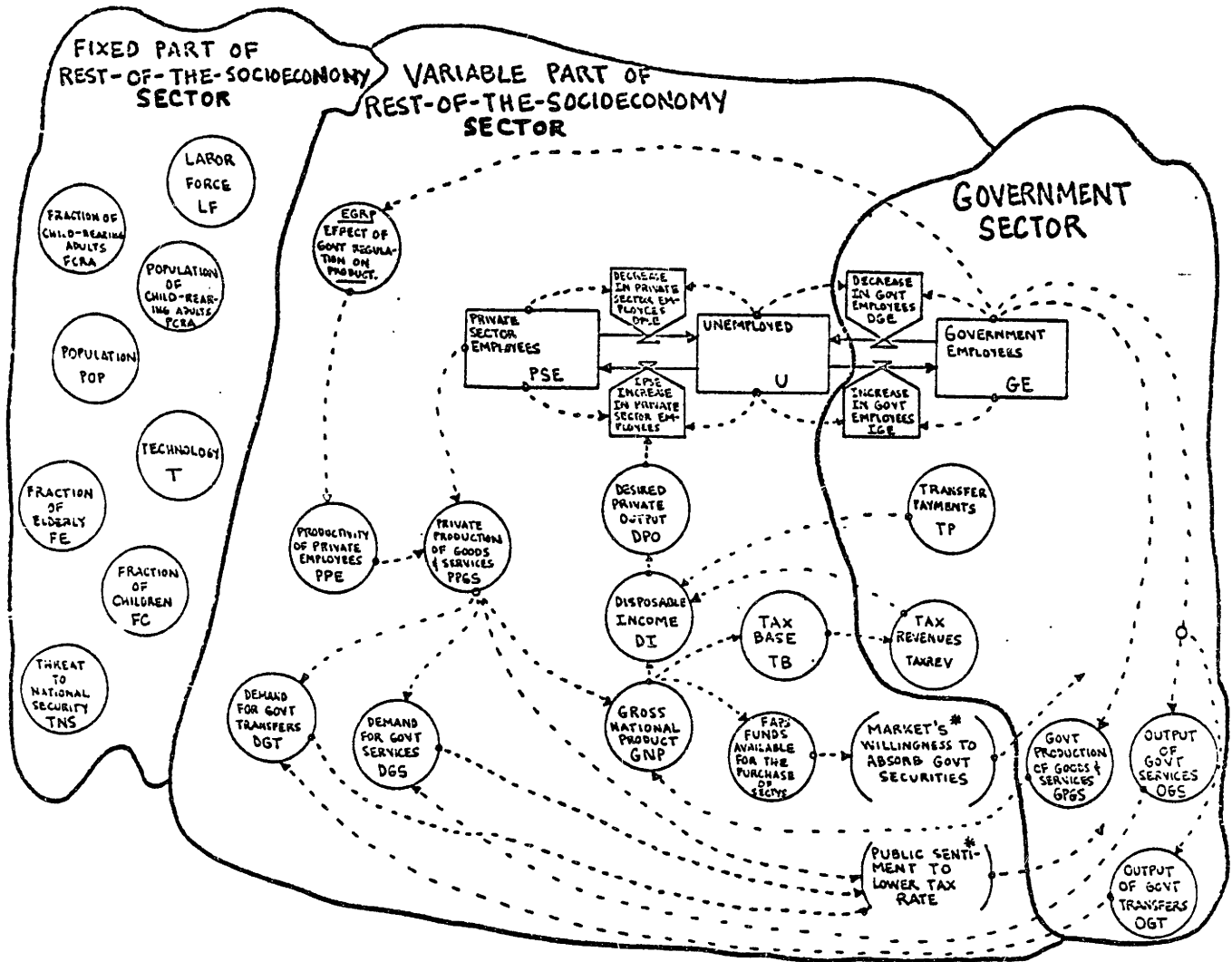


FIGURE 2-4. A Graphic Overview of the Interface Between the Government Sector and the Rest-of-the-Socioeconomy Sector of the Model.

Briefly, Population POP is used to calculate a Population of Child-Rearing Adults PCRA, a fraction of whom constitute the Labor Force LF. The available LF is then distributed among Private Sector Employees PSE, Government Employees GE and Unemployed U, in order to establish the initial employment conditions in the model. The level of Technology T--an aggregate index of education level and capital sophistication in the socioeconomy--is positively related to both Productivity of Private Employees PPE and productivity of government employees (not shown in the Figure). Threat to National Security--an index of crisis situations, like war--impacts primarily upon public sentiment to lower taxes and market response to government's desired sale of securities*, neutralizing both during times of National crisis. Finally, Fraction of Children FC and Fraction of Elderly FE play a role in determining the Demand for Government Services DEGS and the Demand for Government Transfers DGT.

The specific influence of each variable in the fixed component of the Rest-of-the-Socioeconomy sector on the remaining variables in the model is detailed at the time when each is altered for testing purposes (in Chapter 4).

* Neither "public sentiment to lower taxes" nor "market response to government's desired sale of securities" is a real model variable. Both names are used to serve as aggregate representations of several effects that are generated in the model, and that do impact upon tax rates and sale of government securities, respectively.

Figure 2-4 also outlines the labor allocation structure contained in the model. Components of the structure are examined in detail in the next section. As the Figure indicates, both government and the private sector must draw labor from the pool of unemployed. As subsequent discussion details, however, each sector can also exert a direct pull on the other's pool of employees. For example, the private sector can draw government employees into the pool of unemployed, from which it can then acquire these employees. Government can do the same. Thus, government and the private sector actively compete for the fixed supply of labor that is available in the model.

Government's success in the competition is directly related to its ability to generate a volume of money inflows that will enable it to maintain an adequate money stock. Government money inflows come from Tax Revenues TAXREV and Sale of Government Securities SGS. As Figure 2-4 suggests, both sources of money are influenced by the level of Private Production of Goods and Services PPGS.

The level of PPGS is one of several determinants of Public Sentiment to Lower Tax Rate. It is assumed that the public grows increasingly less tolerant of a given level of tax rate as it

experiences any decline in its material standard of living (indicated by PPGS). Declining tolerance in the model translates into pressures to cut tax rates. And, other things equal, lower tax rates, mean a smaller inflow of tax revenues. As Figure 2-4 indicates, PPGS also influences Tax Base TB, the second component of Tax Revenues TAXREV. TB is assumed to be a fixed fraction of GNP, an important component of which is PPGS. Other things equal, any decline in PPGS causes TB to erode and thereby depresses TAXREV. Thus, government's first source of money inflow, TAXREV, is tightly coupled to the level of private output.

Government's second source of money inflow, Sale of Government Securities SGS, is also closely coupled to the level of PPGS. As Figure 2-4 suggests, Funds Available for the Purchase of Securities FAPS are determined as a fraction of GNP. One of the several restrictions on government's ability to sell securities is the amount of funds that are available for the purchase of securities. If private output is reduced, other things equal the quantity of FAPS is, also reduced. With a smaller quantity of FAPS, government's sale of government securities is depressed.

Thus, when PPGS declines, government's capacity for expansion is likewise diminished. From Figure 2-4, it is evident that PPGS can only decline if either Productivity of Private Employees PPE or Private Sector Employees PSE declines. Both PPE and PSE are in turn seen to be linked to the level of governmental activity.

PPE is assumed to be constant, except for the Effect of Government Regulation on Productivity EGRP. EGRP, depends upon the

level of Government Employees GE. The assumption here is that more GE means more regulation which, in turn, implies lower productivity. Thus, one way in which government growth creates its own limiting pressures is via a depression of private productivity. Reduced PPE lowers PPGS which has the aforescribed depressive influences on government's money inflows.

The level of governmental activity also influences the level of Private Sector Employees PSE, the second determining component of PPGS. With a fixed labor force, increases in GE can only come at the expense of a reduced pool of Unemployed U or Private Sector Employees PSE. Assuming constant productivity, any reduction in PSE, depresses PPGS. A depressed level of private output, as previously described, constricts government's money-raising capabilities. Hence, a second way in which government growth creates its own limiting pressures is by draining employees out of the private sector to fill its own employment pool.

In addition to the two direct impacts on PPGS, government's growth can also operate in a number of indirect ways to generate growth-limiting pressures. As Figure 2-4 indicates, the Demand for Private Output DPO depends upon the level of Disposable Income DI. The model assumes that the level of demand for private output is constrained by DI. If DI is not adequate to allow people to purchase previously-established levels of private output, the private sector will be compelled to discharge employees. In doing so, a positive

feedback process is set in motion. Fewer Private Sector Employees PSE produce lower levels of PPGS which, in turn, depresses DI, thereby further restricting demand.

Government can set this reinforcing spiral in motion by taxing at a rate in excess of its spending, a policy that government might attempt to implement in an effort to rebuild its money stocks. Government can also exert pressures to turn such a spiral around by spending more than it is taking in taxes.

As the summary overview of structure suggests, government is tightly coupled to the private economy. A more detailed description of the coupling between government and the rest-of-the-socioeconomy will emerge in the discussion of the specific feedback loops that go to make up the two sectors.

2.4 MAJOR FEEDBACK LOOPS

As previously described, the model consists of two sectors: government and the rest-of-the-socioeconomy. Both sectors are constructed out of blocks of equations. Each block performs a central function, and is usually organized around a major stock or accumulation. Again, Appendix I provides an equation-by-equation description of each equation within each block, as well as detailed flow diagrams of each equation block.

The government sector consists of five equation blocks: Government Employees, Government Output, Government Money Balance, Government Debt and Government Tax Rate Setting. Four of these blocks are organized around one of the state variables depicted in Figure 2-2. The rest-of-the-socioeconomy sector is composed of eight equation blocks: Population, Labor Force, Private Sector Employees, Demand for Government Services, Demand for Government Transfers, Demand for Private Output, Private Production & GNP and Productivity of Private Sector Employees.

The feedback loop structure of the model transcends both equation block and sector boundaries. This section traces through a progression of feedback loops. The progression begins with the smallest major loop within the government sector and then expands both by weaving in additional loops, and by branching to new loops.

2.4.1 Empire-Building

At the core of the growth-generating pressures within the government sector of the model is an assumption that government management personnel desire to expand their employment pools by a fixed percent per year. As previously discussed, the assumption that

management personnel possess such empire-building urges has considerable support in the literature [9] [10] [11] [12]. To summarize the arguments which have been advanced in the literature: expansion provides a sense of viability and security, as well as often increasing the manager's power, prestige, responsibility and remuneration.

Figure 2-5 depicts the basic feedback loop structure of the empire-building assumption in terms of model variables.

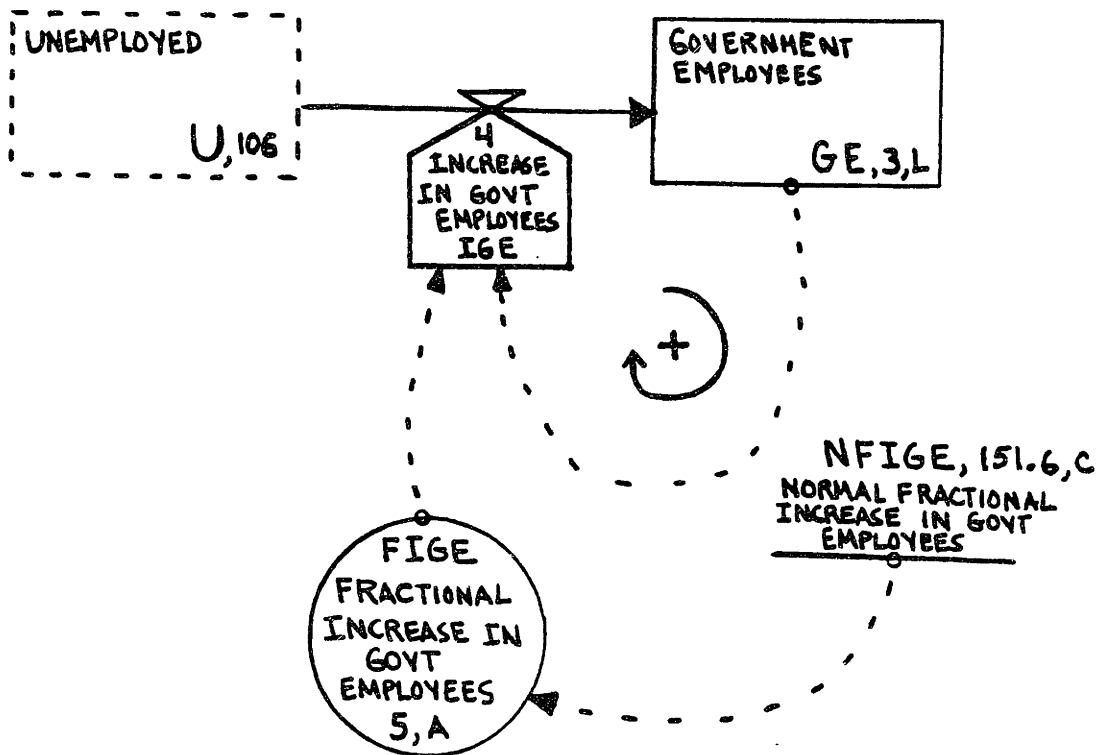


FIGURE 2-5. The Feedback Loop Structure of the Empire-Building Assumption.

As Figure 2-5 indicates, the empire-building assumption translates into a simple positive feedback loop. In this loop, Increase in Government Employees IGE is proportional to the level of Government Employees GE. The proportionality constant is equal to Normal Fractional Increase in Government Employees NFIGE. Thus, as GE increases, IGE increases, which further increases GE, and so on in a reinforcing growth spiral.

NFIGE is set equal to 5% in the model. Conceptually, NFIGE represents the percent by which government management personnel would like to expand their employment pools under "normal" conditions. Normal conditions are defined as those in which any influences that might serve to constrain the expansion of government employment are neutral. A detailed justification for why the value of 5% was selected for NFIGE is provided in Appendix I. Briefly stated, a 5% growth rate appears both high enough to satisfy a manager's empire-building urges, yet not so high that managers would feel that they were losing control of their growing empires.

2.4.2 Constraints Upon Empire-Building

Left to its own doing, the structure depicted in Figure 2- will grow exponentially at a rate of 5% per year. At this rate, the stock of Government Employees will double roughly every fourteen years. And, before very many years, every member of the labor force would be an employee of government.

In order to prevent this impossible event from occurring in the model, two constraints are added. The first is a financial

constraint. The second is a physical constraint.

Figure 2-6 portrays one way in which the financial constraint can operate.

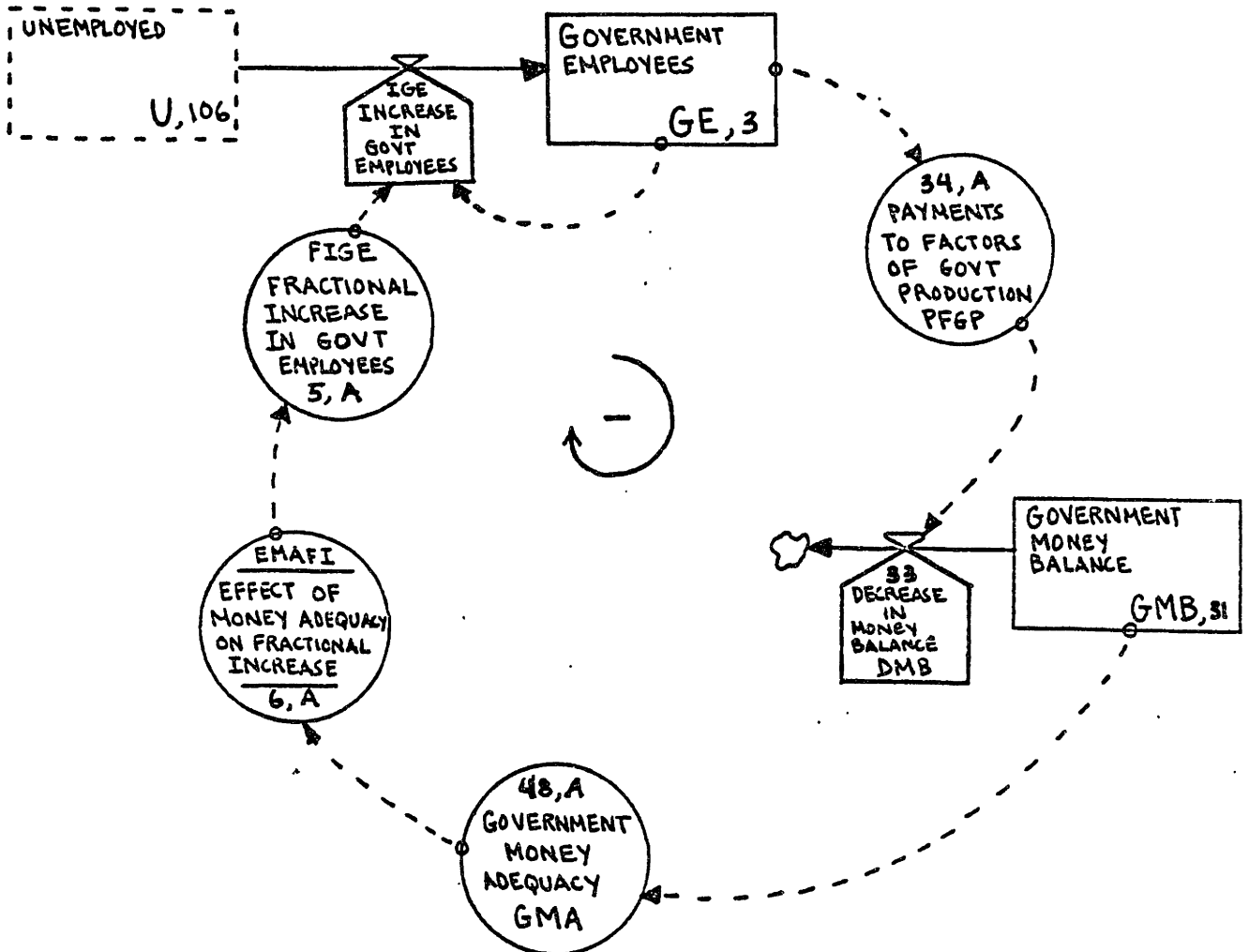


FIGURE 2-6. A Financial Constraint on the Expansion of Government Employment.

As Government Employment GE increases, Payments to Factors of Government Production $PFGP$ --the wages and salaries paid to government employees--increases. A rise in $PFGP$ increases Decrease in Money Balance DMB , which, other things equal, lowers Government Money Balance, GMB . A decline in GMB drives down

Government Money Adequacy GMA.* A reduction in GMA depresses the Effect of Money Adequacy on Fractional Increase EMAFI, thereby reducing Fractional Increase in Government Employees FIGE and slowing the assimilation of new employees.

Figure 2-7 depicts the physical constraint that operates to brake the expansion of GE.

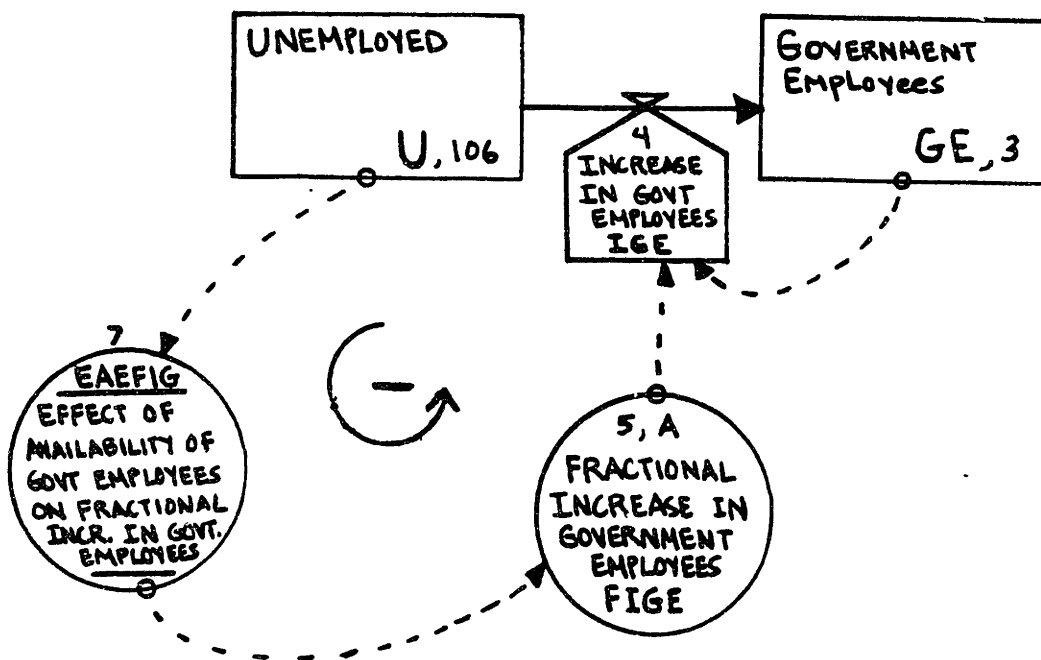


FIGURE 2-7. A Physical Constraint on the Expansion of Government Employees.

* Government Money Adequacy GMA is defined in equation 48 (see Appendix I or II) as:

$$GMA = GMB / (ADPAY * DMC OV)$$

where: GMA = Government Money Adequacy (Dimensionless)
 GMB = Government Money Balance (\$)
 ADPAY = Average Desired Payments (\$/Year)
 DMC OV = Desired Money Coverage (Years)

As discussed in detail in Appendix I, GMA is an indicator of how much money government has, relative to what it requires to meet a stream of desired spending commitments.

Like its financial analogue, the physical constraint, operates as a negative feedback process. As GE increases, the pool of Unemployed U is drawn down. As U declines toward frictional levels, Effect of Availability of Employees on Fractional Increase in Government employees EAEFIG approaches zero. EAEFIG multiplies FIGE. Therefore, Increase in Government Employees IGE is also driven toward zero, halting the growth of GE.

2.4.3 Bolstering Money Adequacy

As Figure 2-6 indicates, Government Money Adequacy GMA can serve to constrain the expansion of government employment. Figures 2-8 and 2-9 depict two of government's preferred options for increasing GMA.

Figure 2-8 shows a reduction in GMA giving rise to a pressure to increase Tax Revenues.

Government's second major option for restoring depressed money adequacy is to increase its sale of securities. Figure 2-9 traces the associated negative feedback loop.

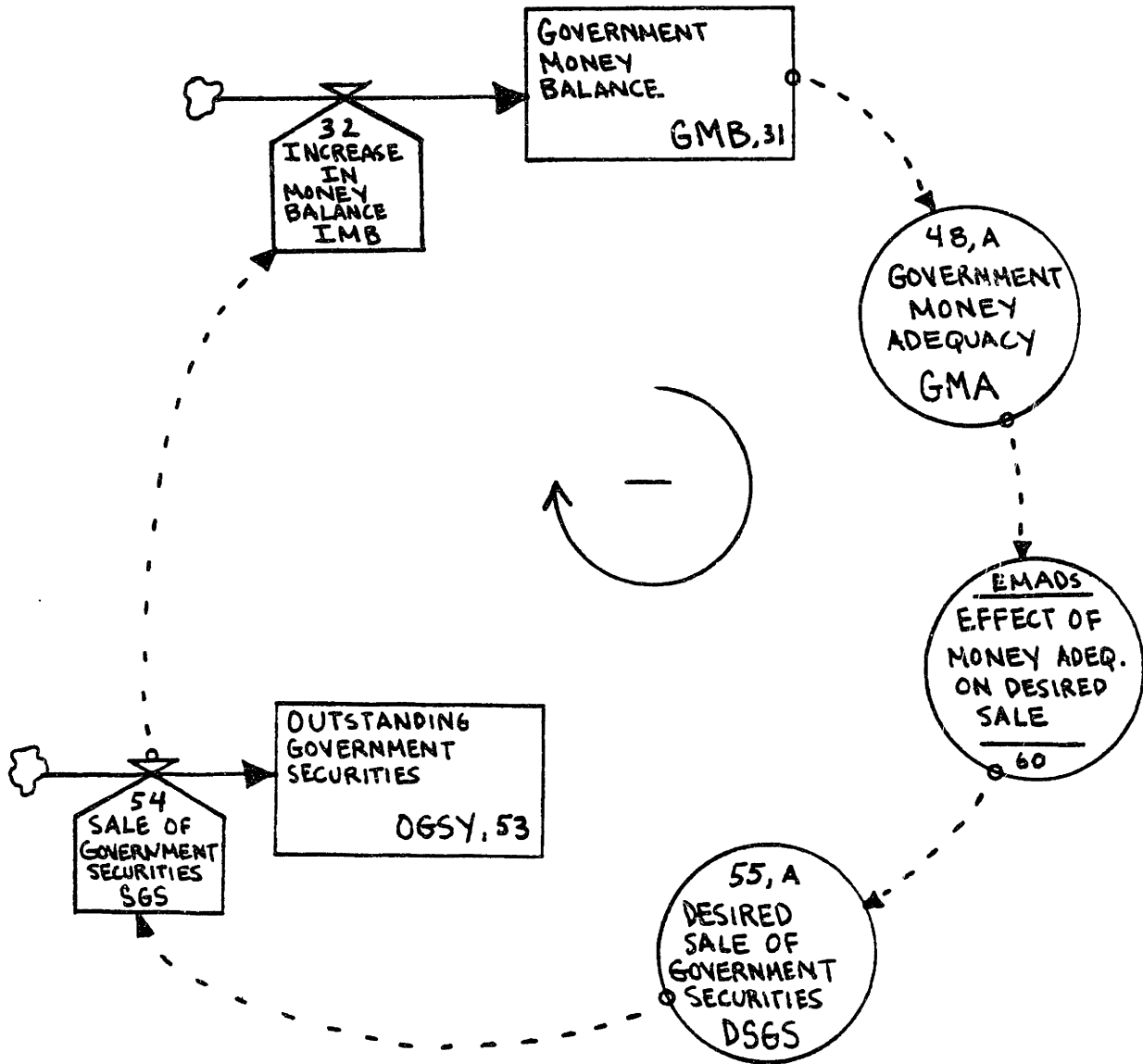


FIGURE 2-9. Restoration of Government Money Adequacy Via Sale of Government Securities.

As the loop indicates, a decline in GMA pushes up on the Effect of Money Adequacy on Desired Sale EMADS, which increases government's Desired Sale of Government Securities DSGS. An increase in DSGS raises Sale of Government Securities SGS. A higher volume of SGS raises Increase in Money Balance IMB and therefore Government Money Balance GMB. The latter then returns to bolster GMA.

2.4.4 Limits to the Restoration of Money Adequacy Through Exercise of the Tax Rate Increase Option.

Figure 2-8 indicates that one option for restoring depressed money adequacy is tax rate increases, which yield higher tax revenue inflows. As Figures 2-10 through 2-11 suggest, there are a number of limits upon government's ability to exercise this option.

Figure 2-10 depicts a negative loop that involves but one of the five model influences that go to make up the public's reaction to tax rates. When Tax Rate TR rises, Perceived Tax Rate PTR rises. A rise in PTR drives Fractional Change from Level of Tax FCLT negative which, in turn, depresses Fractional Change in Tax from Public Sentiment FCTPS below zero. This causes Fractional Change in Tax Rate FCTR to go negative thereby leading to a reduction in Tax Rate TR. Thus, tax rate increases--one of government's two preferred options for restoring money adequacy--do not pass unnoticed by the public in the model.

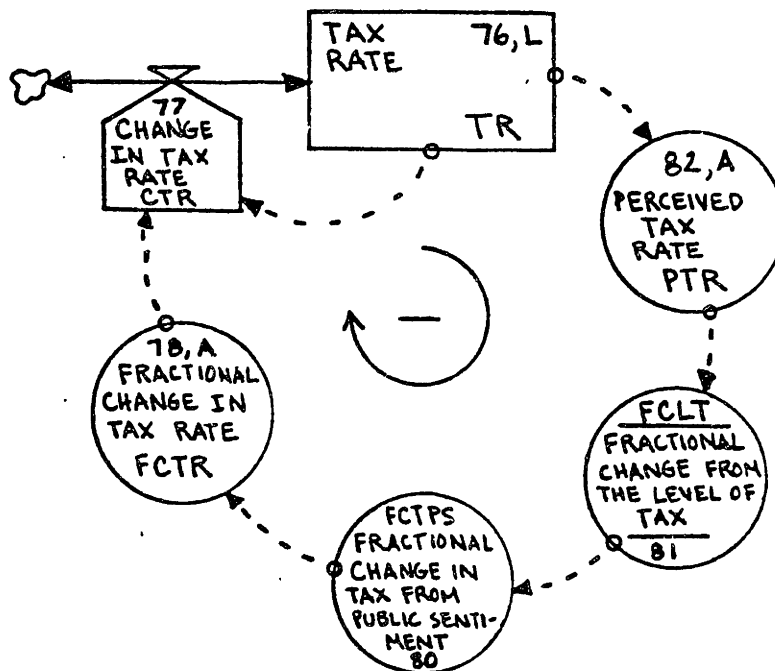


FIGURE 2-10. Public Sentiment Responds to the Level of Tax Rate.

Figure 2-11 shows another way in which government's practice of raising tax rate to restore money adequacy generates counterpressures. The feedback loop depicted in Figure 2-11 transcends the boundary of the government sector. It points up one of the critical interface relationships between the government sector and the private economy.

As Figure 2-11 indicates, increases in TR bolster Tax Revenues TAXREV. An increase in TAXREV, however, lowers Per Capita Disposable Income PCDI. A reduction in PCDI reduces the Effect of Per Capita Income on Demand EPCID, which depresses Per Capita Demand for Private Output PCDPO. Lowered PCDPO lowers Demand for Private Output DPO. When DPO declines, Desired Private Sector Employees DESPSE follows suit, leading Decrease in Private Sector Employees DPSE to rise. The resulting drop in Private Sector Employees PSE

causes Private Production of Goods and Services PPGSP to decline. Any decline in PPGSP causes the Effect of Level of Output on Acceptable Tax Rate ELOATR to decline. When ELOATR declines, Acceptable Tax Rate ATR likewise declines, in reflection of the assumption that a lower material standard of living will cause people to be less tolerant of any given tax rate. Any decline in ATR causes Fractional Change from Level of Tax FCLT, a component of FCTPS, to go negative. A negative fractional change in tax rate, in turn, leads to a reduction in Tax Rate TR.

Figure 2-11 thus indicates that government, in the model, can not get away with "biting the hand that feeds it" for very long. When the public experiences any decline in the material standard of living to which it, has grown accustomed, public tolerance for tax burden declines quite rapidly.

Figure 2-12 depicts a second sectoral interface feedback relationship which acts to limit government's ability to rely on tax rate increases to restore its money adequacy.

To observe the operation of the negative feedback process depicted in Figure 2-12, assume that Tax Rate TR is increased. A higher TR raises TAXREV. But, an elevated TAXREV lowers Per Capita Disposable Income PCDI, thereby depressing, in sequence, Effect of per Capita Income on Demand EPCID, Per Capita Demand for Private Output PCDPO, and Demand for Private Output DPO. With lower DPO, Desired

Private Sector Employees DESPSE declines, leading to the discharge of Private Sector Employees PSE. When PSE declines, Private Production of Goods and Services PPGS follows suit. A decline in PPGS depresses GNP, which, in turn, causes government's Tax Base TB to erode. An eroding tax base completes the loop by diminishing Tax Revenues TAXREV.

Thus, as Figures 2-10 through 2-12 clearly indicate, government's attempts to restore its money adequacy via exercise of the taxation option generate pressures that ultimately serve to restrict further exercise of the option.

One relationship that is capable of serving as an offset to the pressures that limit the exercise of the taxation option is depicted in Figure 2-13.

As the Figure indicates, when Tax Rate TR is cut, Tax Revenues TAXREV, and hence Government Money Balance GMB, are reduced. A reduction in GMB lowers Government Money Adequacy GMA. Depressed GMA forces government to increase the rate at which it is discharging employees. Employment cutbacks, in turn, reduce the Output of Government Services OGS. The strength of the public response to cutbacks in the level of government output is determined by comparing the current level of output to the level to which the public has become accustomed. This comparison is embodied in the model variable called Service Ratio SR.

SR affects what the public considers to be an Acceptable Tax Rate ATR through the variable Effect of Service Ratio on Acceptable Tax Rate ESRATR. If government services (or transfer payments) have been cut back, the public, other things equal, raises what it considers to be an Acceptable Tax Rate ATR. A higher ATR reduces Fractional Change from the Level of Tax FCLT, which is a negative pressure that results from a comparison (by the public) of TR to ATR. A reduced FCTR, other things equal, reduces Fractional Change in Tax from Public Sentiment FCTPS.

FCTPS is a negative component of Fractional Change in Tax Rate FCTR. Because FCTPS is reduced (i.e., is less negative), the positive component of FCTR, Fractional Change in Tax from Money Adequacy FCTMA, is able to exert relatively more influence. If FCTMA dominates FCTPS, FCTR becomes positive, pushes up TR, and thereby completes the loop by restoring the initial depression of TR.

Thus, as Figure 2-13 suggests, the Service Ratio mechanism does not, by itself, restore tax cuts. Instead, the relationship has its effect by reducing public sentiment against tax rate and thereby enabling government's response to its money adequacy to push up tax rate.

2.4.6 Limits to the Restoration of Money Adequacy Through the Exercise of the Debt Option.

Attempts by government to restore money adequacy through exercise of the debt option, like their taxation counterparts, generate limiting pressures.

Figure 2-14 represents the first of these pressures. As government increases its Sale of Government Securities SGS less of the total Funds Available for the Purchase of Securities FAPS are available for the purchase of non-government securities. As funds available for the purchase of non-government securities become increasingly short, Market Response from Funds Available for the Purchase of Securities MRFAPS rises, driving Market Response MR--an overall index of market willingness to absorb government securities*--toward zero. As MR approaches zero, the Effect of Market Response on Desired Sale EMRDS likewise approaches zero, forcing Sale of Government Securities SGS toward zero.

* Market Response MR, includes three other components (see equation 62 in Appendix I or II).

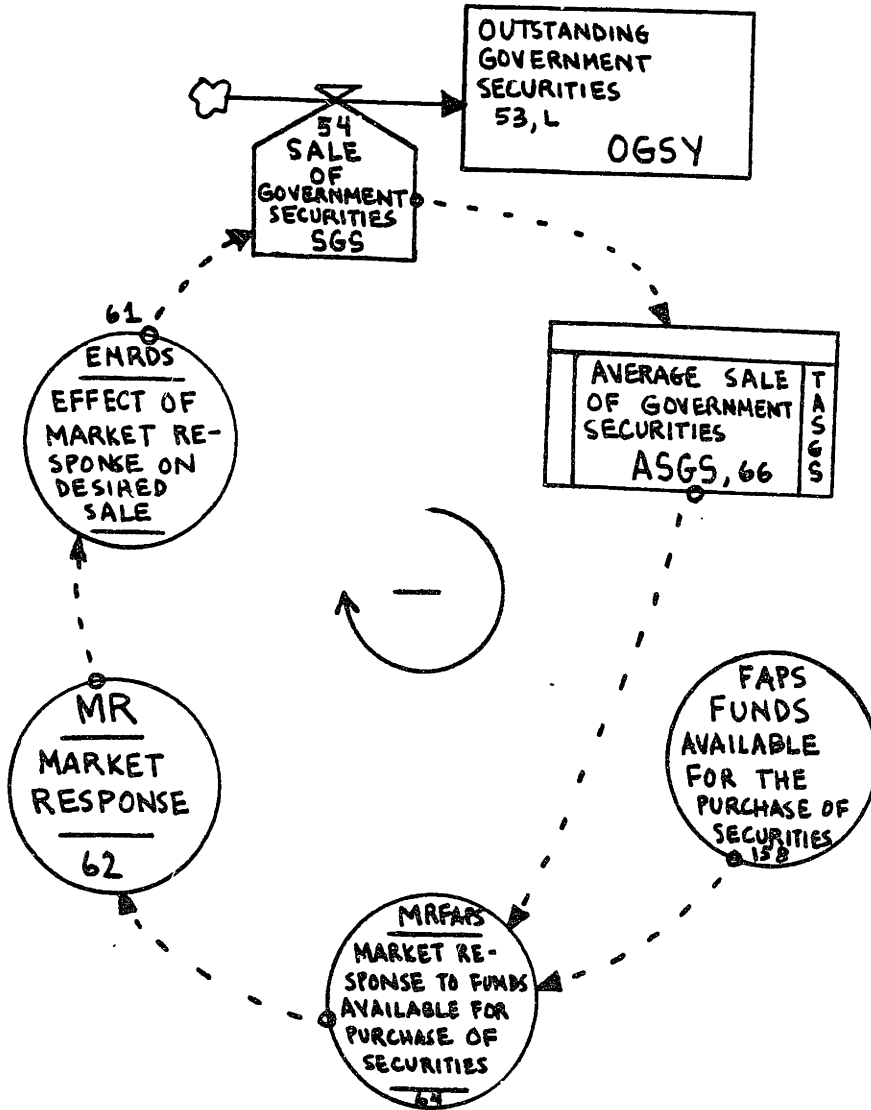


FIGURE 2-14. Attempts to Restore Money Adequacy via Sale of Government Securities Self-Limits by Claiming Too Large a Share of Available Funds.

Figure 2-15 shows another way that the attempt to restore money adequacy by selling securities is self-limiting.

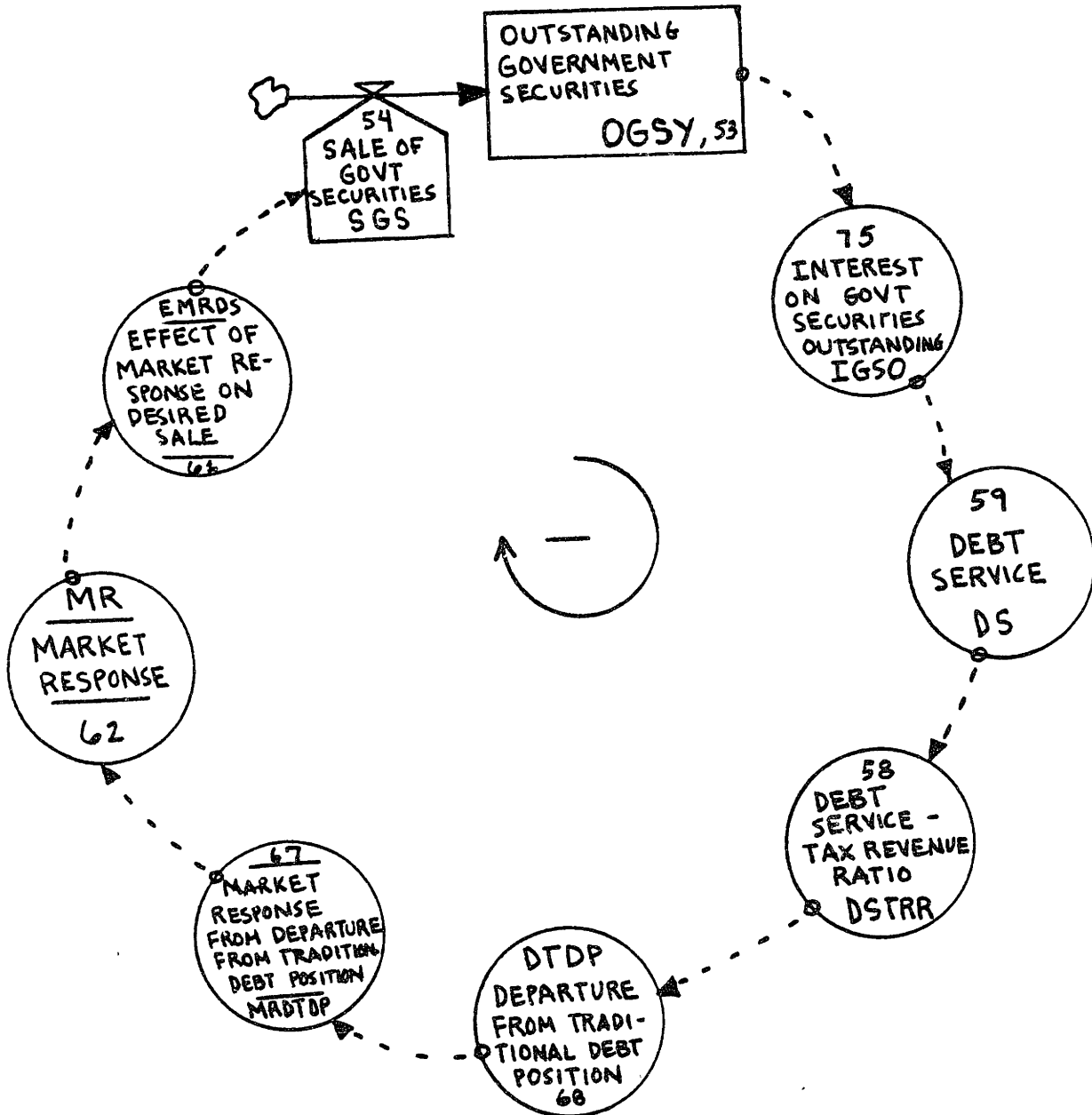


FIGURE 2-15. Attempts to Restore Money Adequacy by Sale of Government Securities Self-Limit by Exceeding Debt-Service/Tax Revenue Ratio.

Increasing the Sale of Government Securities SGS pushes up the stock of Outstanding Government Securities OGSY. Because interest must be paid on these obligations, Interest on Government Securities Outstanding IGSO rises, driving up Debt Service DS. An increase in DS raises the Debt Service to Tax Revenue Ratio DSTRR. When the market compares the rising DSTRR to its Debt Service Tax Revenue Ratio Goal DSTRRG, it will record an increase in the Departure from Target Debt Position DTDP. Any such increase drives up Market Response from Departure from Target Debt Position MRDTP, thereby pushing both Market Response MR, and hence, Effect of Market Response on Desired Sale EMRDS, toward zero. Sale of Government Securities SGS follows suit.

A potential offset to the relationships that serve to restrict exercise of the sale of government securities option for restoring money adequacy is diagrammed in Figure 2-16. The relationship is exactly analogous to the mechanism that operates through the taxation channel, as depicted in Figure 2-13.

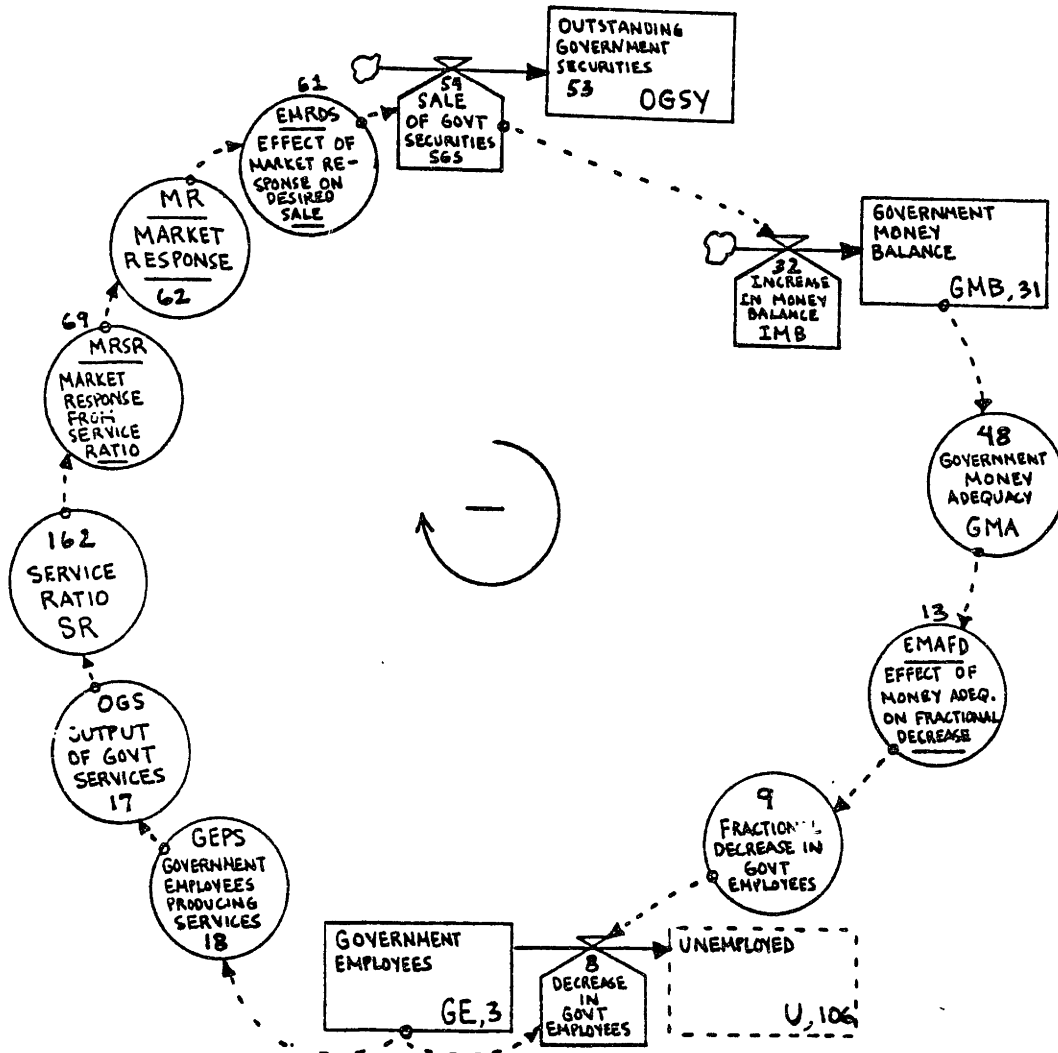


FIGURE 2-16. Cuts in Public Services Increase Tolerance of Debt Burden.

As Figure 2-16 indicates, a decrease in Sale of Government Securities SGS depresses Increase in Money Balance IMB which, other things equal, lowers Government Money Balance GMB. A reduced money balance causes GMA to decline, and thereby forces government to lay off employees. Fewer employees mean less Output of Government Services OGS. Service reductions lower Service Ratio SR which, in turn, reduces Market Response from Service Ratio MRSR. As MRSR declines, Market Response MR, other things equal, follows suit. With less market response, Effect of Market Response on Desired Sale EMRDS declines, thereby completing the loop by pushing up Sale of Government Securities SGS.

2.4.7 Sidestepping the Physical Constraints to Growth

As Figure 2-7 indicates, government's attempts to expand employment are constrained by physical, in addition to financial, restrictions.

One way of attempting to sidestep the physical limits to expansion of employment is depicted in Figure 2-18. As the Figure indicates, an increase in Government Employees GE increases Payments to Factors of Government Production PFGP, which depletes Government Money Balance GMB. A decline in GMB causes GMA to fall, thereby putting upward pressure on Fractional Change in Tax Rate FCTR via Fractional Change in Tax from Money Adequacy FCTMA.

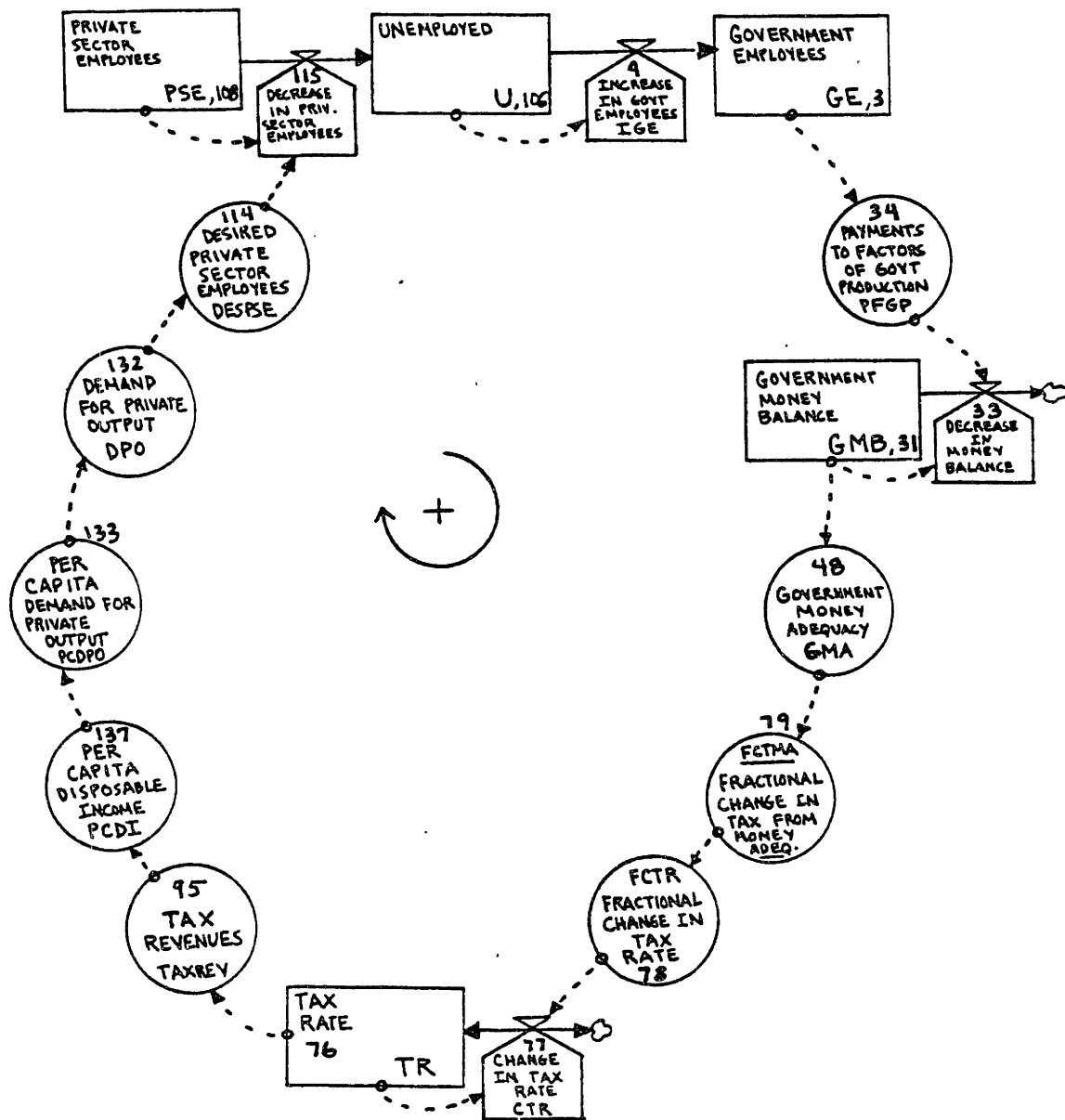


FIGURE 2-18. A Potentially Reinforcing Spiral Capable of Sidestepping the Physical Limits to Expansion of Government Employment.

The subsequent increase in Tax Rate TR raises Tax Revenues TAXREV causing Per Capita Disposable Income PCDI to decline. A decline in PCDI sets in motion the previously encountered chain of declines in demand which ultimately results in a discharge of Private Sector Employees PSE into the pool of Unemployed U. An expansion of U, in turn, relaxes the employee availability constraint.

2.4.8 Compensating for the Reinforcing Spiral.

Figure 2-~~18~~ depicts a reinforcing, rather than a corrective, feedback process. Left on its own, the process would drain the private sector of its employees. Figures 2-~~19~~ and 2-~~20~~ depict two restrictions on the operation of the reinforcing spiral diagrammed in Figure 2-~~18~~.

As Figure 2-~~19~~ indicates, when Private Sector Employees PSE begin to decline, Private Production of Goods and Services PPGS follows suit. From here, there are several paths to Government Money Adequacy GMA. All of them, however, end with GMA declining. For example, declining PPGS depresses GNP which, in turn, reduces both Tax Base TB and Funds Available for Purchase of Securities FAPS. The former reduces tax revenues. The latter reduces sales of government securities. Reductions in either, result in the depletion of Government Money Balance and hence depress GMA. Alternatively, a depressed PPGS can translate through to GMA via reducing the Acceptable Tax Rate and thereby causing tax rate, and therefore tax revenues, to decline. Irrespective of the path, a decline in private output ultimately causes GMA to decline. The decline in GMA, in turn,

depresses Fractional Increase in Government Employees •FIGE via depression of the Effect of Money Adequacy on Fractional Increase EMAFI.

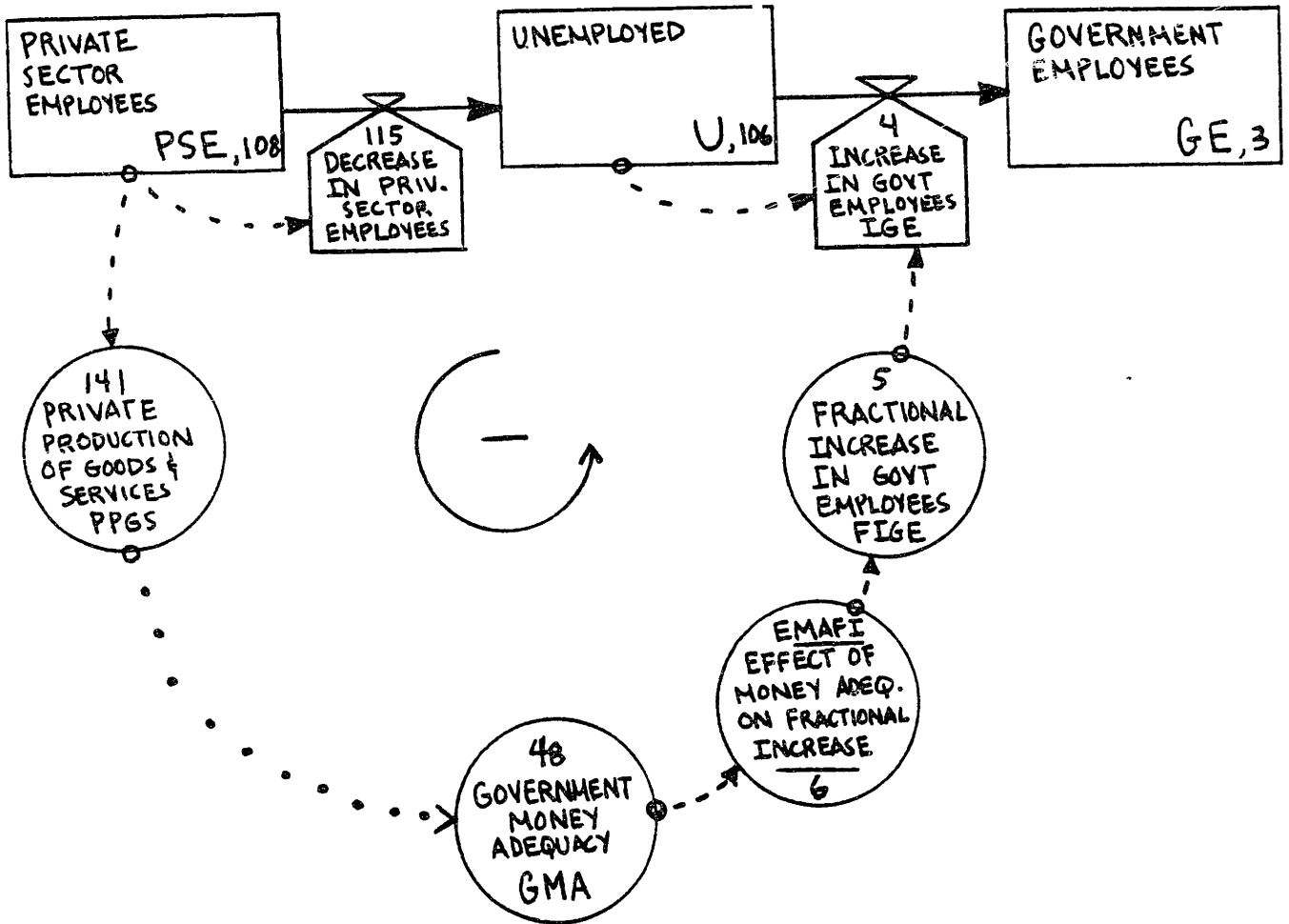


FIGURE 2-19. A Financial Counterpressure to The Attempt to Sidestep The Physical Limit to Expansion of Employment.

Figure 2-19 thus indicates that, were the positive loop from Figure 2-18 to begin to operate, its very operation would stimulate compensating financial pressures that would ultimately shut the reinforcing loop down.

Figure 2-20 shows an even more direct feedback process that compensates for the positive loop depicted in Figure 2-18.

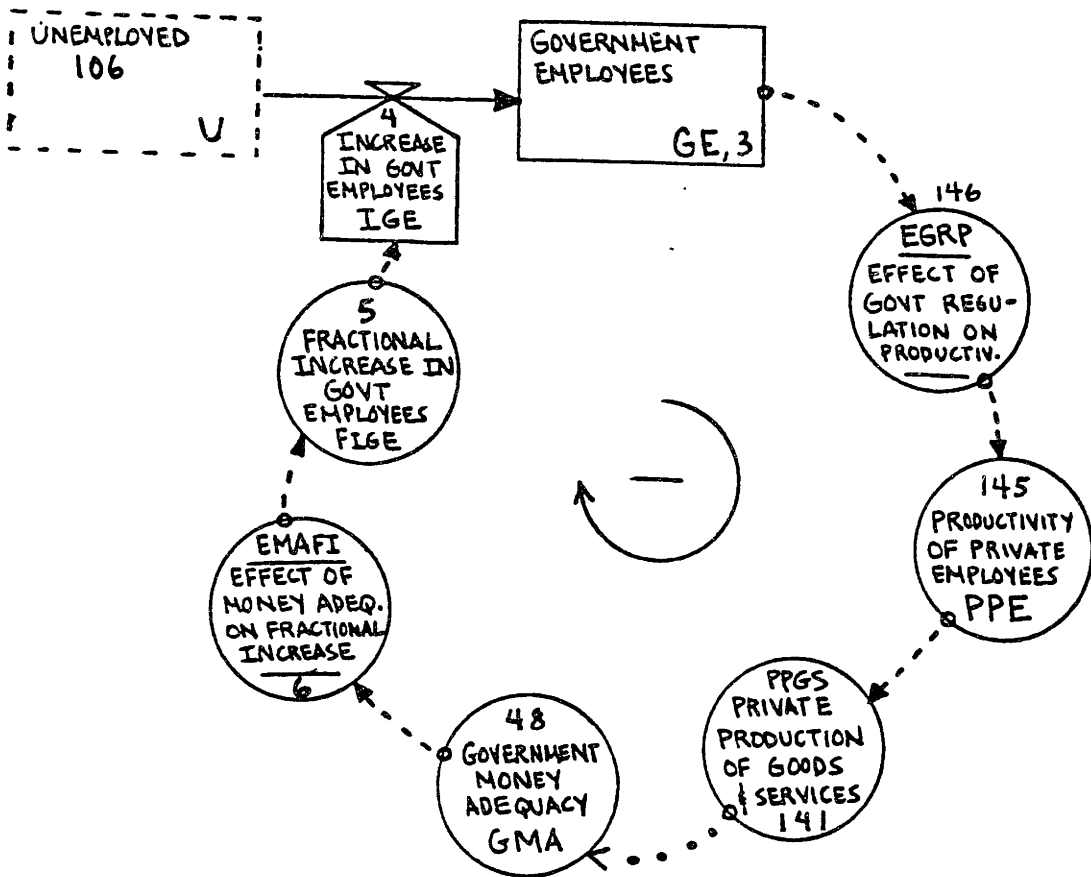


FIGURE 2-20. Compensating For The Positive Loop Through Productivity Effects.

The negative loop depicted in Figure 2-20 ultimately achieves its compensating effect in the same way as the loop presented in Figure 2-19. Both loops compensate for expanded physical availability

of employees by driving money adequacy lower (and thereby preventing government from absorbing the available employees). The loop in Figure 2-19 works on PPGS via Private Sector Employees PSE. The loop in Figure 2-20 depresses PPGS via depression of productivity, the second component necessary to generate output.

As Government Employees GE expand, the Effect of Government Regulation on Productivity EGRP exerts an increasingly depressive effect on Productivity of Private Employees PPE. Declining productivity pushes down Private Production of Goods and Services PPGS. The subsequent decline in GMA then serves to depress Increase in Government Employees IGE via the same mechanism as described for Figure 2-19.

The depressing effect exerted by the expansion of Government Employees GE on Productivity of Private Employees PPE creates two additional counterpressures which oppose the action of the positive loop depicted in Figure 2-18. And, as Figures 2-21 and 2-22 indicate, these counterpressures, unlike the previous two, are physical.

Figure 2-21 indicates that when Government Employees GE increase, the Effect of Government Regulation on Productivity EGRP follows suit. Productivity of Private Employees PPE is accordingly depressed. However, when PPE declines, Desired Private Sector Employees DESPSE, other things equal, increases. This is due to the fact that, with a decline in productivity, more private workers are needed to produce the same level of private output. As DESPSE rises, the Fractional Decrease from Private Sector Employment Discrepancy

FDPSD climbs. FDPSD represents the direct tug of the private sector on government's labor pool. An increase in FDPSD causes Fractional Decrease from Private Sector Demand FDPD--and thus, Fractional Decrease in Government Employees FDGE--to rise. An increase in FDGE causes GE to be depleted, thereby completing the compensating loop.

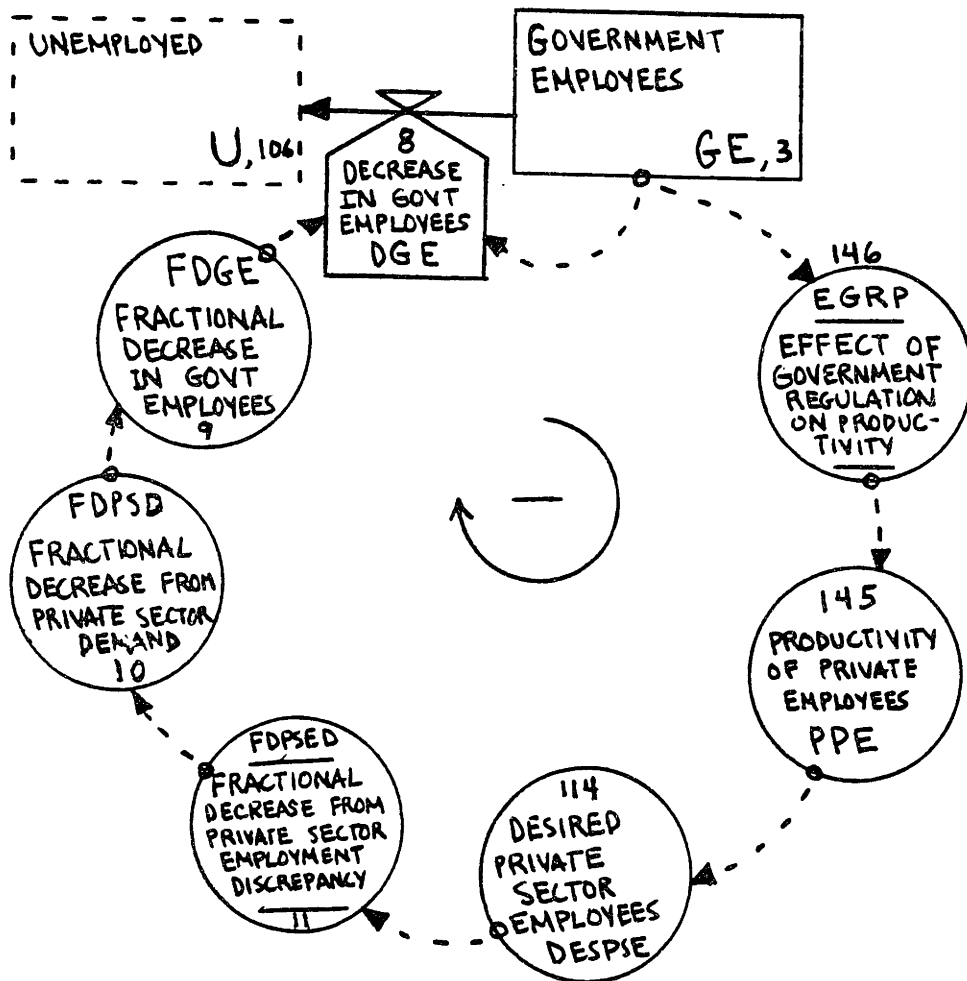


FIGURE 2-21. A Physical Compensation for the Positive Loop Underlying the Expansion of Government Employment.

The second physical compensating process operates in a manner similar to the mechanism depicted in Figure 2-21. In this case, however, the effect is not to speed the depletion of GE, but rather to hasten the increase of PSE and thereby shut down the increase in government employees due to availability constraints. Figure 2-22 depicts this mechanism.

As Government Employees GE begins to expand, and Effect of Government Regulation on Productivity EGRP exerts an increasingly depressive influence on PPE, DESPSE rises (as before). An increase in DESPSE, in turn, causes Fractional Increase from Employment Discrepancy FIED to rise. As a result, Fractional Increase in Private Sector Employees FIPSE increases, leading to a restoration of Private Sector Employees PSE. But, at the same time, when Increase in Private Sector Employees IPSE rises, it depletes the pool of Unemployed U. As U is drawn down, the Effect of Availability of Employees on Fractional Increase in Government Employees EAEFIG becomes an increasingly constraining influence on Fractional Increase in Government Employees FIGE.

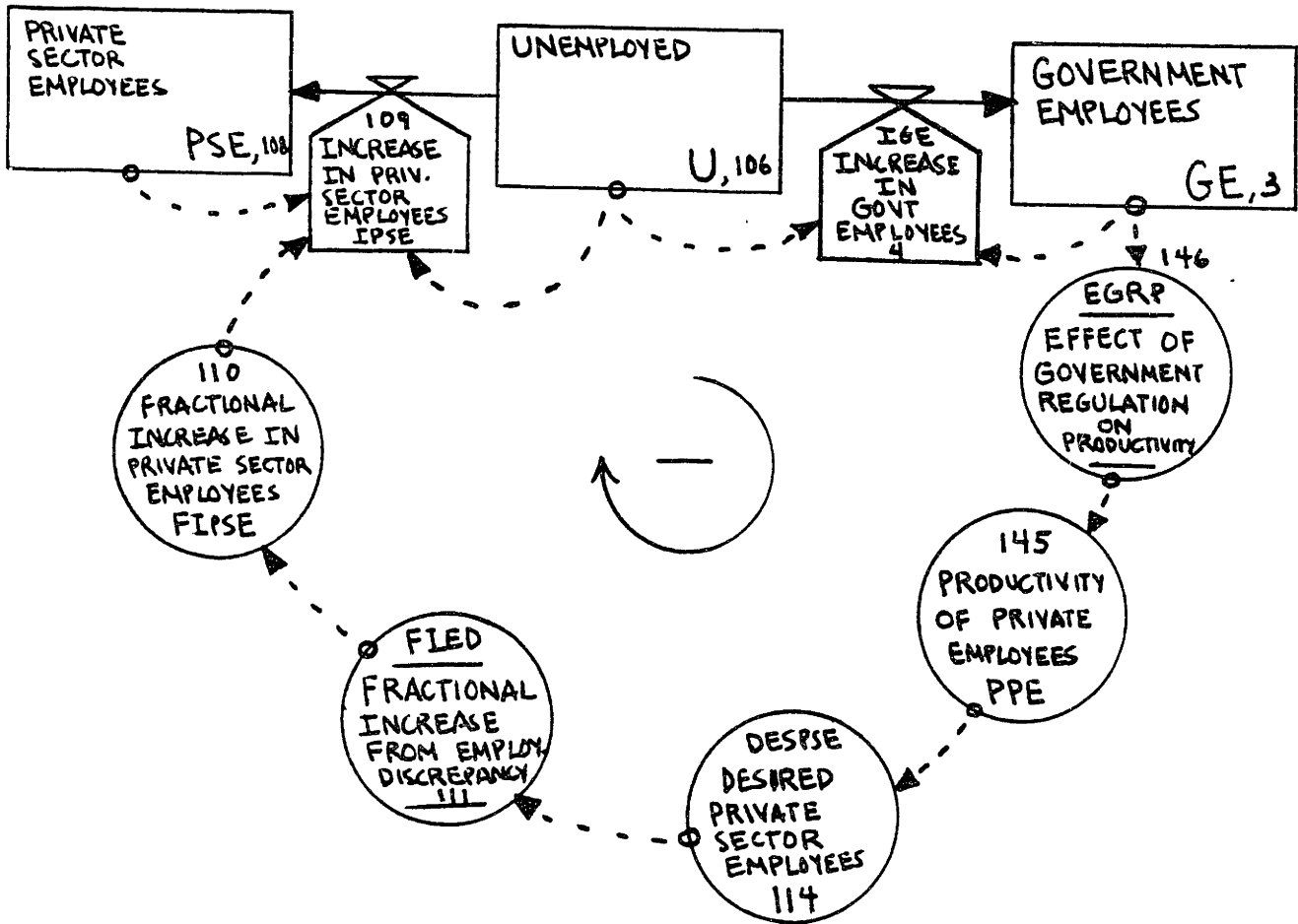


FIGURE 2-22. A Second Physical Compensation for the Positive Loop Underlying the Expansion of Government Employment.

2.4.9 In Summary: Major Feedback Loops.

Departing from the simplest positive feedback loop, representing the empire-building urges of government managers, this section proceeded through a sequence of feedback loops which depict both the mechanisms operating within government that respond to these urges, as well as the mechanisms (both physical and financial) that serve to restrain these urges. The next two Chapters show these two sets of countervailing feedback mechanisms as they interact to determine the balance of employment and production that is struck between government and the private sector.

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CHAPTER 3

THE FORCES THAT PRODUCE AND LIMIT
GOVERNMENT GROWTH IN A FIXED ECONOMY

In this Chapter, the model discussed in Chapter 2 is used to examine the forces that produce, and limit, the growth of government in a "fixed" economy. In order to accomplish this task, the model's initial equilibrium condition is disturbed by decreasing the size of government. The behavior of the resulting growth-producing and growth-limiting forces, as model variables retrace their paths to the initial equilibrium condition, is then recorded and analyzed.

The Chapter begins with a description of the initial equilibrium condition. Next, the exact procedure for disequilibrating the model is discussed. Finally, an analysis of the behavior exhibited by the model in response to the disequilibrating stimulus is presented.

3.1 THE REFERENCE EQUILIBRIUM CONDITION

The model is initialized in a reference equilibrium condition. This section describes the meaning of this equilibrium.

The defining feature of any equilibrium condition is that all states, or levels, in the system remain unchanging. For all states to remain unchanging, the sum of the inflows and outflows to each state must be zero. Figure 3-1 summarizes the pressures that

cause the employment pools in the model to remain unchanging in the reference equilibrium.

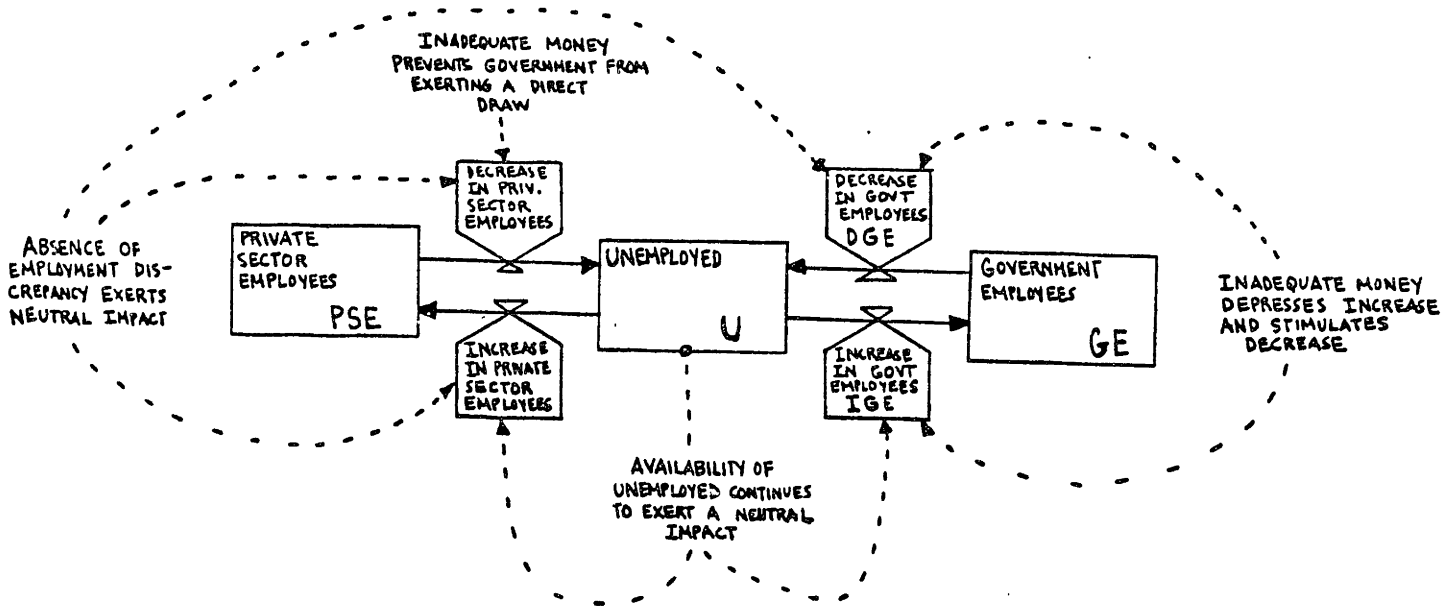


FIGURE 3-1. The Pressures Holding the Employment Pools Constant in the Reference Equilibrium.

As discussed in Chapter 2, in the absence of availability and financial constraints, the pool of government employees will expand at 5% per year. In the reference equilibrium, as Figure 3-1 indicates, availability of employees exerts a neutral influence on the increase of government employees. The increase and decrease in government employees must therefore be brought into balance by an inadequacy of

money. To achieve this inadequacy, Government Money Adequacy GMA is set equal to 0.75 in the reference equilibrium. This indicates that government has 25% less money than it needs to service its desired flow of spending obligations. Government's money shortfall both depresses hiring and stimulates quits and layoffs so that, on balance, no net change in Government Employees GE occurs.

At the same time, low government money adequacy prevents government from exerting a direct pull on private sector employees. And, because Private Sector Employees PSE is just equal to Desired Private Sector Employees DESPSE in the equilibrium condition, no pressure to either acquire or discharge private employees is generated. Thus, like GE, PSE remains unchanging in the reference equilibrium condition.

Because government money adequacy is below 1.0 in the reference equilibrium condition, government is seeking to restore its money shortfall by increasing both Tax Rate TR and the Sale of Government Securities SGS.

As Figure 3-2 indicates, the upward pressure on TR exerted by government in response to its money shortfall is offset by a downward pressure generated by public sentiment. This latter pressure results from a perception by the public that the reference equilibrium Tax Rate TR is in excess of what it considers to be Acceptable Tax Rate ATR. ATR is defined as a level of burden that stimulates no pressure from public sentiment to lower tax rate. The positive discrepancy between TR and ATR in the reference equilibrium creates a downward pressure that exactly counterbalances the upward pressure exerted by government in response to its depressed money condition. As a result,

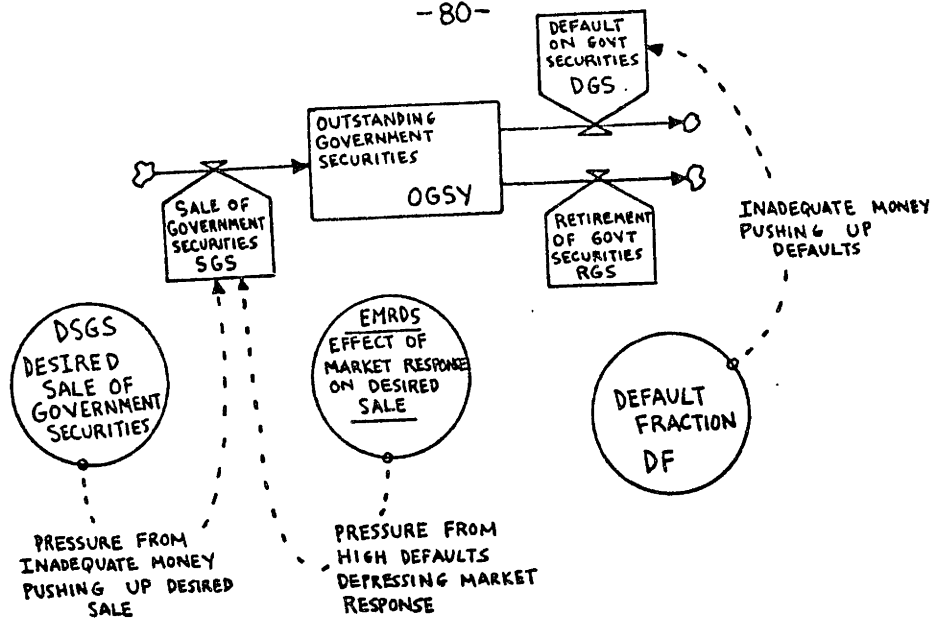


FIGURE 3-3. The Forces Causing the Level of Outstanding Government Securities to Remain Constant in the Reference Equilibrium.

In the reference equilibrium, Demand for Government Services DEGS and Demand for Government Transfers DGT are just equal to the Output of Government Services OGS and Output of Government Transfers OGT, respectively. These equalities imply that people have accommodated to the level of government output that is being supplied. People find this level, in view of all other conditions in the socioeconomy, acceptable. In addition, the Demand for Private Output DPO is just equal to Private Production of Goods and Services PPGS. Thus, in the reference equilibrium, people are demanding exactly the level of private output that is being supplied. It is this latter equality, in fact, that causes PSE to equal DESPSE in the reference condition.

In summary, the reference equilibrium is a condition in which society has achieved, for a fixed set of conditions, the most desirable standard of living. In this equilibrium, government has grown as much as it can. Societal preferences are such that

government simply can not restore its depressed money adequacy. Tax rate has been elevated to a level above that which leaves public sentiment neutral. And, government's defaults are high enough above normal--due, again, to low money adequacy--to prevent government from selling all of the securities that it desires. With a permanently depressed money adequacy, government is unable to increase its employment base or to otherwise further expand its output of services or transfers. Thus, a permanent balance has been struck between government and the private sector.

3.2 UPSETTING THE BALANCE: Resetting the Clock on Government Growth

At some time prior to the achievement of the reference equilibrium condition, government played a relatively smaller role in the socioeconomy. In the real socioeconomy, for example, in 1900, only 2% of the American labor force was employed by government, and less than 8% of GNP was generated by the public sector. By 1975, these figures had grown to 16% and 36% respectively. The idea of the test described in this Chapter is to return government to such an earlier position in its path of relative expansion, while leaving the rest of the socioeconomy "frozen" in its current state. By doing this, it will be possible to reinitiate the forces responsible for generating the relative expansion of government, and then to observe these forces as they clash with, and are ultimately brought into balance by, a set of pressures that restrain further relative expansion.

Implementing the "resetting the clock" test requires activation of testing equations numbered 165 to 173 in the documentor

equation listing which appears in Appendix II. These equations are activated by setting Time to Implement Experiment 1 TIE1 and Time to Implement Experiment 2 TIE2 equal to some value within the simulation time horizon.

When activated, equations 165 through 167 introduce an instantaneous pulse-transfer of 50% of the employees in government from government to the private sector. Doing so, returns the socioeconomy to a time when government employees measured only 7.5% of the labor force.

When activated, Equations 168 and 169 cause Government Money Balance GMB to be instantaneously reduced by 35%. Equation 171 through 175, when activated, implement an instantaneous 50% reduction in government spending, desired spending and tax rate. By reducing desired spending by a larger percent than money balance, government's money adequacy is restored so that it is no longer constrained by financial limits to expansion. And, by reducing spending and tax rates by an equivalent fractional amount, inflows and outflows to government's money balance are maintained in approximate balance.

In order to further help in maintaining the balance between inflows and outflows to government's money stock, equations 176 and 177 implement an instantaneous 50% reduction in government's stock of outstanding securities. A smaller stock of outstanding securities means that less securities are retired each year, and that (with constant interest rates) less interest must be paid. Furthermore, the restoration of government's money adequacy causes government's default fraction to return to "normal." As such, the market's wariness about absorbing the full volume of government's

desired sale of securities is eliminated.

Finally, the traditional standard of government output, which the society has gotten used to is reduced by 50% by activating equations 178 through 181. Lowering the reference standard ensures that the society will not "notice" the reductions in government output that are caused by the reduction in employment levels.

3.3 THE RETURN TO EQUILIBRIUM: Relative Expansion and Its Limits

Figure 3-4 shows the response of government employment and production, the two most commonly cited barometers of relative expansion, to the "resetting the clock" test. The test is initiated in year 4 of the simulation.

Initially, Government Employees as a Percent of the Labor force GEPLF declines from 15% to 7.5%, while Government Production as Percent of Gross National Product GPPGNP falls from 30% to about 16%. Both variables then exhibit a roughly sixty year period of sustained relative expansion. In both cases, expansion occurs rapidly at first and then becomes progressively slower as each variable asymptotically approaches its reference equilibrium value. By about year 70, both variables have returned to their reference equilibrium values without overshoot.

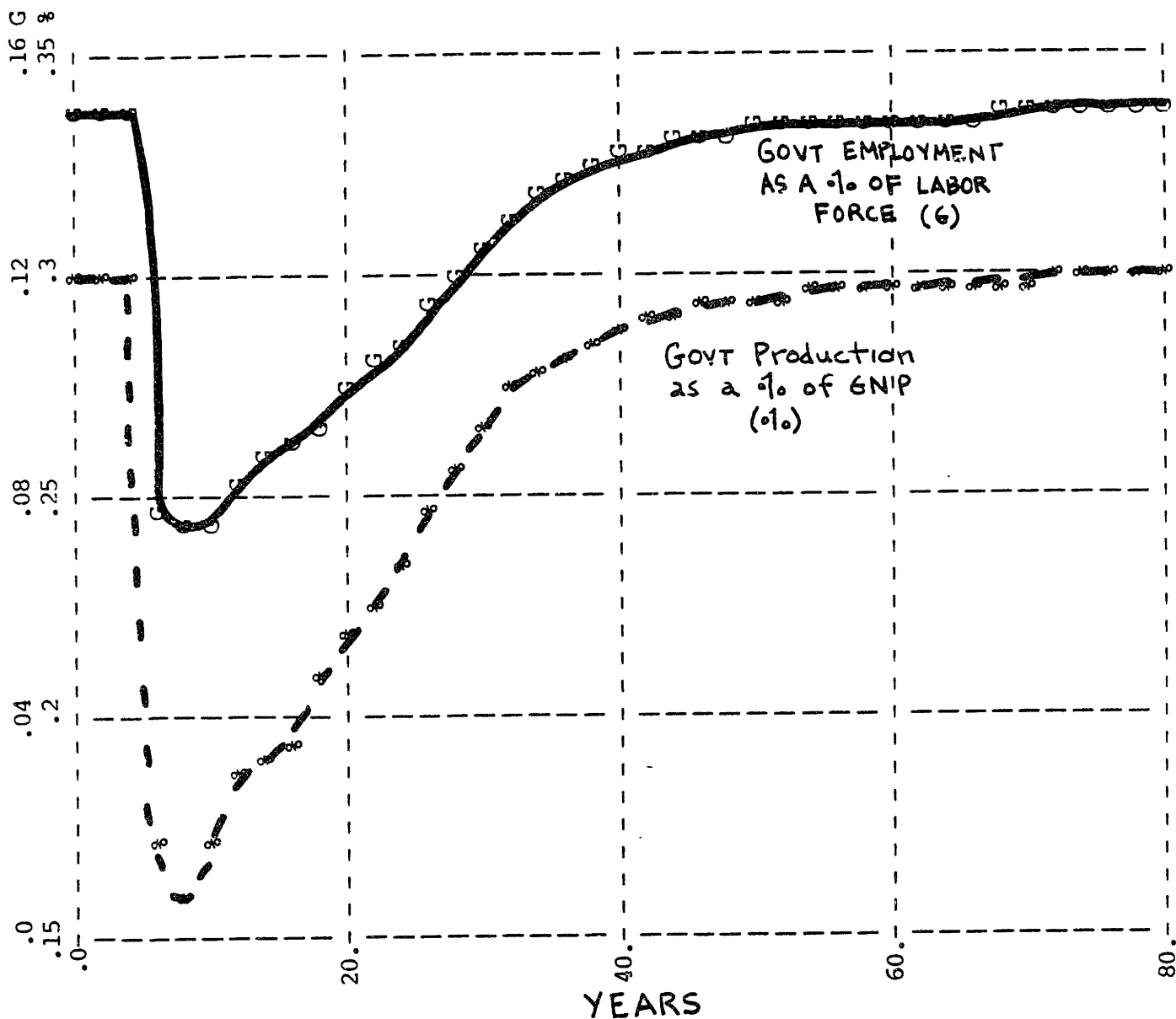


FIGURE 3-4. The Relative Expansion of Government Employment and Production Following Implementation of the "Resetting the Clock" Experiment.

The key to government's ability to regenerate to its former size is Government Money Adequacy GMA. As Figure 3-5 indicates, except for a brief transient, GMA remains above its reference equilibrium level for the entire period during which government's relative expansion is taking place.

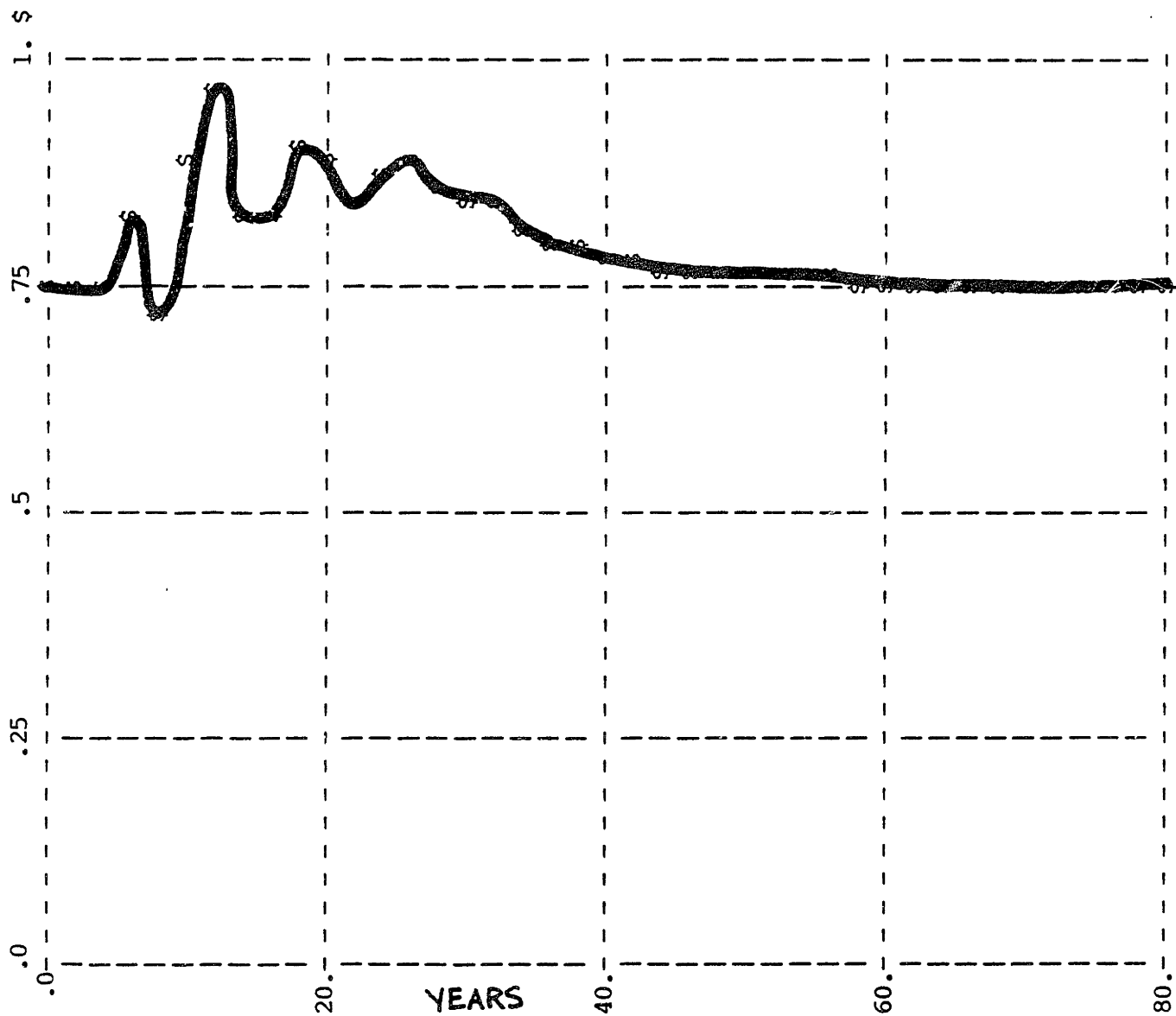


FIGURE 3-5. Government Money Adequacy During the Period of Relative Expansion.

Government can sustain a higher-than-equilibrium money adequacy position during its regeneration phase because it is able to continue to increase both Tax Rate TR and Sale of Government Securities SGS at a pace commensurate with its expansion of spending. Figure 3-6 charts the behavior of Tax Rate TR and Sale of Government Securities SGS over the course of the test interval.

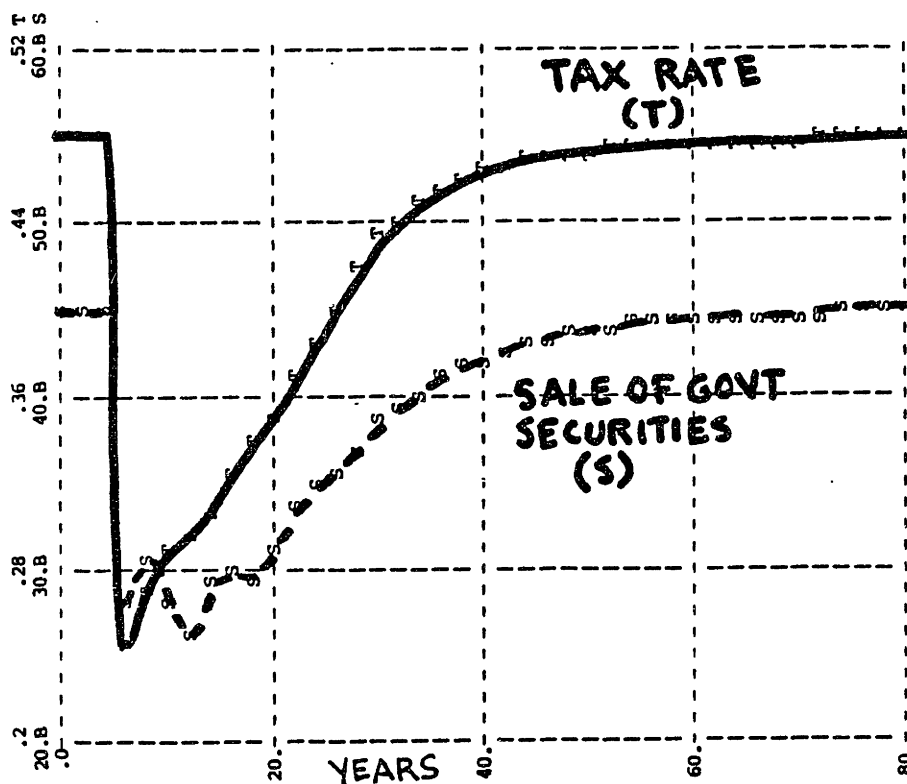


FIGURE 3-6. The Behavior of Tax Rate and Sale of Government Securities Over the Test Interval.

Following implementation of the test, TR declines by 50%. It then follows a pattern of regeneration similar to that exhibited by Government Employees as a Percent of Labor Force GEPLF and Government Production as a Percent of Gross National Product GPPGNP in Figure 3-4. During roughly the first twenty years of the simulation, Tax Rate TR increases rapidly. By about year 25, Tax Rate has climbed back up to about 80% of its reference equilibrium value. It then takes nearly another forty years for TR to recapture the last 20% of its initial stature. Sale of Government Securities SGS, although exhibiting a longer transient, exhibits a very similar behavior pattern: rapid growth initially, followed by a slowing and asymptotic

approach to its reference equilibrium value.

Figure 3-7 begins the explanation of why Tax Rate TR behaves as it does under the test conditions. The behavior of TR is being determined by the interplay of two influences: Fractional Change in Tax from Money Adequacy FCTMA and Fractional Change in Tax from Public Sentiment FCTPS.*

As Figure 3-7 indicates, FCTMA and FCTPS are exactly offsetting each other in the reference equilibrium so that Fractional Change in Tax Rate FCTR is zero. Following implementation of the test input, FCTPS rises immediately from $-.05$ to 0 and remains near zero for roughly twenty-five years. The behavior of FCTPS over this period indicates that the public is no longer exerting a pressure to cut taxes. The absence of public pressure to cut taxes results from the fact that Tax Rate lies below Acceptable Tax Rate during this period. Over the same interval, FCTMA declines from $.05$ to a low of about $.01$, and then gradually climbs back up to its reference equilibrium value. FCTMA declines because of the improvement in government's money adequacy position which results from implementation of the test input. Although FCTMA declines, it nevertheless remains positive throughout the test interval, indicating that GMA never returns to 1.0 . GMA does not return to 1.0 because government is expanding employment and spending very rapidly during the interval. With FCTMA pushing up on Tax Rate and FCTPS offering essentially no counter-pressure, FCTR takes on a positive value and therefore TR rises.

* The third influence on TR, Fractional Change in Tax from Fiscal Action FCTFA, is not operative during this test because Private Production of Goods and Services Per capita PPGSP never falls below Reference Level of Private Production Per capita RLPPP. When PPGSP does dip below RLPPP, government is assumed to want to implement tax cuts in order to stimulate aggregate demand.

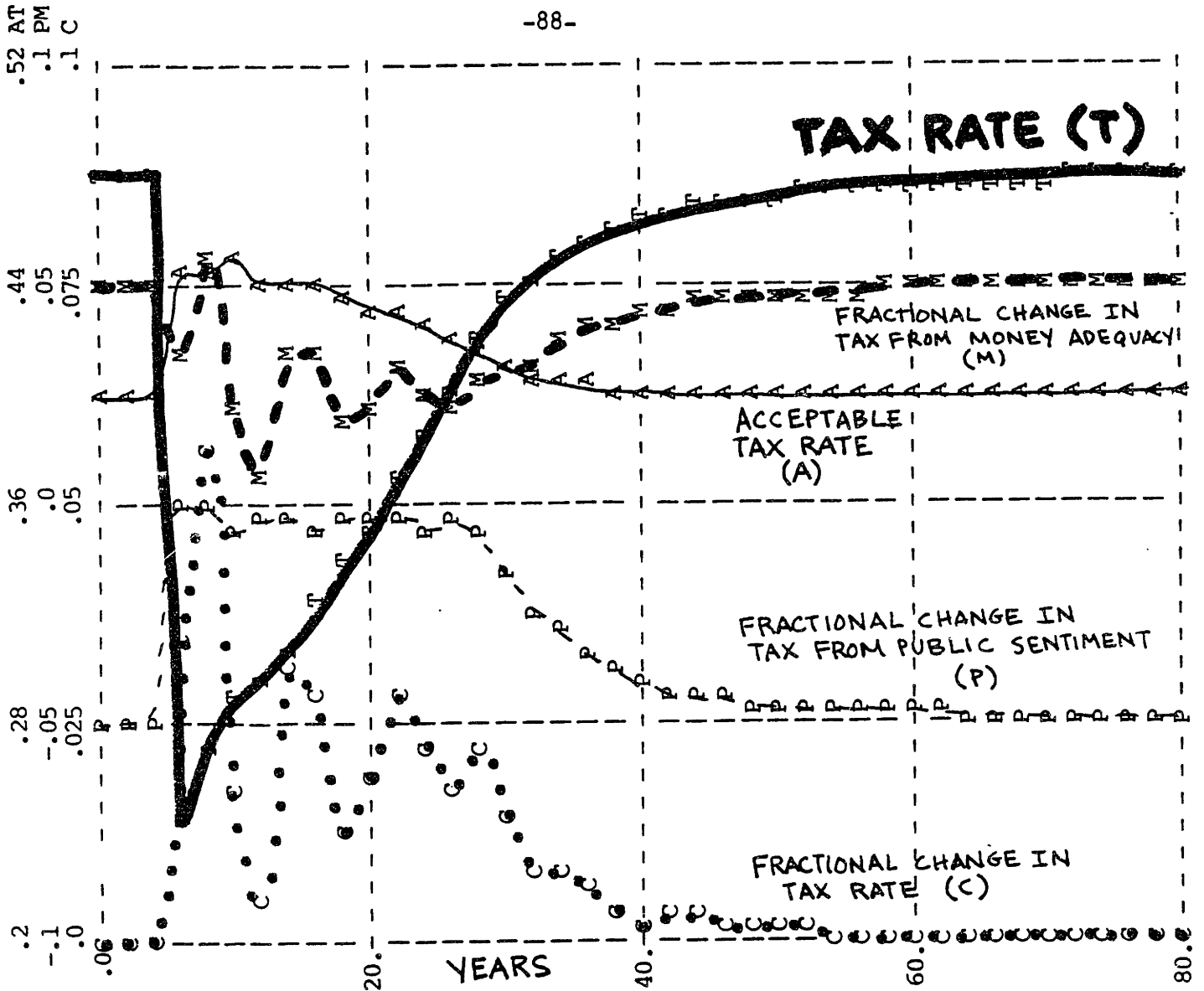


FIGURE 3-7. The Determinants of Tax Rate Change Over the Test Interval.

As Figure 3-8 indicates, the neutralization of Fractional Change in Tax from Public Sentiment FCTPS during government's relative expansion phase results from the fact that Tax Rate TR remains below Acceptable Tax Rate ATR during most of this phase. As a result, Fractional Change from the Level of Tax FCLT, which dominates the behavior of FCTPS during the test, goes to zero.

As Figure 3-8 shows, TR remains below ATR during government's relative expansion phase both because TR has declined and because ATR

has risen. TR declines as a direct result of the implementation of the test condition; i.e., as part of the roll-back in the size of government, TR is cut in half. The increase in Acceptable Tax Rate ATR can be seen, in Figure 3-8, to result primarily from the Effect of Level of Output on Acceptable Tax Rate ELOATR.

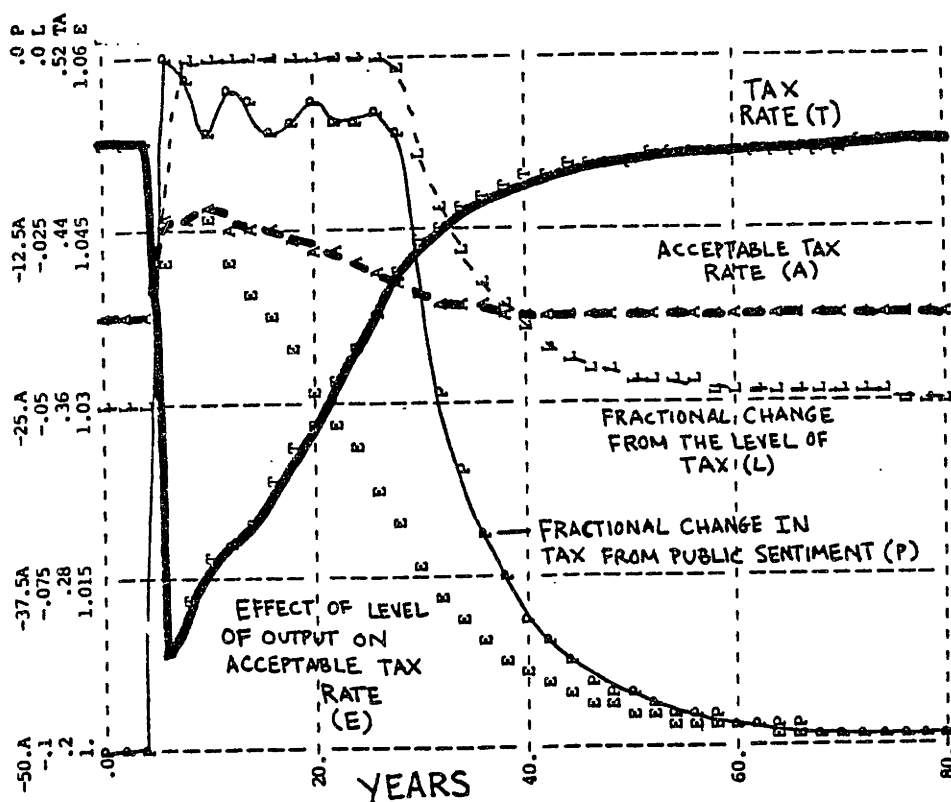


FIGURE 3-8. The Determinants of Fractional Change in Tax From Public Sentiment Over the Test Interval.

Effect of the Level of Output on Acceptable Tax Rate ELOATR reflects the buoying effect that the higher level of Private Production of Goods and Services Per capita PPGSP is having on what the public implicitly considers to be an Acceptable Tax Rate. The

higher level of PPGSP is a direct result of the implementation of the test-input conditions.

As Figure 3-9 indicates, both Private Sector Employees PSE and Productivity of Private Employees PPE, the two variables which determine of PPGSP, immediately step up following activation of the test input. The former increases because of the pulse-transfer of 50% of the government employment pool to the private sector. The latter rises, as Figure 3-9 suggests, as a direct consequence of this transfer. When GE is reduced, the Effect of Government Regulation on Productivity EGRP--which had been exerting a depressive influence on productivity in the reference equilibrium--becomes less negative. As a result, Productivity of Private Employees PPE increases. Hence, with both PSE and PPE up, PPGSP rises. And, with higher levels of private output, the public is more tolerant, other things equal, of a higher tax rate.

As Figure 3-9 indicates, PSE, PPE and PPGSP all trace a steady decline back to their initial reference equilibrium values following the step increases caused by the implementation of the test condition. These declines are the mirror images of the increases posted by the government employment and production variables plotted in Figure 3-4. The relative decline of private employment and output are caused by government's siphoning of productive resources out of the private sector. Government can continue to siphon productive resources as long as it can maintain its money adequacy at a

higher-than-reference equilibrium level. And, government can maintain an elevated money adequacy position as long as society will tolerate its tax and debt burdens. As Figure 3-6 indicates, this tolerance declines over the course of government's relative expansion, ultimately falling to zero. However, during the period in which society is tolerating a rising TR and SGS, it is expressing an implicit willingness to accept public, in exchange for private, output.

Figure 3-10 helps to bring the Tax Rate behavior together. The combination of a suddenly higher-than-reference-equilibrium Acceptable Tax Rate ATR and a suddenly lower-than-reference-equilibrium Tax Rate TR provides government with considerable slack for increasing TR. And, as government expands its employment and output, it takes advantage of this slack by driving up Tax Rate in order to pay for its expanding spending commitments. At the same time, however, government's expansion is coming at the expense of private employment and output. And, as these decline, ATR follows suit. By about year 28 of the simulation, TR and ATR cross paths; the former continuing to rise under pressure from money adequacy, the latter continuing to decline under pressure from declining private output.

At this point, Fractional Change in Tax from Money Adequacy FCTMA is exerting an upward pressure on TR; a pressure which, by itself, translates into a growth in Tax Rate of roughly 3% per year. Fractional Change in Tax from Public Sentiment FCTPS, on the other hand, is only beginning to reassert its previously depressive effect because TR has just exceeded ATR for the first time since the administration of the test input. Thus, TR continues to rise above the declining ATR.

As the now positive gap between TR and ATR widens, the rising TR very rapidly encounters increasingly stiff resistance from public sentiment (the public is reacting to TR relative to ATR). Within a decade after the cross-over point between TR and ATR, the depressive influence of Fractional Change in Tax from Public Sentiment FCTPS has nearly regained its reference equilibrium magnitude. By depressing the rate of growth of Tax Rate TR, FCTPS makes it increasingly difficult for government to maintain its money adequacy in the face of expanding spending commitments. As Government Money Adequacy GMA

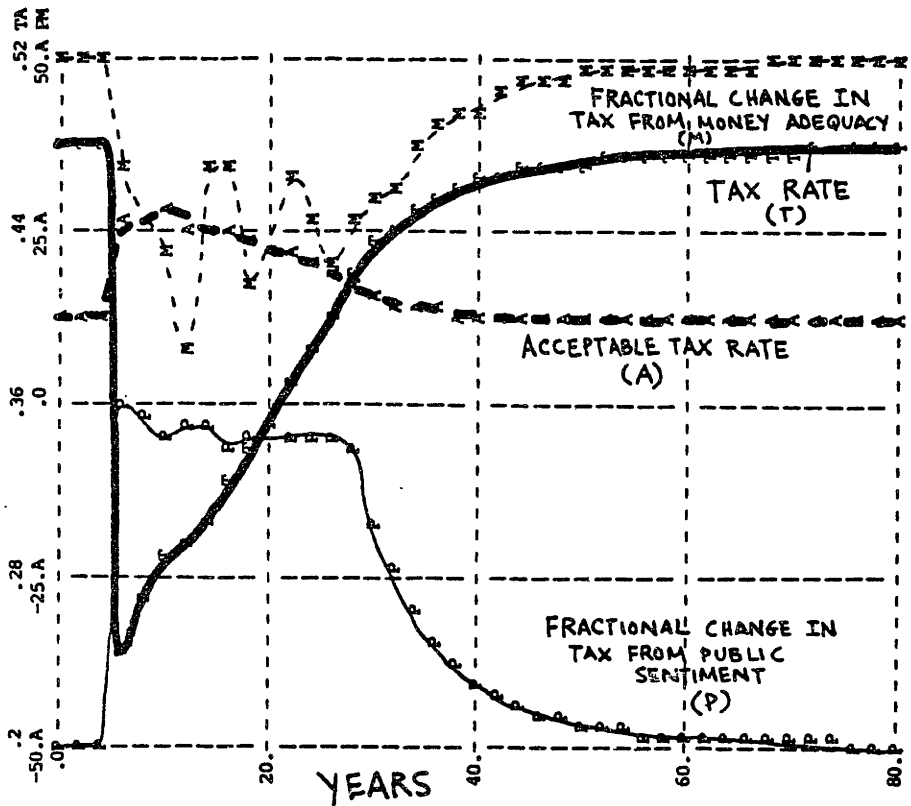


FIGURE 3-10. A Summary of Tax Rate Behavior Over the Test Interval.

declines, Fractional Change in Tax from Money Adequacy FCTMA begins to rise. A rising FCTMA, in turn, helps to offset the increasingly depressive influence of Fractional Change in Tax from Public Sentiment FCTPS. The two influences, each fueling the other (as suggested by Figure 3-11), continue to grow in opposing directions until by year 60 they have re-achieved their exactly counterbalancing reference equilibrium magnitudes. At this point, the roughly fifty year rise in Tax Rate is brought to a halt.

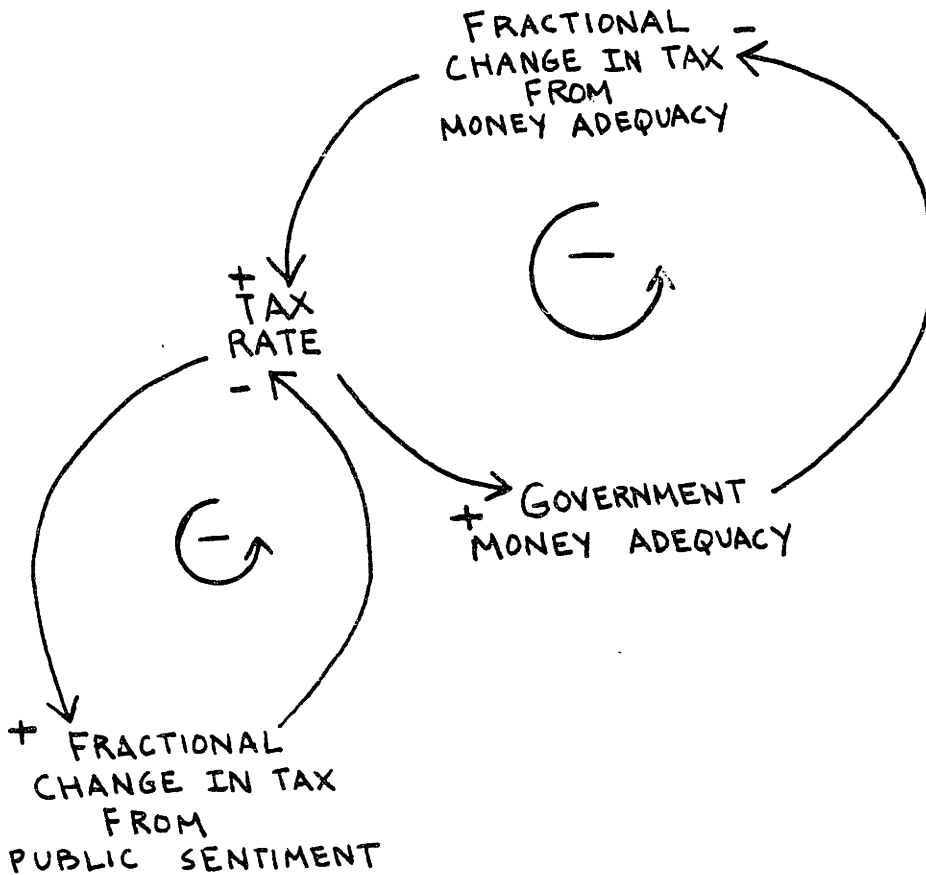


FIGURE 3-11. The Interaction Between Fractional Change in Tax From Money Adequacy and Fractional Change in Tax From Public Sentiment in the Post-Cross-Over Interval.

responsible for the disparity between desired and actual sale of government securities that prevails in the reference equilibrium. MRDF is depressed below 1.0 in the reference equilibrium because low Government Money Adequacy GMA causes government to default on a higher than acceptable fraction of its outstanding obligations.

Following initiation of the test-input in year 4 of the simulation, GMA improves and therefore MRDF begins to exert a less depressive effect on Sale of Government Securities SGS. At the same time, as Figure 3-12 indicates, Market Response to Service Ratio MRSR rises above 1.0, thereby further boosting the market's willingness to absorb government security offerings. MRSR rises because people, with relatively high incomes and relatively low levels of government output, are requesting more government output than is being supplied. Government's improved default performance, and the public's increased willingness to accommodate additional government output, thus combine to effectively neutralize the market's response to government's security offerings. Between year 10 and year 28 of the simulation, the market is seen to be willing to absorb all of the securities that government desires to sell (i.e., SGS equals DSGS over this interval).

Government promptly takes advantage of its ability to sell a growing volume of securities. Between year 12 and year 26, the last year in which market sentiment toward the purchase of government securities is completely neutralized, Sale of Government Securities SGS climbs from a low of about \$27 billion per year to about \$36 billion per year; an increase of 33%. Over the next fourteen year

interval depicted in Figure 3-12, SGS climbs about another 15%. And, over the remaining years of the simulation, SGS rises by only another 6%.

Thus, as with Tax Rate, government progressively "wears out its welcome" with its sale of securities. As government generates higher levels of output, Market Response from Service Ratio MRSR exerts a less and less buoying influence on the market's willingness to absorb government securities. In addition, as government's hiring and spending activities continue to outpace the growth of its money inflows, government's money adequacy slowly declines back toward the reference level. With falling money adequacy, government's defaults begin to rise again, thereby further constraining the sale of government securities. But, because the sale of government securities is increasingly constrained, government's money adequacy declines even more. Declining money adequacy causes government to desire to sell an even larger volume of securities. However, at the same time, eroding money adequacy exacerbates government's already-deteriorating default record, which makes it increasingly difficult for government to sell the volume of securities that it desires.

Thus, government is trapped in a depressed money adequacy position. Increasingly vigorous attempts to extricate itself from this position are met with increasingly sharp reactions from the market.

3.4 IN SUMMARY

Resetting the clock on government growth essentially provides government with a "fresh start". Government Money adequacy is

restored. Tax rates are rolled back to levels below those which stimulate counterpressures from public sentiment. And, the sales volume of government securities is reduced to a level that does not strain the financial markets.

Model simulations show that given this "fresh start" government grows rapidly at first, encountering little or no resistance to its progress. However, as government growth continues in the "fixed" economy, it begins to create the counterpressures that ultimately halt further expansion.

Government's money adequacy becomes increasingly depressed because tax rate and sale of government securities can no longer be increased rapidly enough to keep pace with government's expanding spending commitments. As money adequacy declines, government pushes even harder to increase tax rate and sale of government securities. However, tax rate has, by this time, achieved levels which stimulate exactly matching counterpressures from public sentiment. And, the sale of government securities is limited by a rising record of defaults (a direct consequence of government's eroding money adequacy position).

Thus, ultimately, government's inherent growth-promoting forces are brought under control by society's unwillingness to tolerate any more publically-produced output; expressed as an unwillingness to shoulder higher tax and debt burdens. The system comes to rest at a point where government is supplying as much output as it can, given all other conditions in the socioeconomy.

Chapter 4 departs from this "clash of forces" resting point by systematically altering the physical parameters of the socioeconomy

in an effort to determine whether such alterations can affect the ultimate balance that is struck between the public and private sectors of the socioeconomy.

CHAPTER 4

TESTING ALTERNATIVE THEORIES
OF GOVERNMENT GROWTH

Chapter 3 explored the forces that produce and limit government growth in a "fixed" socioeconomy. In this Chapter, various aspects of the socioeconomy are, one-at-a-time "un-fixed" in order to test several alternative theories of government growth.

The procedure for testing each theory is the same. First, the theory is summarized citing references to the appropriate literature. Next, the manner in which the theory is to be implemented into the model is explained. Finally the theory is implemented into the model and the resulting model behavior is analyzed.

In order to implement each theory into the model, the model is first initialized in the reference equilibrium condition described in Chapter 3. In year 4 of the simulation, the parameter (or parameters) needed to reflect the particular theory under investigation is altered in a one-time, step-change fashion. The resulting behavior of model variables is then examined to determine, in particular, whether the system returns to its reference equilibrium condition. If model variables do return to their reference equilibrium values, then the test results indicate that the theory, by itself (and in light of the assumptions embodied in the model), can not account for government's relative expansion. However, if the perturbation does cause the system to settle at a new equilibrium position, with government employment and production occupying a

relatively larger share of total employment and production, then the particular theory is entertainable as an explanation of relative expansion.

4.1 THEORY 1: WAR CAUSES GOVERNMENT GROWTH

Perhaps the clearest statement of the belief in war as a major causal force driving the expansion of the public sector is provided by Buchanan:

"The single best explanation for the tremendous growth in the public sector of the economy and also for the increased concentration in the Federal government is provided by the predominant expenditures, direct or indirect, made necessary by wars or threats of wars." [1]

4.1.1 Implementing A War Into the Model*

War, or, as it is more generically referred to in the model, Threat to National Security TNS, is modeled as an index number that can take on values from 0 to 1.0, inclusive. A value of zero indicates that no threat to National security exists. A value of 1.0 indicates that a full threat to National security, such as World War II, exists. In the reference equilibrium, TNS, which is defined as a Table

* All equation numbers referenced in this Chapter refer to the documentor equation listing that appears in Appendix I and II.

Function of time (equation 159), is set equal to zero. To implement a war into the model, the original setting of TNS is modified as follows:

TTNS	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
PRESENT	0.	0.	0.	1.	1.	1.	1.	1.	1.	0.	0.
ORIGINAL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

With TNS modified as indicated, war is absent until year 3 of the simulation. At the beginning of year 3 war breaks out, increases linearly in intensity reaching full strength at the beginning of year 4, continues for six years at full strength, declines linearly to zero strength in year 10, and remains at zero strength for the duration of the simulation.

War impacts the model in four places.

The first two impacts influence government's ability to finance a war. Because of the need for a sharp increase in government spending to meet wartime commitments, it is essential that government be able to raise the funds needed to underwrite these commitments. Government, in the model, raises funds either through taxation or debt issuance. Effect of Threat to National Security on Public Sentiment ETNSPS (equation 93) and Market Response from Threat to National Security MRTNS (equation 70) guarantee that government will be able to meet its wartime spending commitments.

ETNSPS neutralizes public sentiment against tax rate increases to a degree that is commensurate with the magnitude of the

Threat to National Security TNS. With public sentiment neutralized, Fractional Change in Tax from Money Adequacy FCTMA will operate unopposed, and can therefore push up Tax Rate as much as needed to cover spending commitments. MRTNS functions analogously to ETNSPS, but operates to allow for expanding the sale of government securities. During war, MRTNS neutralizes the market's response to government's Desired Sale of Government Securities DSGS. In the absence of restrictions imposed by the market, government's money needs will push up DSGS and the market will then absorb all of the securities that government desires to issue.

The third way that war impacts on the model is by increasing the rate at which government hires employees. The Effect of War on Fractional Increase EWFI (equation 187) is defined as a Table Function. The Function ranges between 1.0 and 2.5 and is positively related to TNS. EWFI is a multiplicative term in the equation for Fractional Increase in Government Employees FIGE (equation 5). When TNS is zero, indicating that no war is being waged, EWFI exerts a neutral impact on FIGE. As TNS rises above zero, EWFI causes FIGE to increase, thereby drawing more employees into government.

The final way that war impacts on the model is by affecting the Productivity of Private Employees PPE. As discussed in Chapter 2 (and Appendix I), PPE is assumed to be influenced by the number of government employees relative to the total number of employees in the labor force. This influence is embodied in the variable Effect of Government Regulation on Productivity EGRP (equation 146). EGRP acts to depress private productivity as the level of government employees

expands as a fraction of the labor force. The assumption here is that a growing government involvement in the affairs of the private sector will serve to reduce productivity due to regulation and other statutory interventions.

A problem with this formulation arises during wartime because the model does not distinguish between military and civilian government employees. Government employment swells during a war because of the rapid increase in military personnel. However, these personnel do not become involved in regulating the activities of the private sector. Therefore, it is necessary to prevent EGRP from exerting its usual impact on private productivity during wartime. This is done by defining the variable Effect of War on Productivity EWP (equation 188). EWP becomes equal to the inverse of EGRP when TNS takes on a value greater than zero. This formulation is oversimplified and represents the extreme-case assumption that government regulation has no impact on private productivity during war-time. Although this assumption is extreme, testing of less-extreme assumptions revealed that the severity of the assumption only affects the magnitudes achieved by model variables during the test, and not the ultimate test results.

The four impacts resulting from the implementation of a war into the model are summarized in Table 4-1.

TABLE 4-1

A Summary of the Impact of War on Model Variables.

<u>Variable</u>	<u>Impact</u>
ETNSPS	Neutralizes public sentiment against tax rate increases.
MRTNS	Neutralizes Market Response to Desired Sale of Government Securities.
EWFI	Increases Growth Rate of Government Employees.
EWP	Neutralizes Effect of Government Regulation on Productivity of Private Employees.

4.1.2 Theory 1: Simulation Results

Figure 4-1 charts the response of government employment and production--the two principal barometers of government expansion--to the imposition of a war. As the Figure indicates, war does not permanently displace government employment and production from their reference equilibrium positions. In particular, war does not cause a relative expansion of the public sector.

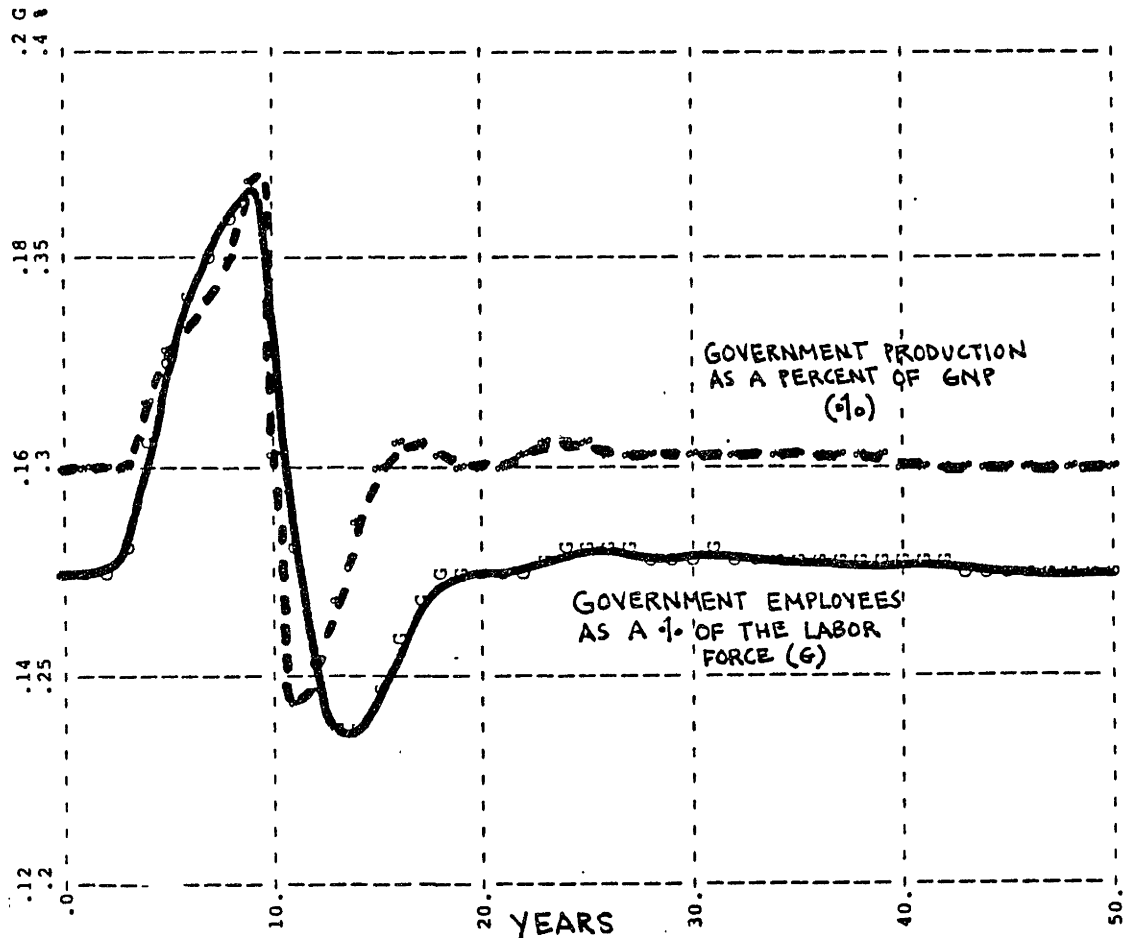


FIGURE 4-1. The Response of Government Employment and Production to the Imposition of a War.

Figure 4-1 shows that war does indeed cause a very sharp rise in the relative stature of government employment and production. Government employment climbs from 15% to nearly 19% of the labor force during the war-time interval. And, government production moves from 30% to roughly 55% of GNP during the same interval. Following the termination of the war, however, both variables decline very precipitously to levels below their reference equilibrium values. Each then rebounds sharply and, within about a decade, settles at its

original equilibrium value.

The steepness of the declines, and the lightly oscillatory return-to-equilibrium paths, traced by the employment and production variables are somewhat unrealistic. They result from several simplifying assumptions that have been incorporated into the model. To begin with, war, in the model, terminates in a much more abrupt fashion than it does in reality. In the model, war goes from peak intensity to zero in one year. In reality, even after the fighting has ended, the post-war period winds down more slowly. Time is needed to dismantle the physical and organizational machinery that was set up to administer the war. There are, in addition, several post-war spending commitments to be honored. Veterans benefits must be paid, military plant and equipment must be serviced and transported, and foreign aid payments to help in the restoration effort are frequently made. As a result, in reality, post-wartime spending and employment levels taper off more gradually than model variables indicate. This more gradual tapering, in turn, implies that public and market sensitivity to tax rates and government debt issuance likewise returns only gradually (after having been neutralized by the war). In the model, however, these sensitivities return to full strength immediately following the abrupt termination of the war.

These simplifications have been retained because the model is not intended to focus on issues relating to the military. However, despite these simplifying assumptions, the essential nature of the model response is reasonable, as Figures 4-2 and 4-3 suggest. These Figures chart the behavior of actual government employment and

spending over an interval that includes the World War II years. Both time series, like model output, show a sharp rise following the outbreak of war. Each, like their model counterpart, climbs to a peak near war's end. And, finally, after the war, each declines sharply, ultimately reaching pre-wartime levels (if these levels are extrapolated using pre-wartime trends).

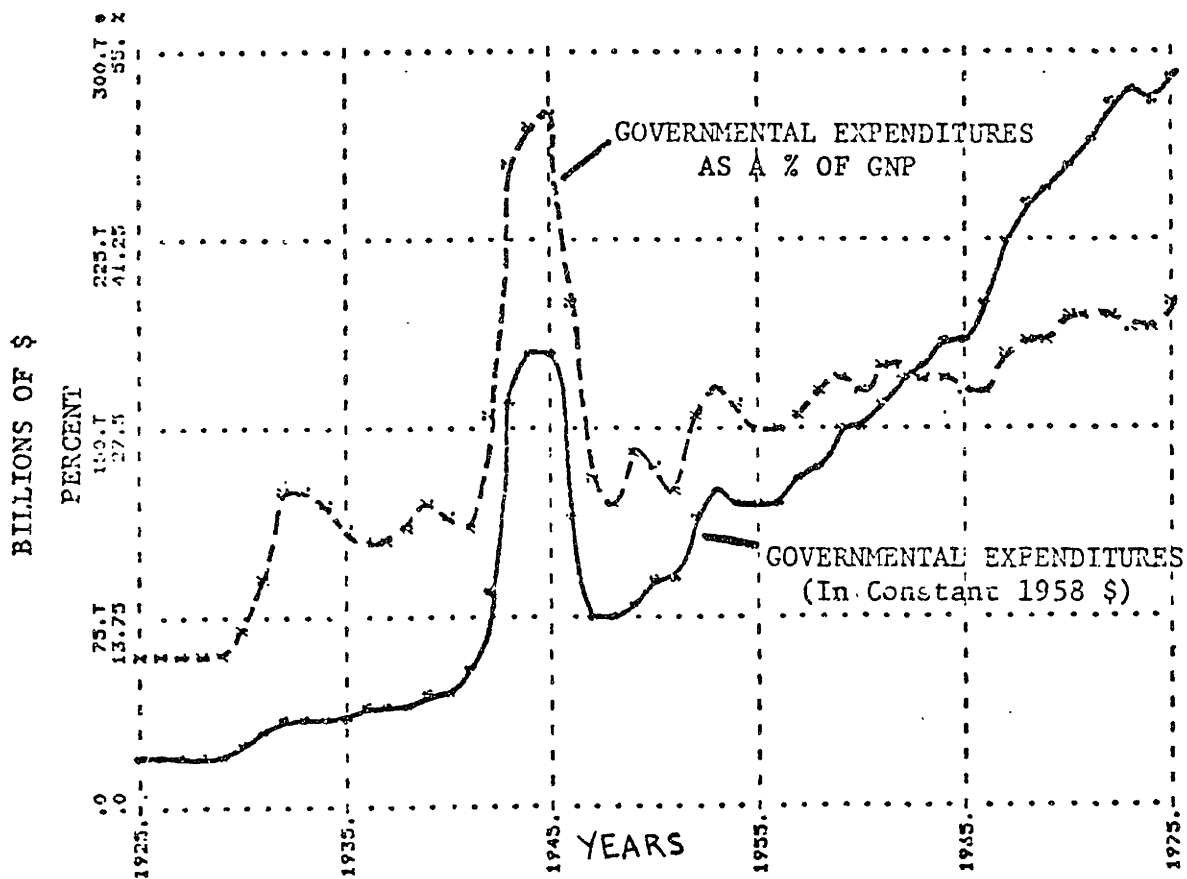


FIGURE 4-2. Government Spending in Constant (1958) Dollars and As a Percent of GNP.

Source: Historical Statistics of the United States, p. 1123 and p.224.

Statistical Abstract, 1976, p. 273 and p.394

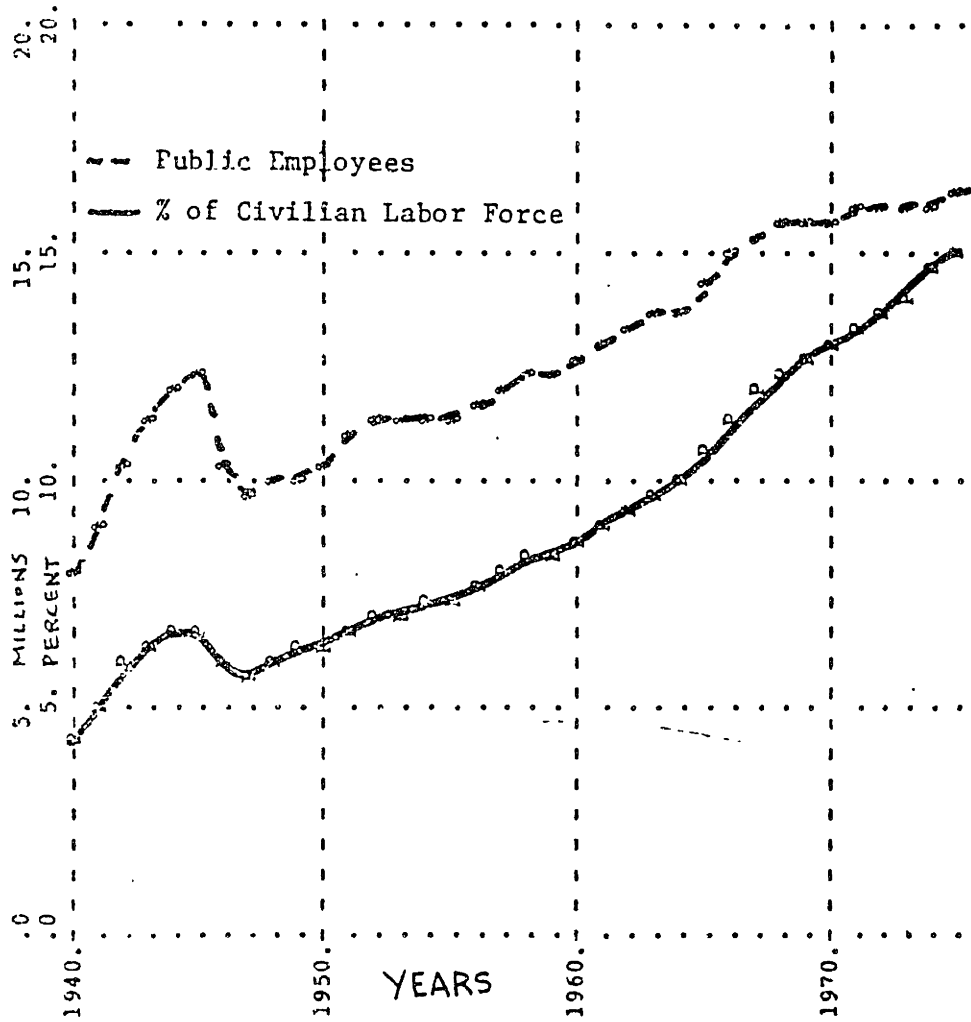


FIGURE 4-3. Public Employees and as a Percent of the Civilian Labor Force, 1940-1975.

Source: Historical Statistics of the U.S., p. 1100 and p. 126-7.

Statistical Abstract, 1976, p. 284 and p. 355.

In order to finance the rapid infusion of employees and sharp increase in spending occasioned by the war, it is necessary that government increase tax rates and sale of government securities quite precipitously. Figure 4-4 indicates that this is, in fact, exactly

what occurs in the simulation.

Tax Rate TR, and hence Tax Revenues TAXREV, are pushed up sharply following the outbreak of war. Tax Rate rises by nearly 25%--from .48 to about .6--between year 3 and 8 of the simulation. Tax revenues show an even larger increase, moving up 33% over the same interval. Sale of Government Securities posts a smaller percentage increase, climbing some 20%--from \$45 billion to roughly \$60 billion--during the war years. All three variables decline very sharply following termination of the war. Each then rebounds quickly and, after some oscillation, settles down to its respective reference equilibrium level.

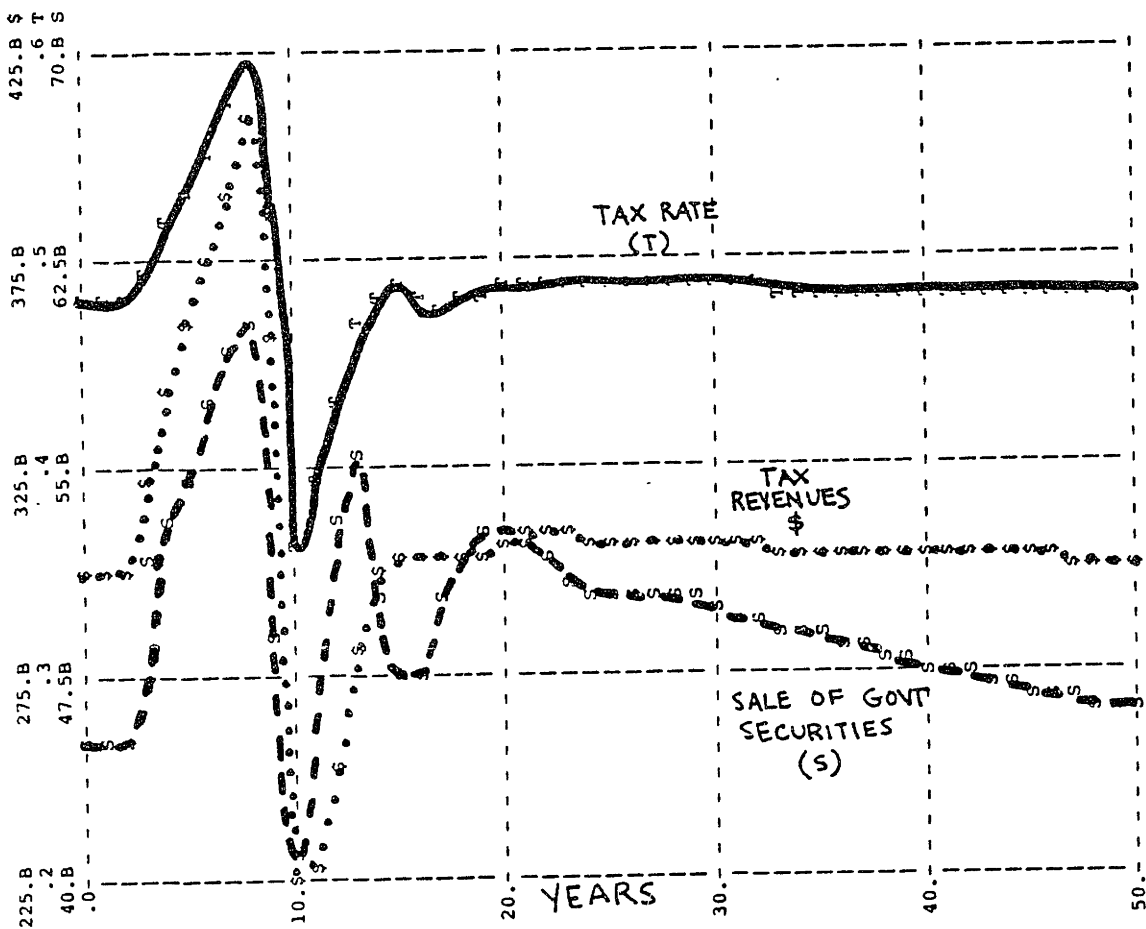


FIGURE 4-4. The Response of Tax Rate, Tax Revenue and Sale of Government Securities to the Imposition of a War.

Government, in the model, is able to increase its money inflows so rapidly because public sentiment against tax rate increases, as well as the market's reaction to government's desired sale of securities, are both neutralized by the war. Figures 4-5 and 4-6 tell the story.

As Figure 4-5 indicates, a sizeable positive discrepancy between Tax Rate TR and Acceptable Tax Rate ATR opens up during the war. The discrepancy arises for two reasons. First, with public sentiment neutralized, low money adequacy operates without a counterbalance to push up TR. And, second, a declining standard of living--due to the reallocation of labor away from private production--depresses what the public considers to be an Acceptable Tax Rate ATR. When the war terminates, public sentiment is abruptly "de-neutralized." The resulting immediate, and forceful, response of the public to the large disparity between TR and ATR forces TR down very sharply. As a consequence of the very strong push unleashed by public sentiment, TR falls to a level well below its reference equilibrium value. The sharp drop in TR causes government's money adequacy to drop. A decline in GMA, in turn, stimulates government to apply strong upward pressure on tax rate in an attempt to restore its money adequacy position. As TR rebounds, another much smaller wave of public sentiment is aroused, counterbalancing the upward thrust provided by government's response to its money adequacy position. Ultimately, the two opposing pressures come into a balance when TR settles at its reference equilibrium position.

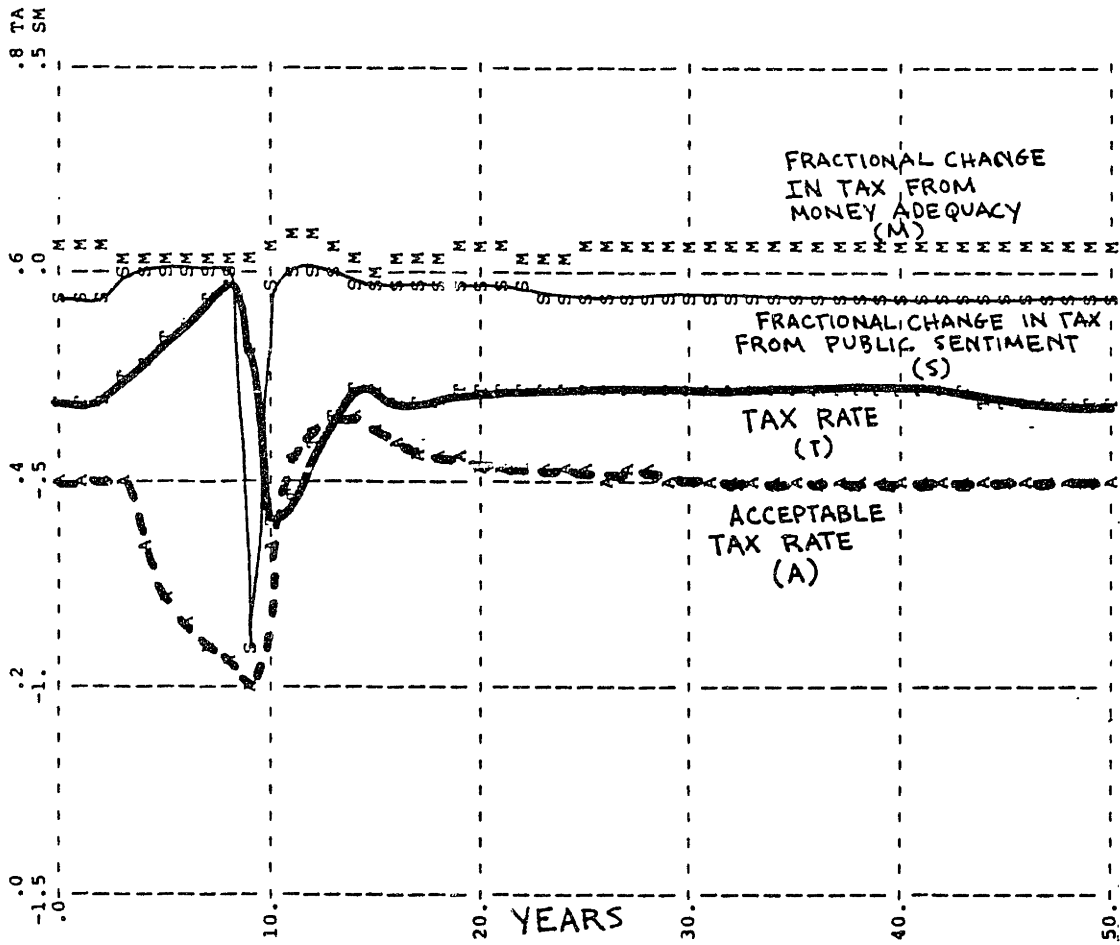


FIGURE 4-5. The Behavior of Tax Rate, Acceptable Tax Rate, Fractional Change in Tax From Public Sentiment and Fractional Change in Tax from Money Adequacy to the Imposition of a War.

Figure 4-6 shows the analogous result for Sale of Government Securities SGS, government's second means of financing wartime activities. With the onset of war, the Effect of Market Response on Desired Sale EMRDS, which is exerting a depressive influence in the reference equilibrium, is neutralized (i.e., driven to 1.0). This enables the Effect of Money Adequacy on Desired Sale EMADS, which remains in excess of 1.0 throughout the wartime interval, to continue

to push up Desired Sale of Government Securities DSGS. Without any response from the market to modulate DSGS, government is able to sell all of the securities that it desires. When market sensitivity is abruptly "de-neutralized" at the conclusion of the war, the market responds sharply on several accounts.

First, the previously discussed sharp contraction of tax rate forces tax revenues, and hence government money adequacy, down. Low government money adequacy causes government's default fraction to rise. A higher than normal default fraction decreases the market's willingness to absorb government securities. Second, during the war years, government was absorbing a high fraction of the dwindling pool of funds that were available for the purchase of securities. At the end of the war, the market's willingness to absorb further government security issues declines because the market wishes to balance its portfolios by adding private securities. Finally, due to the sharp rollback in tax rate, and consequent decline in tax revenues immediately following the war, the ratio of debt service to tax revenues rises above its traditional value. When this ratio departs from tradition, it indicates to the market that government is selling too many securities relative to its ability to service them.* Such an indication further reduces the market's willingness to absorb additional government securities.

The aforescribed set of pressures combine to cause a sharp contraction in the sale of government securities. As with the rollback in tax rate, the contracted sale of government securities

* Debt service, in the model, includes repayment at maturity and interest charges.

stimulates substantial counterpressures from within government. The sharp reduction in the sale of government securities causes government money adequacy to decline. Low money adequacy leads government to desire to sell more government securities. Thus, sale of government securities, like tax rate, rebounds quickly after being forced down sharply at war's end. Ultimately, the opposing pressures resolve themselves into a balance in which government is, once again, selling securities at the reference equilibrium rate.

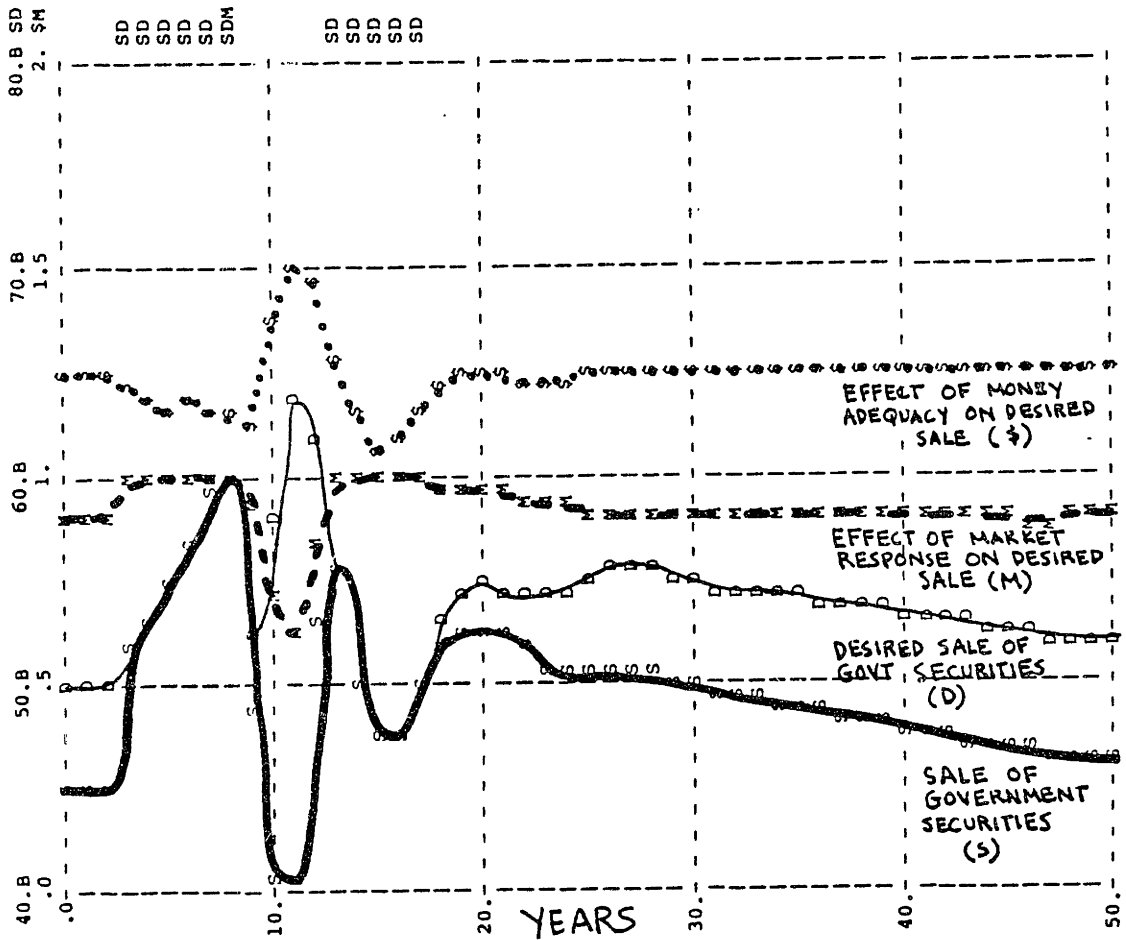


FIGURE 4-6. The Response of Sale of Government Securities, Desired Sale of Government Securities, the Effect of Market Response on Desired Sale and the Effect of Money Adequacy on Desired Sale to the Imposition of a War.

The system returns to equilibrium following the imposed disturbance because the war has not caused any lasting alteration of societal preferences for public, relative to private, output. Preferences remain the same because war, at least in the model, has not altered any of the "physical" parameters that define overall conditions in the socioeconomy. The level of technology, the age distribution of the population, productivity, and the size of the labor force have all remained unchanged.

Thus, rather than a cause of relative expansion, war appears to function more as an event which temporarily suspends the mechanisms that normally serve to control government growth. Following the war, these control mechanisms become reactivated (although somewhat too rapidly and forcefully in the model), driving government back to its pre-war stature.

4.2 THEORY 2: DEPRESSION CAUSES GOVERNMENT EXPANSION

Several authors [2] [3] cite economic depressions as a major cause of government growth. And, an examination of most government time series during the interval encompassing a major economic downturn is indeed likely to reveal a bulge during these years. Peacock and Wiseman have put forth a hypothesis that links economic depression with war as a cause of government expansion:

"...under normal conditions of peace and economic stability, public expenditure changes are extremely limited, bounded by what individuals consider to be

'tolerable' limits of taxation. When a major crisis threatens the community, however, people do not object at all to supporting measures specifically designed to eliminate or alleviate the calamity. During this crisis period people's thresholds of tax tolerance permanently rise. After the crisis, however, the level of expenditure does not recede to precrisis levels, but instead noncrisis activities are enlarged in scope by expansion-minded politicians and bureaucrats. This is known as the Displacement Effect. For similar reasons, ... activities are centralized during the crisis since the top level of government is best able to cope with a society-wide cataclysm. This is called the Concentration Effect.' [4]

4.2.1 Implementing a Depression into the Model

A depression is implemented into the model by switching on a one-time, pulse-transfer of 25% of private sector employees into the Unemployed pool (see equations 189-190). The transfer is switched on by setting Time to Implement Experiment 9 TIE9 equal to 4.

4.2.2 Theory 2: Simulation Results

Figure 4-7 charts the course of Government Employees as a Percent of the Labor Force GEPLF and Government Production as a Percent of Gross National Product GPPGNP following the implementation of a depression. The Figure also includes plots of the behavior of Private Sector Employees as a Percent of the Labor Force PEPLF and Unemployed as a Percent of the Labor Force UPLF, in order to provide a broader perspective on the impact of a depression on the economy. As the Figure indicates, a depression does not cause a permanent

displacement of governmental activity as Peacock & Wiseman and others suggest. As with the imposition of a war, the system rebounds from the depression, returning to the reference equilibrium condition. In fact, as Figure 4-7 indicates, rather than expanding government output and employment, the depression causes both to contract!

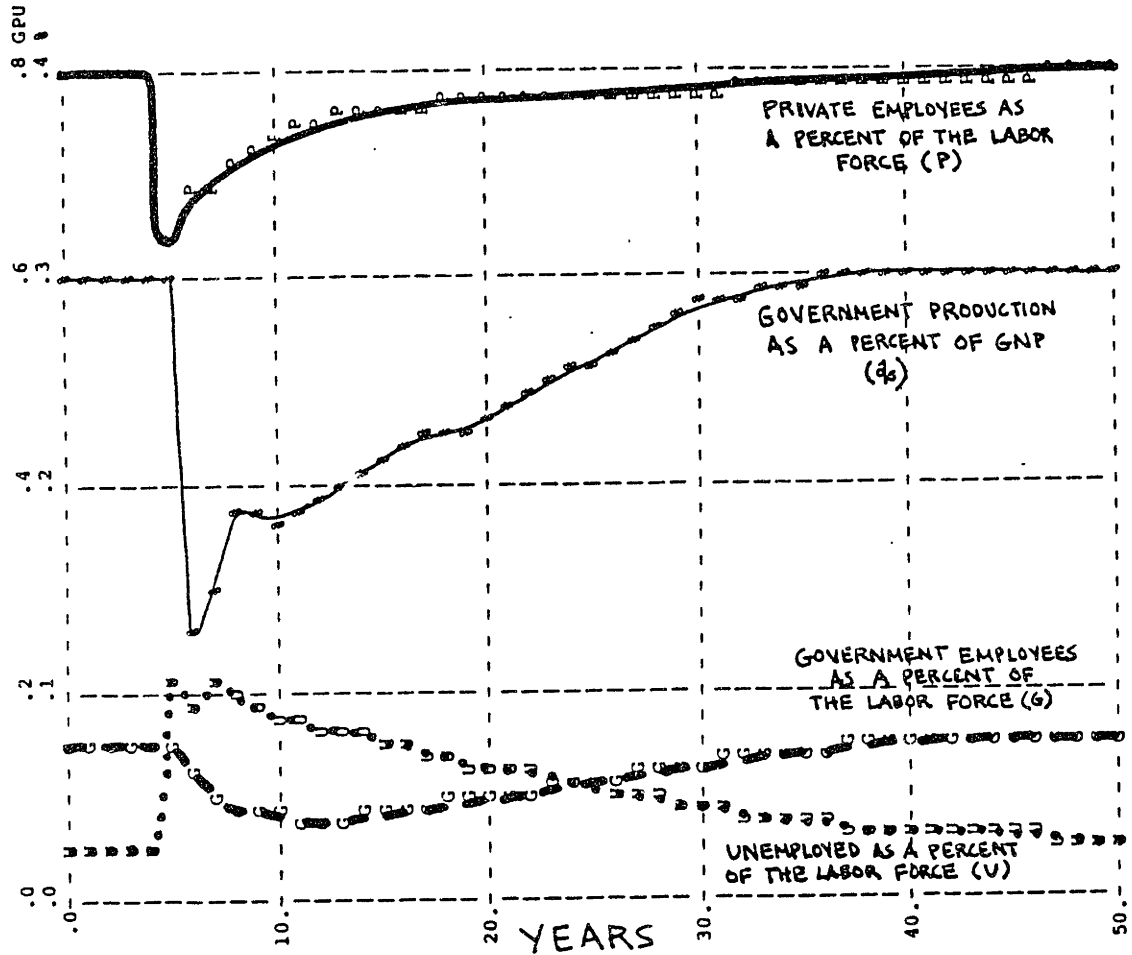


FIGURE 4-7. Government and Private Employment, and Unemployed as Percents of the Labor Force and Government Production as a Percent of GNP in Response to a Depression.

This result is unrealistic, at least in view of the history of the 1930's. It results primarily from the assumption that government can not print money. Because of this assumption,

government's revenues, in the model, are completely dependent upon the level of private output (even in the short-run). And, because the level of private output is sharply depressed--by the transfer of 25% of the private labor force into the unemployment pool--government must cut back both production and employment.

To see how government's revenue base is eroding during the depression, Figure 4-8 charts the course of Tax base TB and Funds Available for the Purchase of Securities FAPS over the test interval. TB declines some 30%--from \$625 billion to \$425 billion--in response to the depression of private output. Funds Available for the Purchase of Securities FAPS, declines by a similar percentage magnitude, falling from \$150 billion to \$110 billion. But, as the Figure indicates, the declines in Tax Revenues TAXREV and Sale of Government Securities SGS are even more severe! TAXREV is cut in half following the onset of the depression. And, government's sale of securities is nearly extinguished, dropping from \$45 billion to less than \$5 billion after the economic downturn.

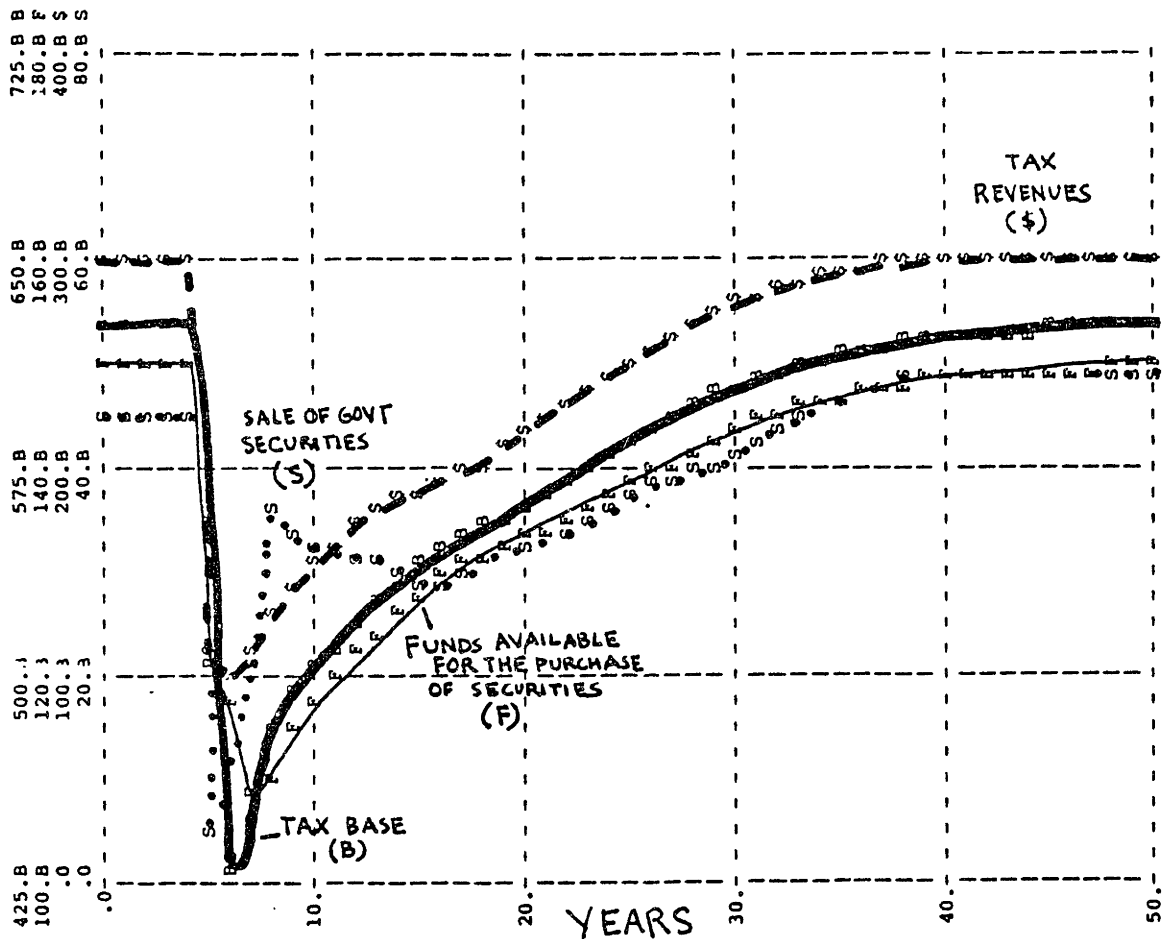


FIGURE 4-8. The Behavior of Tax Base, Funds Available for the Purchase of Securities, Tax Revenues and Sale of Government Securities in Response to a Depression.

As Figure 4-8 suggests, the reason that TAXREVE falls by more than TB is that government is cutting the tax rate. The reason that government takes this seemingly counterproductive action is that the sharp reduction in private output creates a pressure for government to stimulate aggregate demand. Because government can not print money, aggregate demand can only be stimulated in the model, by cutting tax rates. Thus, as Figure 4-9 indicates, Fractional Change in Tax from

Fiscal Action FCTFA declines sharply following the exogenously imposed drop in economic activity. The sharp decline, in turn, causes Tax Rate TR to fall off precipitiously. The downward pressure exerted by FCTFA is, however, quickly overpowered by Fractional Change in Tax from Money Adequacy FCTMA, government's response to its now severely depressed money position.

FCTMA is helped, in its efforts to push up Tax Rate, by the fact that Fractional Change in Tax from Public Sentiment FCTPS--a potential counterpressure--has been effectively neutralized by the depressed level of Tax Rate TR relative to Acceptable Tax Rate ATR. At the same time, the steady recovery of the private economy is progressively de-fusing the original pressure to cut taxes for purposes of stimulating aggregate demand. As such, FCTFA begins to increase back toward zero. In the absence of a significant counterpressure from either FCTFA or FCTPS, FCTMA is able to push up TR quite rapidly.

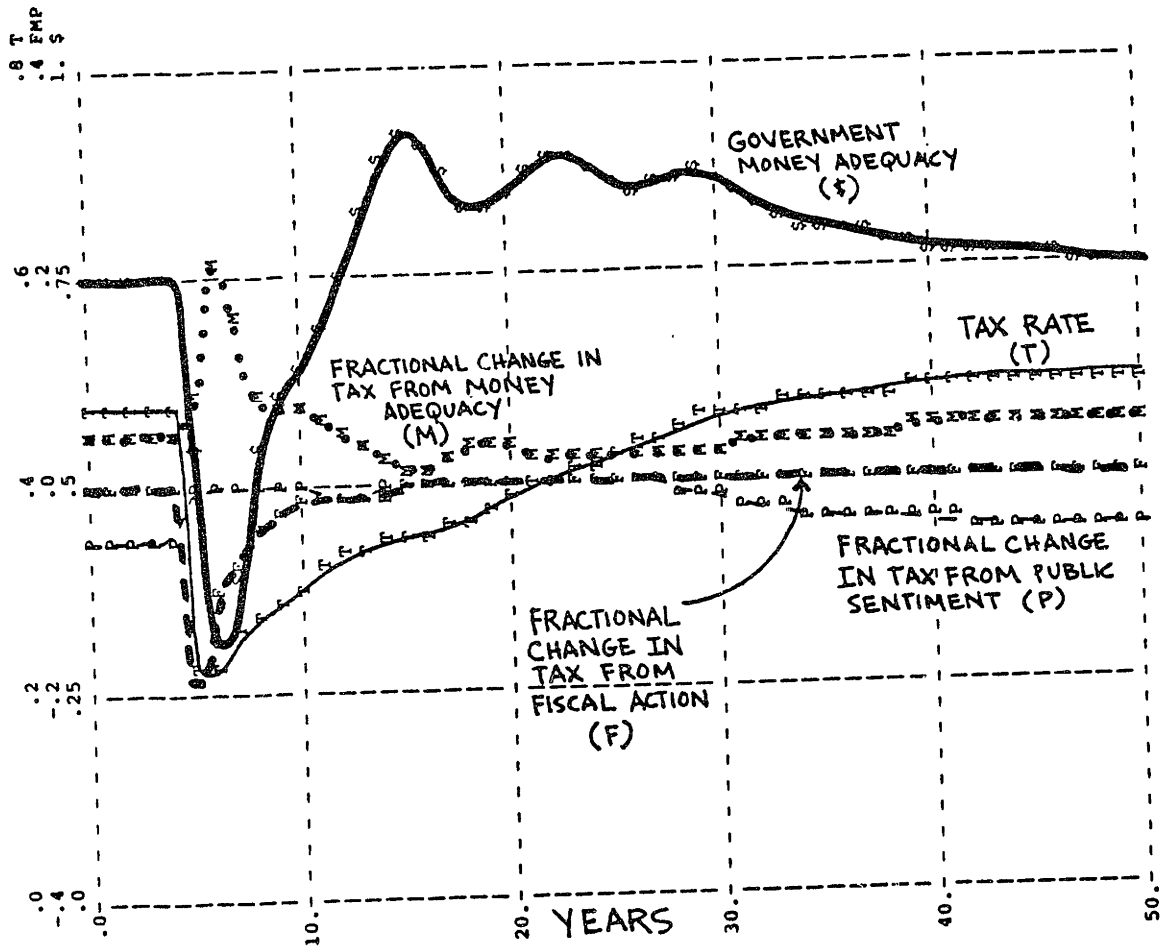


FIGURE 4-9. The Behavior of Taxation Variables and Government Money Adequacy in Response to a Depression.

The combination of a rebuilding tax base and a growing tax burden succeeds in boosting Government Money Adequacy GMA up to its reference equilibrium value by year 12 of the simulation. As Tax Rate continues to climb, however, public sentiment is re-stimulated. Again, a balance between an upward pressure on tax rate exerted by government to restore money adequacy, and a downward pressure exerted by the public in response to the level of the tax burden, is ultimately struck. The balance holds Tax rate at its reference equilibrium value.

As Figure 4-10 indicates, government is in fact being asked to expand its output at the onset of the Depression, as it was asked to do in the '30's. In fact, Per Capita Demand for Government Transfers PCDGT, an index number, more than doubles following imposition of the depression. The sharp increase in PCDGT is caused by the large infusion of people into the Unemployed U pool. However, despite the rapid increase in demand for government Transfer Payments TP, government's depressed money position actually causes TP to decline in the period immediately following the economic downturn. In reality, government would likely print money in order to meet the increased need for transfer payments that arises at the onset of a severe economic downturn. However, because the money creation option is not open to government in the model, it is not until GMA is restored (in about year 12) that TP can rise above its reference equilibrium value.

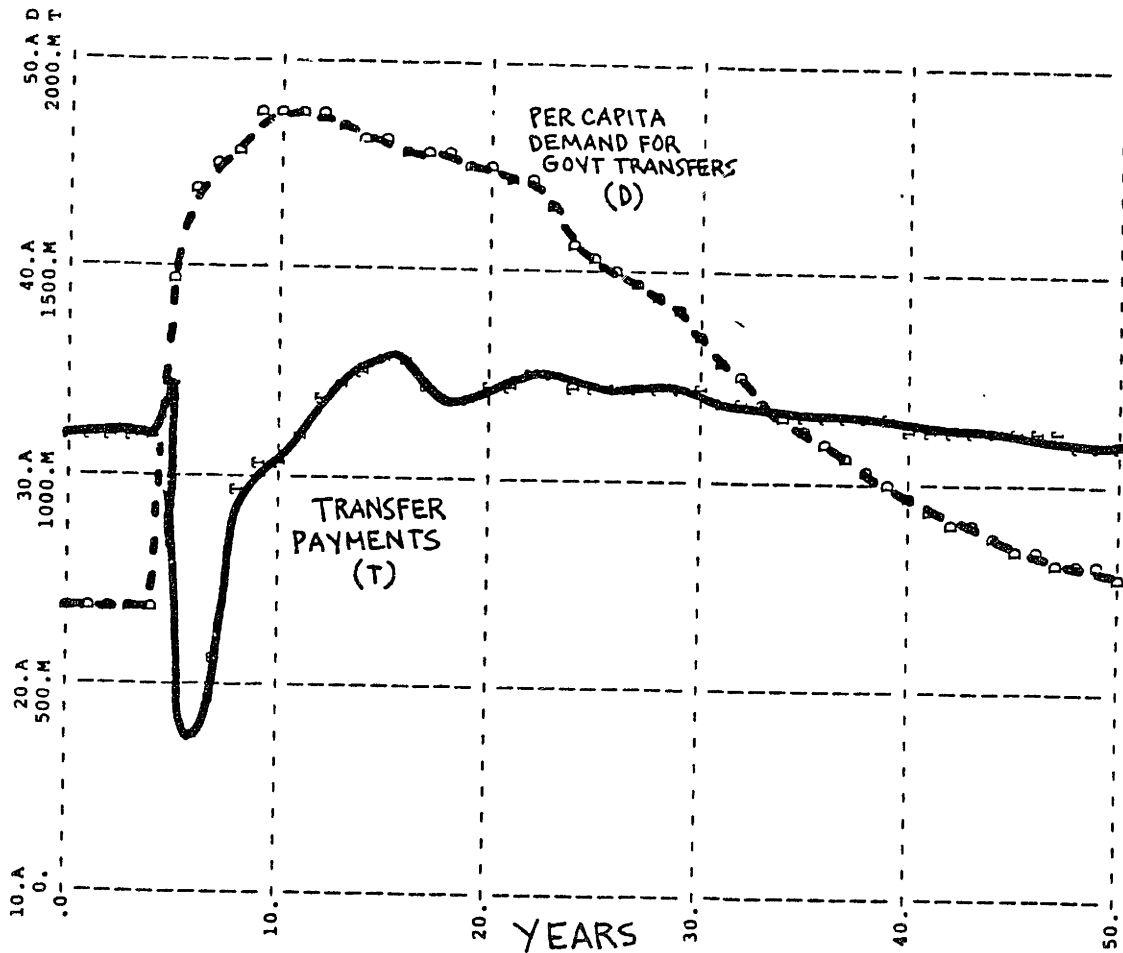


FIGURE 4-10. The Behavior of Per capita Demand for Government Transfers and Transfer Payments in Response to the Imposition of a Depression.

The simulation results, then, do not support the Peacock & Wiseman hypothesis. Depression, by itself, does not cause a permanent increase in the level of government employment and spending. The simulations do show a transient increase in the level of government activity (following government's restoration of its own depressed money position). Transfer Payments, for example, rise to a peak nearly one-half billion dollars above their reference equilibrium level and remain above this level for some thirty years following imposition of the depression (see Figure 4-10). Such an increase may indeed be

attributed, as Peacock and Wiseman suggest, to the "activities of expansion-minded politicians and bureaucrats." However, such activities can not be sustained, at least in a "fixed" economy. As unemployment recedes to pre-depression levels, public and market tolerance of the tax and debt burdens needed to maintain transfer payments at depression levels erodes. Government is, as a consequence, driven back down to its pre-depression stature.

4.3 THEORY 3: PRODUCTIVITY DIFFERENTIALS CAUSE GOVERNMENT GROWTH

A theory of government growth put forth by Baumol [5], cites productivity differentials between the public and private sectors as the cause of government growth. Baumol argues that there are forces inherent in the technological structure of service-producing industries, of which government is one, that lead to a progressive and cumulative increase in the real costs of production. The "technological structure" of service industries is such, he asserts, that the productivity of workers in these industries is nearly immune to the effects of innovation, capital accumulation and economies of large scale which act to bolster the productivity of goods-producing workers. As a result, over time, a productivity imbalance between the goods and service-producing sectors of an economy develops. The imbalance generates pressures which, in turn, create a relative expansion of costs and employment in the less productive sector:

"If productivity per man hour rises cumulatively in one sector relative to its

rate of growth elsewhere in the economy, while wages rise commensurately in all areas, then relative costs in the nonprogressive sectors must inevitably rise ... For while in the progressive sector productivity increases will serve as an offset to rising wages, this offset must be smaller in the nonprogressive sectors...On the other hand, if in the nonprogressive sector productivity is constant, every rise in wages must yield a corresponding addition to costs...Thus, the very progress of the technologically progressive sectors inevitably adds to the costs of the technologically unchanging sectors of the economy, unless somehow the labor markets in these areas can be sealed off and wages held absolutely constant, a most unlikely possibility. We see then that costs in many sectors of the economy will rise relentlessly. The consequence is that the outputs of these sectors may in some cases tend to be driven from the market. If their relative outputs are maintained, an ever increasing proportion of the labor force must be channeled into these activities and the rate of growth of the economy must be slowed accordingly." [5]

4.3.1 Implementing a Productivity Differential Into the Model

In order to test Baumol's theory, it is necessary to alter the productivity differential that exists between the public and private sector in the reference equilibrium condition. In particular, the productivity of private sector employees must be increased relative to that of government employees. This can be accomplished by increasing the level of Technology T in the model.

Technology has three impacts in the model. It impacts upon: (1) the Productivity of Private Employees PPE, via the Effect of Technology on Productivity ETP (2) the Productivity of Government Employees Producing Services PGEPS, via the Effect of Technology on the Productivity of Government Employees producing Services ETPGES,

and (3) the Productivity of Government Employees Producing Transfers PGEPT, via the Effect of Technology on the Productivity of Government Employees producing Transfers ETPGET. In each case, the impact is positive; i.e., an increase in T increases productivity, and vice versa. However, the strength of the positive influence in each case reflects Baumol's assumption.

A given increase in Technology raises productivity most in the private sector, in reflection of the fact that this sector has a substantial contingent of goods-producing industries. Productivity gain, for a given increase in T, is second highest for government employees producing transfers, and least for government employees producing services. Technological advance is assumed to impact differentially on the productivity of the two classes of government employees because transfer payment production is more capital-intensive than service production. As such, government workers in transfer payment production can benefit more from a given capital-related technological advance.

In order to implement the test, Time to Implement Experiment 6 TIE6 is set equal to 4. This causes T to increase by 10% over its reference equilibrium level in year 4 of the simulation. The 10% increase in T causes Productivity of Private Employees PPE to rise by 10%, Productivity of Government Employees Producing Transfers PGEPT to climb by 4% and Productivity of Government Employees Producing Services PGEPS to increase by 2%.

4.3.2 Theory 3: Simulation Results

Figure 4-11 charts the response of government employment and production to the increase in the productivity differential that exists between workers in the public and private sectors of the model. The results show that a relative expansion of both government employment and production occurs. Government employment increases from 15% to a new steady state of roughly 16.75% of the total labor force. Government production climbs from 30% to approximately 32% of GNP, GNP (not shown) having itself risen by some 9%.

The initial sharp decline in government production as a percent of GNP is strictly an artifact of the activation of the test condition. The step-increase in the productivity of private sector employees steps up Private Production of Goods and Services PPGS directly. And, because Government Production is fixed, at least in the short-run, it therefore automatically declines as a percentage of total production.

As Figure 4-12 indicates, the relative expansion of government employment occurs at the expense of the private labor force. Private employment declines from 80% to slightly more than 78% of the labor force. Unemployment (not shown) remains at 5% of the labor force in the new equilibrium condition. As Figure 4-12 shows, despite the fact that the private labor force has declined by

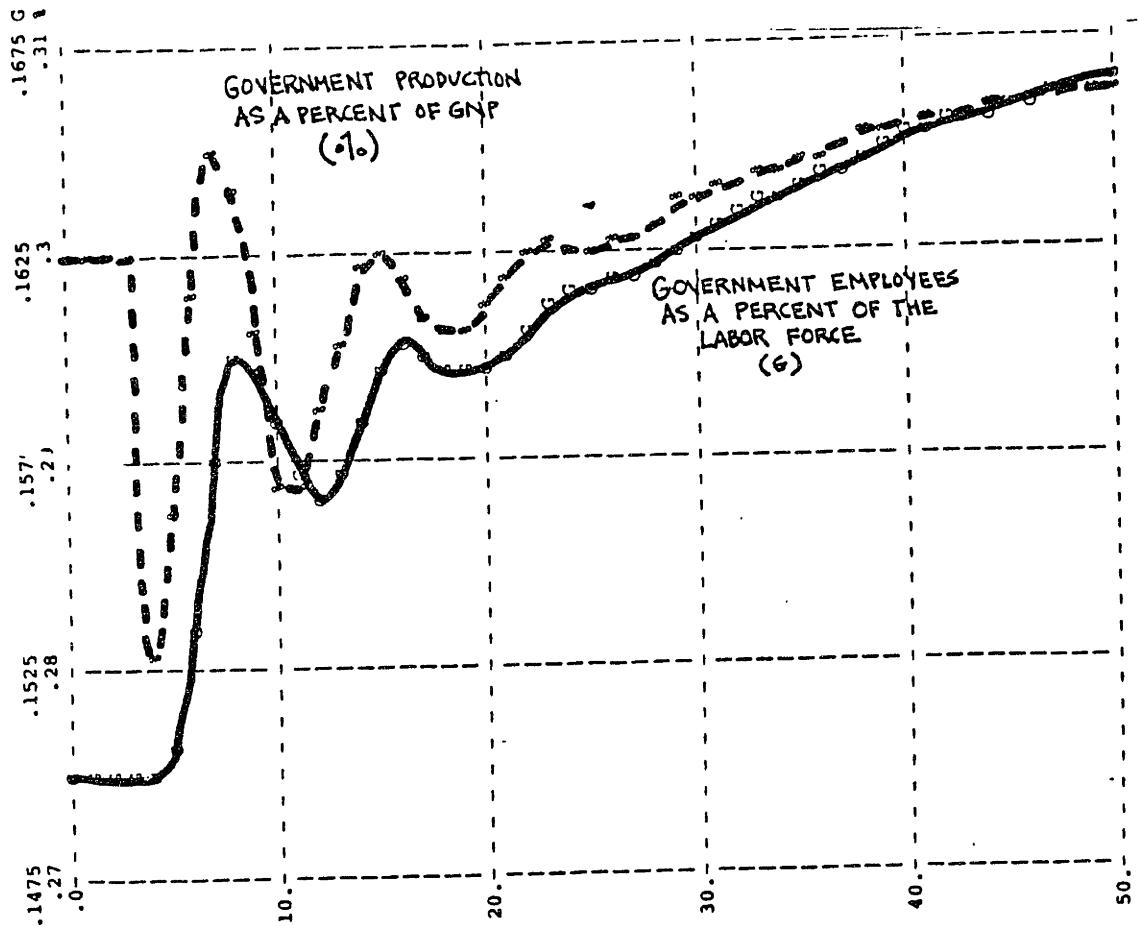


FIGURE 4-11. The Behavior of Government Employment as a Percent of the Labor Force and Government Production as a Percent of GNP, in Response to a Heightened Productivity of Differential.

nearly 2% in the new equilibrium condition, Private Production of Goods and Services Per Capita PPGSP has settled at a level roughly 7% higher than the reference equilibrium.

The steady-state increase in the material standard of living results from the salutary effect of the imposed advance in Technology T on the Productivity of Private Employees PPE. As a result of the

step-increase in T, PPE--measured in \$/worker/year--steps up from roughly \$20,000 to approximately \$24,000, and then declines to an equilibrium level very slightly below \$24,000. The decline in PPE is due to the slow, but steady rise in the level of government employees as a percent of the labor force which occurs over the simulation horizon. With a higher steady-state fraction of the labor force employed by government, the Effect of Government Regulation on Productivity EGRP exerts a more depressive influence on PPE than in the reference equilibrium.

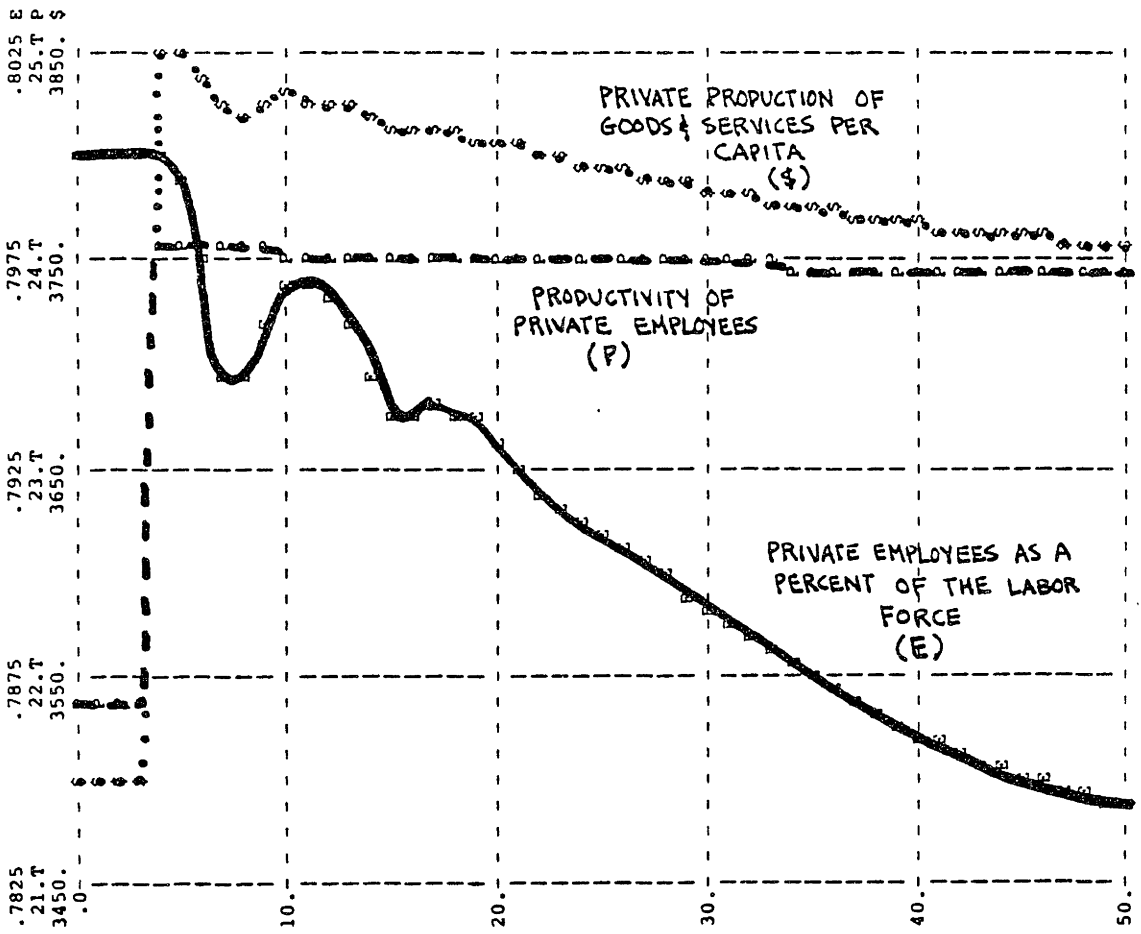


FIGURE 4-12. The Behavior of Private Employment, Private Productivity and Private Output in Response to the Imposed Increase in the Labor Productivity Differentials Between the Public and Private Sectors.

Figure 4-12 indicates that after an initial step-increase in Private Production of Goods and Services Per Capita PPGSP from \$3500 to \$3850, PPGSP declines asymptotically to a new equilibrium level of roughly \$3750. The slow decline in PPGSP results from the combined effects of a gradual movement of labor from the private to the public sector, and a concomitant decrease in the productivity of private sector employees (due to the increasingly depressive influence of Effect of Government Regulation on Productivity EGRP).

Government is able to draw employees away from the private sector because, as Figure 4-13 shows, its money adequacy remains elevated above the reference equilibrium level for the period during which relative expansion is taking place. Following the step-increase in Technology, government's money adequacy likewise steps up sharply because of the increase in tax revenues and revenues from the sale of securities, both of which are linked directly to the level of private output. Both Tax Revenues TAXREV and Sale of Government Securities SGS rise to new, higher equilibrium levels. Government Money Adequacy, however, is ultimately driven back down to its reference equilibrium level.

As Figure 4-14 indicates, TAXREV is able to settle at a higher-than-reference-equilibrium level because both Tax Base TB and Tax Rate TR have risen to higher-than-reference-equilibrium values. TB achieves a higher steady state level because both government and private production, the two components of GNP, are permanently expanded due to the exogenously-imposed higher level of worker productivity. Tax Rate is able to climb to an elevated equilibrium

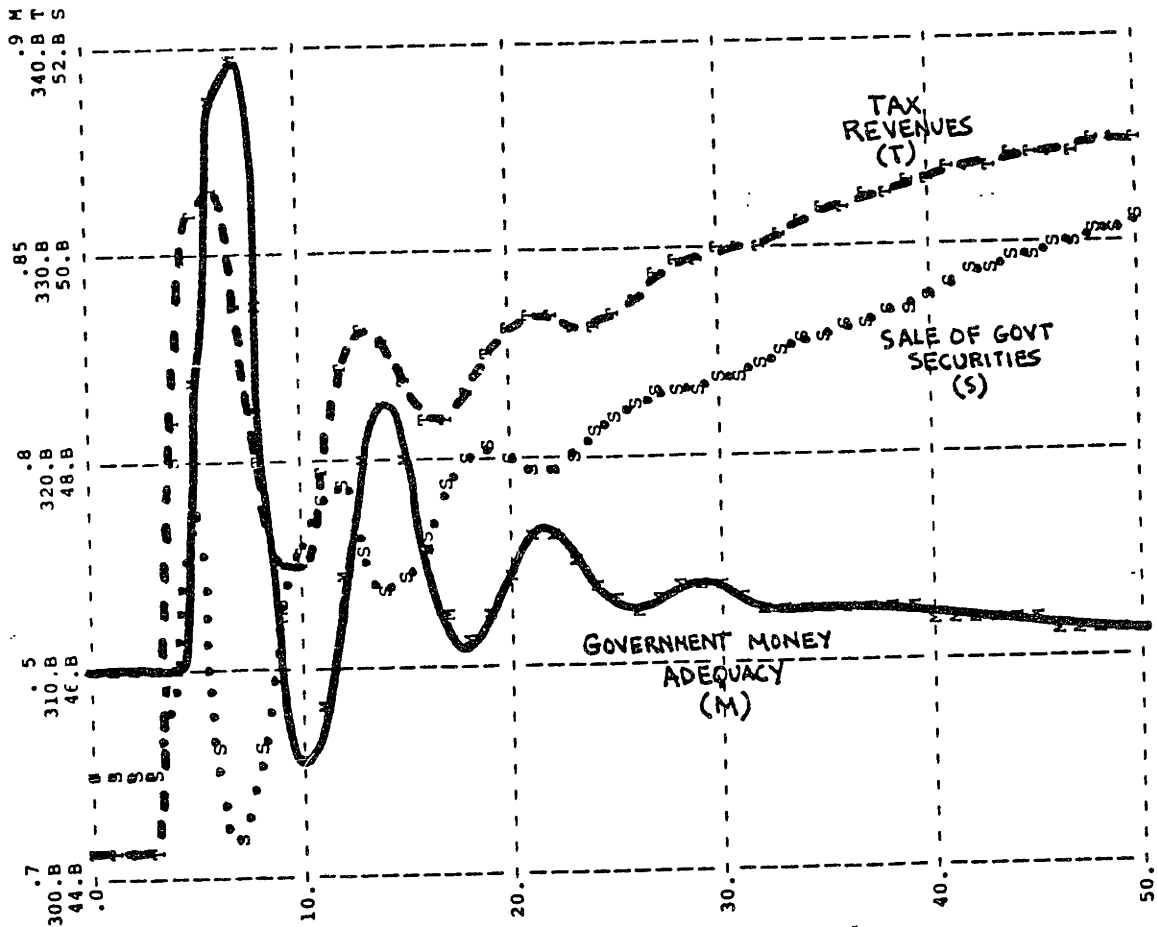


FIGURE 4-13. The Behavior of Government Money Adequacy, Tax Revenues and Sale of Government Securities in Response to the Imposed Increase in Productivity Differentials Between the Public and Private Sectors.

level because what the society considers to be an Acceptable Tax Rate ATR has risen. ATR is higher in the new equilibrium because, with an elevated material standard of living, public tolerance for tax burden increases.

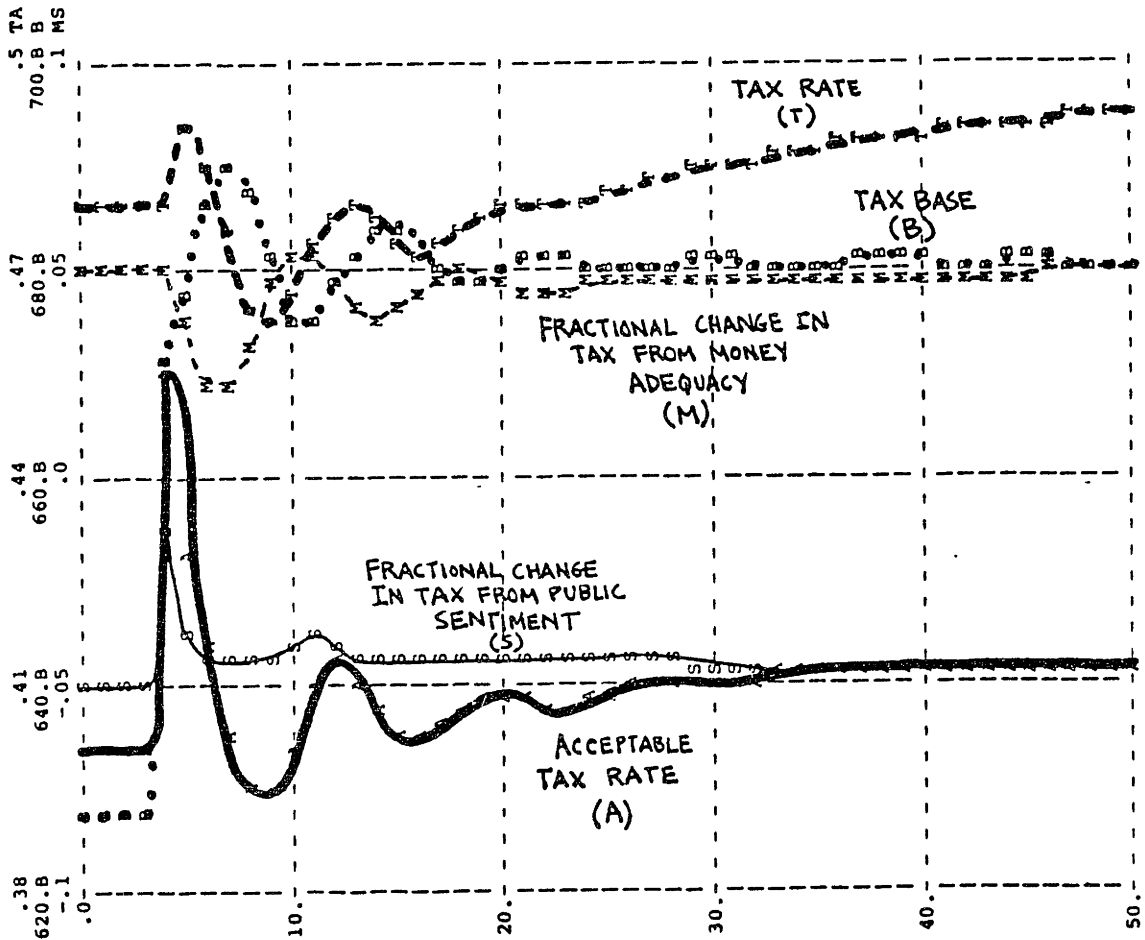


FIGURE 4-14. The Behavior of Tax Base, Tax Rate, Acceptable Tax Rate and the Fractional Changes in Tax from Money Adequacy and Public Sentiment in Response to an Increase in the Labor Productivity Differential Between the Public and Private Sectors.

Tax Rate TR rises over the simulation interval because, as Figure 4-14 shows, Fractional Change in Tax from Money Adequacy FCTMA dominates Fractional Change in Tax from Public Sentiment FCTPS over the interval. FCTPS is less negative than its reference equilibrium value for a fifty year interval following the step change in productivity because the ratio of TR to ATR remains smaller than in the reference condition. FCTMA is also slightly less positive than

its reference equilibrium value during the interval (because GMA is slightly above its reference equilibrium value). However, the upward pressure generated by FCTMA remains in excess of the downward pressure generated by FCTPS during the settling interval. And, as a consequence, TR rises. Ultimately, the two opposing pressures return to their exactly counterbalancing reference equilibrium levels, causing TR to settle.

Figure 4-15 tells an analogous story for Sale of Government Securities SGS. Following the advent of the step-increase in productivity, and the consequent step-rise in tax revenues, government's Debt Service to Tax Revenue Ratio DSTRR drops sharply. With a higher revenue inflow from taxes, government sees that it can tolerate a higher volume of debt service, and therefore Effect of Debt Service to Tax Revenue Ratio EDSTRR pushes up Desired Sale of Government Securities DSGS. In addition, government's improved money adequacy reduces government defaults, and thereby helps to relax the depressive influence of Effect of Market Response on Desired Sale EMRDS. This enables SGS to follow DSGS as the latter variable is pushed up by EDSTRR. Ultimately, as the growth of tax rate, and hence tax revenues, slows, DSTRR comes into line with Debt Service Tax Revenue Ratio Goal DSTRRG, thereby relieving the source of the upward pressure on DSGS. At the same time, EMRDS is beginning to decline because of government's declining money adequacy position which is, again, sensitizing the market by pushing up defaults. As a result, Desired Sale of Government Securities, and hence Sale of Government Securities, cease increasing, settling at new, higher equilibrium values.

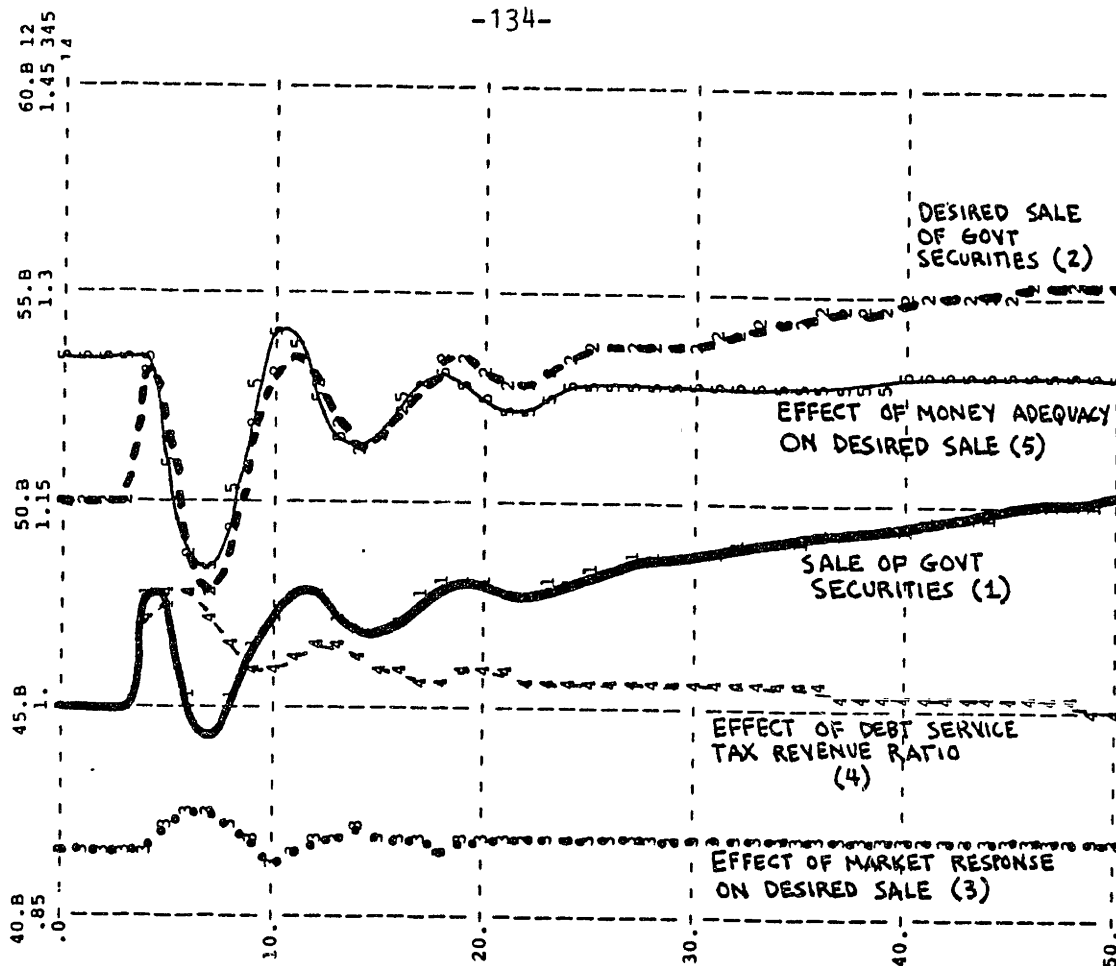


FIGURE 4-15. The Behavior of Government Debt Variables in Response to the Imposed Productivity Differential.

As Figure 4-16 shows, in the new equilibrium, both Per Capita Demand for Government Services PCDGS and Per Capita Demand for Government Transfers PCDGT settle at values roughly 15% higher than in the reference condition. Demand for government output rises over the simulation interval primarily because the supply of government output is being pushed up due to the infusion of new employees into government.*

* Recall that there really is no "demand" for government output, in the same sense as there is demand for private output. Rather, government supplies as high a level of output as it can, and the public then either accomodates, or does not accomodate, to this level.

Government is seen to be paying out a higher dollar volume of Transfer Payments TP in the new equilibrium; this, despite the fact that unemployment remains at reference equilibrium levels. The increase in the steady-state level of TP results from the fact that transfer payment compensation is tied to the material standard of living (i.e., Private Production of Goods and Services Per capita PPGSP), which has risen to a higher steady state level. As Figure 4-16 also indicates, Per Capita Demand for Private Output PCDO also settles at a level higher (by some 7%) than that achieved in the reference equilibrium.

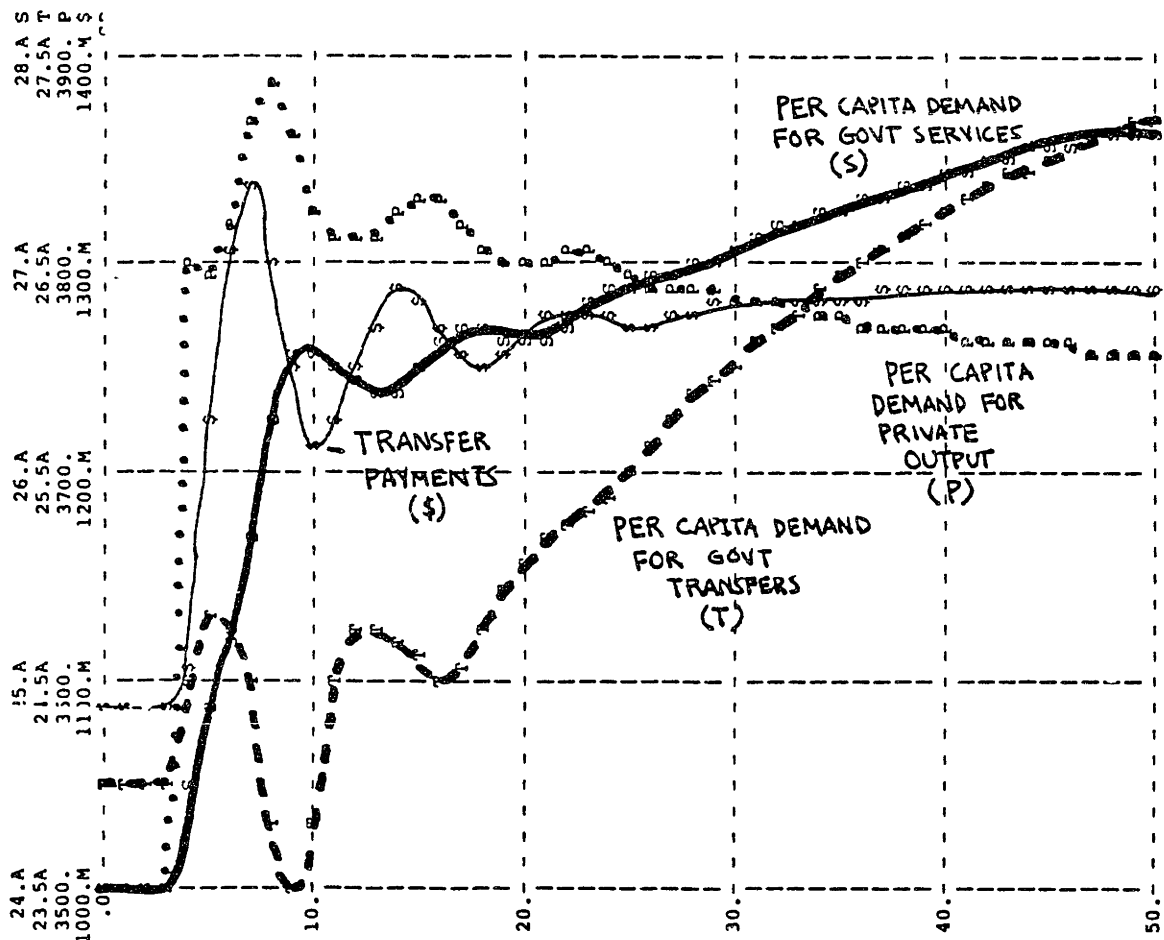


FIGURE 4-16. The Behavior of Demand for Private and Public Output and Transfer Payments in Response to the Increase in Labor Productivity Differentials between the Two Sectors.

As the simulation runs clearly indicate, the society is better off in terms of both material output and government services following imposition of a technological advance which increases the productivity differential between the private and public sector of the economy. In the new equilibrium that is achieved, government accounts for a relatively larger share of the total productive output of the economy than in the reference condition. In addition, government possesses a relatively larger fraction of the available labor force than it did in the original equilibrium. Hence, Baumol's unbalanced productivity hypothesis is tenable as a partial explanation of why a relative expansion of the public sector might occur.

4.4 THEORY 4: DEMOGRAPHIC CHANGES CAUSE GOVERNMENT GROWTH.

A number of authors have mentioned demographic changes in connection with government growth, [6] [7] [8]. However, no formal theory of demographic change as a cause of government growth has been advanced.

There are principally two demographic changes that are frequently mentioned in connection with the level of government activity. The first is an increase in the fraction of school-aged children. An example of such an increase is the post-World War II baby boom. When the fraction of school-aged children rises, primary and secondary educational services must be expanded. An important portion of the educational burden has traditionally fallen upon government. The second demographic change cited in connection with government's stature is an increase in the fraction of elderly in the

population. An elderly population is more likely to utilize many of the services provided by government, and to demand expansion of these services. For example, the so-called "gray power" lobby is generally regarded as being primarily responsible for substantially expanding the benefits and coverage of the social security system.

4.4.1 Implementing Demographic Changes Into the Model.

In order to implement the two demographic changes of interest--i.e., an increase in the fraction of elderly and children in the population--into the model, Time to Implement Experiment 4 TIE4 (equation 183.6) and Time to Implement Experiment 5 TIE5 (equation 184.2) are set equal to 4 (the year in which all tests are switched on).

When TIE4 is set equal to 4, the Fraction of Elderly FE in the population is instantaneously increased from .2 to .4 (equation 100). FE then remains at this higher value for the duration of the simulation. FE exerts two impacts in the model. First, FE is assumed to be positively related to Per Capita Demand for Government Services PCDGS. When FE is doubled, PCDGS, other things equal, increases two-fold (equations 122 and 126). Second, FE is assumed to be positively related to Per Capita Demand for Government Transfers PCDGT. When FE is doubled, PCDGT is likewise doubled (equations 128 and 130).

When TIE5 is set equal to 4, the Fraction of Children FC in the population instantaneously increases from .3 to .4 (equation 101). FC then remains at this elevated level for the duration of the

simulation. FC has one impact in the model. It is assumed to be positively related to PCDGS. When FC is increased by 33% PCDGS similarly rises by 33% (equations 122 and 125).

The two demographic changes are implemented into the model one at a time, in order to isolate the influence of each change.

4.4.2 Theory 4: Simulation Results.

Figures 4-17 and 4-18 show the response of government employment and production to a permanent doubling of the Fraction of Elderly FE and a permanent 33% increase in the Fraction of Children FC, respectively. Both Figures reveal that a relative expansion of government employment and production occurs after implementation of the respective demographic change.

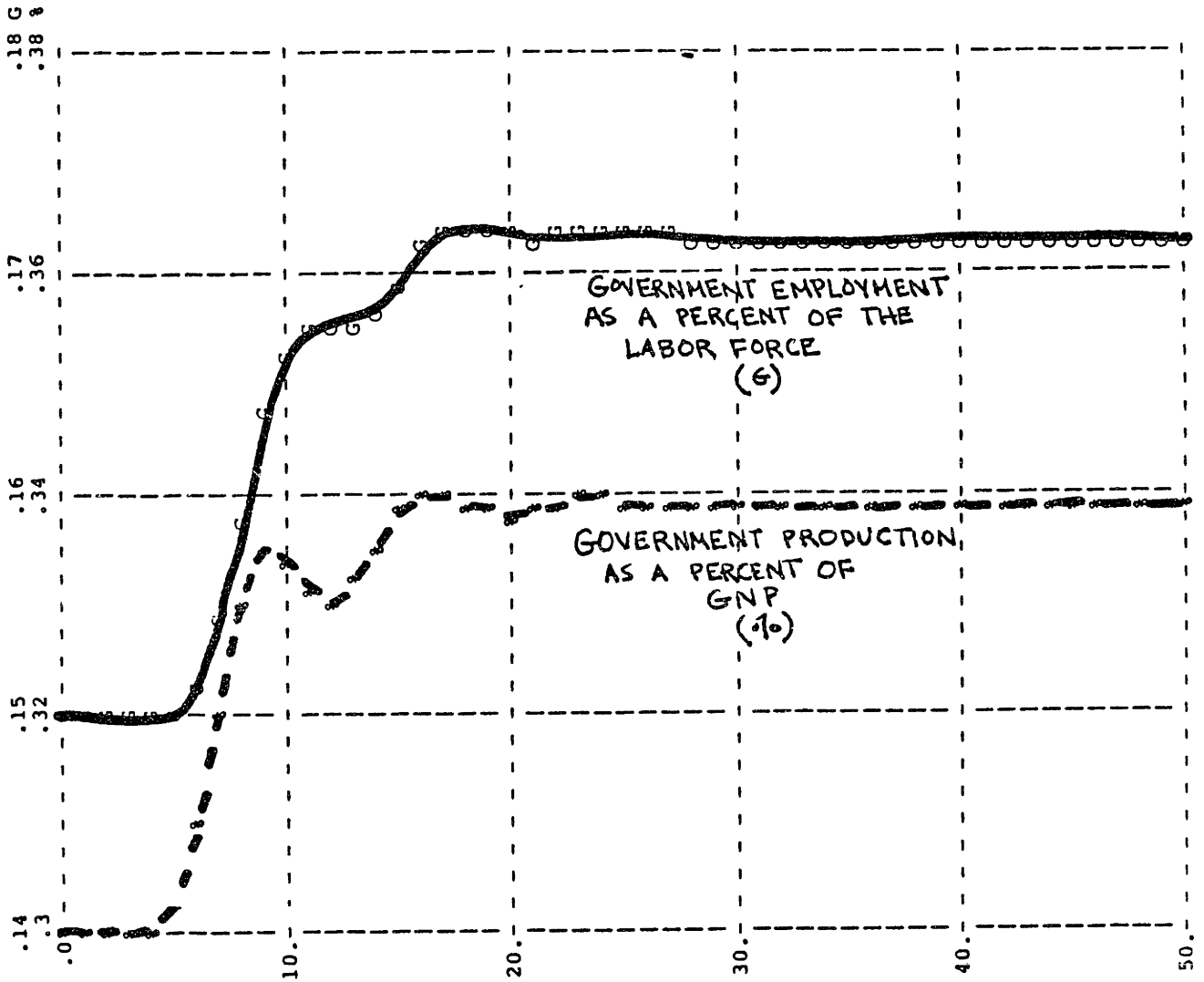


FIGURE 4-17. The Response of Government Employment and Production to a Doubling of the Fraction of Elderly in the Population.

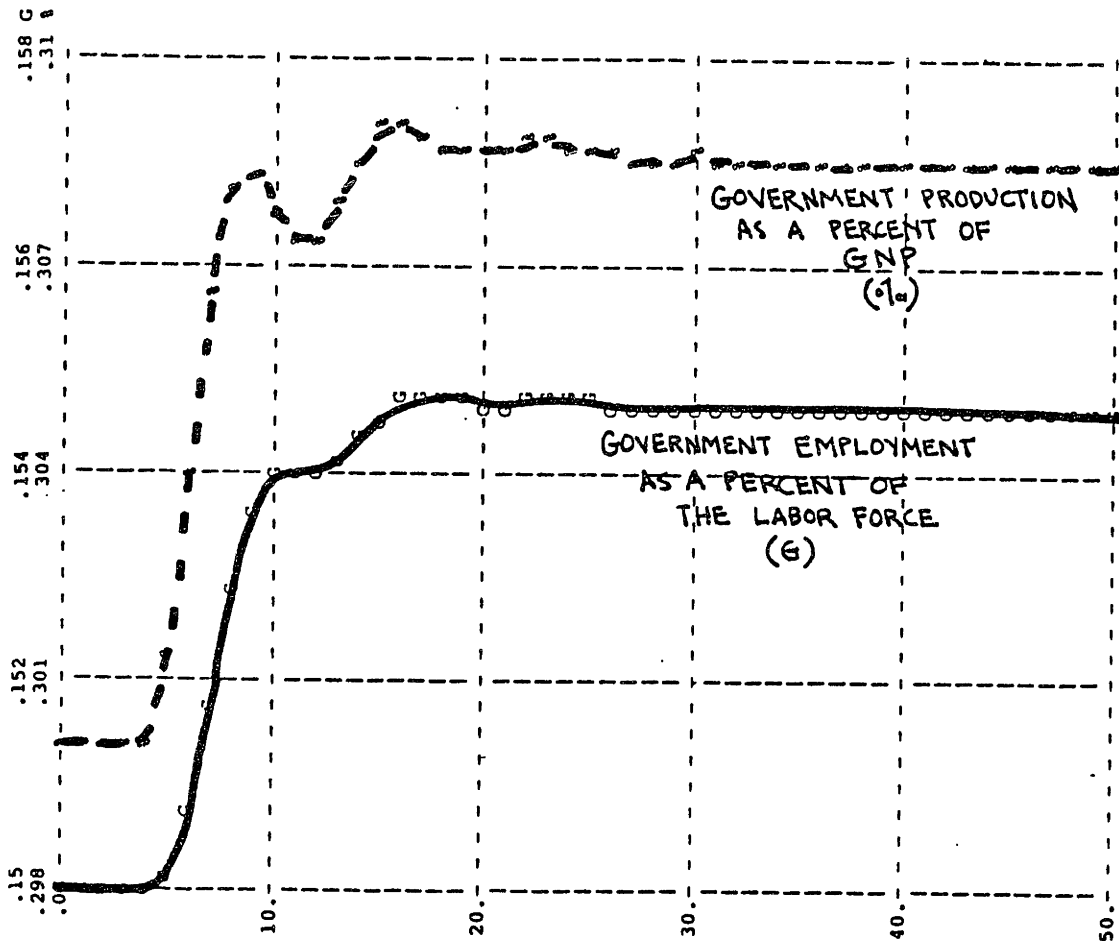


FIGURE 4-18. The Response of Government Employment and Production to a 33% Increase in the Fraction of Children in the Population.

The increase in the relative size of government in both instances occurs because society's preferences for public, relative to private, output have been altered by the exogenously-imposed demographic change. Figures 4-19 and 4-20 chart the changes in societal preferences that occur in each case.

As Figure 4-19 indicates, a permanent doubling of the Fraction of Elderly FE causes Per Capita Demand for Government

Services PCDGS to rise and settle at an equilibrium level about twice that achieved in the reference equilibrium. Per Capita Demand for Government Transfers PCDGT similarly rises to a higher steady state level, though less high in percentage increase terms, than PCDGS. Per Capita Demand for Private Output PCDPO, on the other hand, recedes to a slightly lower (less than 1%) equilibrium level. The older population has, then, traded off a small amount of material output in return for a small increase in public output.

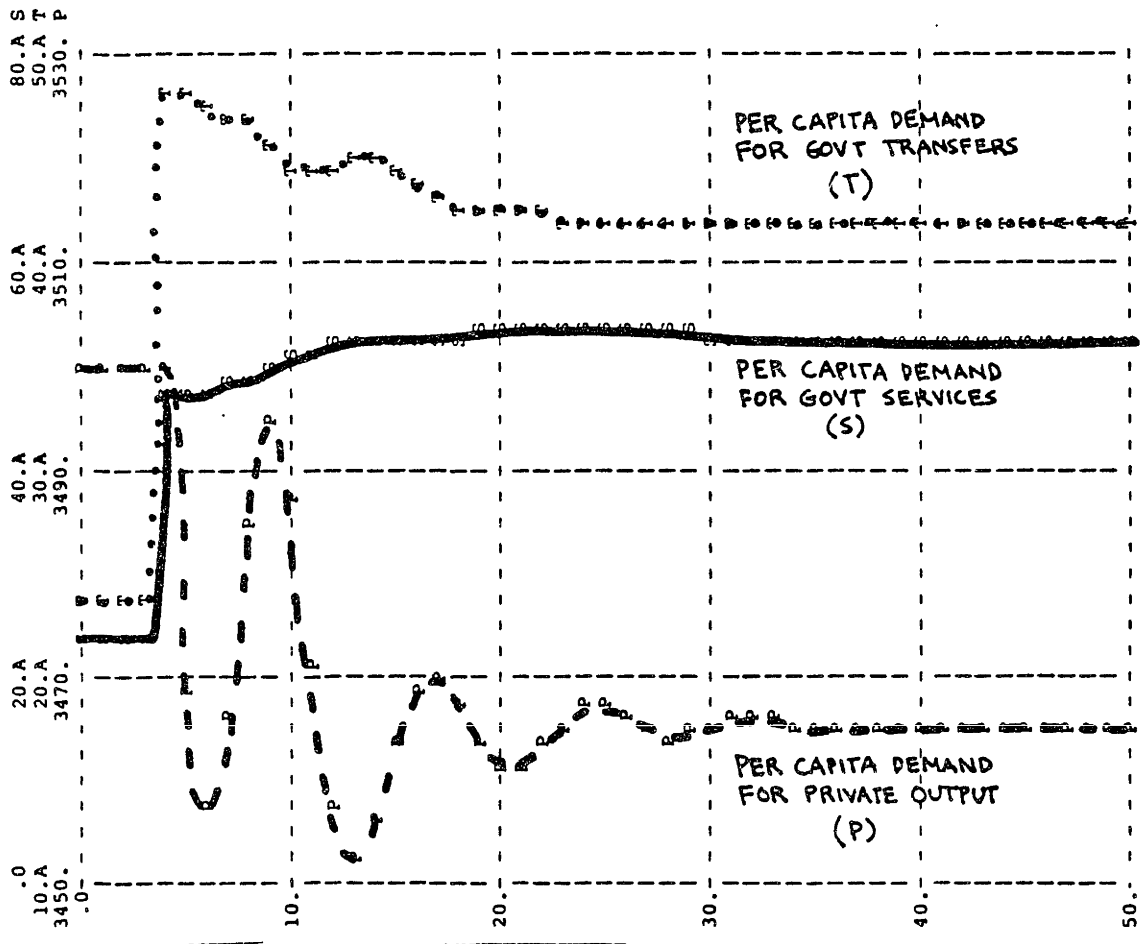


FIGURE 4-19. The Behavior of Societal Preferences for Private and Public Output in Response to a Doubling of the Fraction of Elderly in the Population.

Figure 4-20 tells a similar story. A 33% increase in the Fraction of Children FC cause PCDGS to rise and settle at a level roughly 33% higher than its reference equilibrium level. Per Capita Demand for Government Transfers PCDGT posts a small decline following the relative increase in the size of the childhood population. The decline in Per Capita Demand for Government Transfers PCDGT results from a shift of government employees out of transfer payment production and into service production; a shift that is needed in order to respond to the stepped-up demand for government services. With relatively fewer employees in transfer payment production, relatively less transfer payment output is supplied and hence relatively less transfer payment output is "demanded." Here too, as with the change in fraction of elderly, Per Capita Demand for Private Output PCDPO declines to a slightly lower steady state level. Thus, the society is again willing to give up a bit of material output in exchange for a slightly higher level of public output.

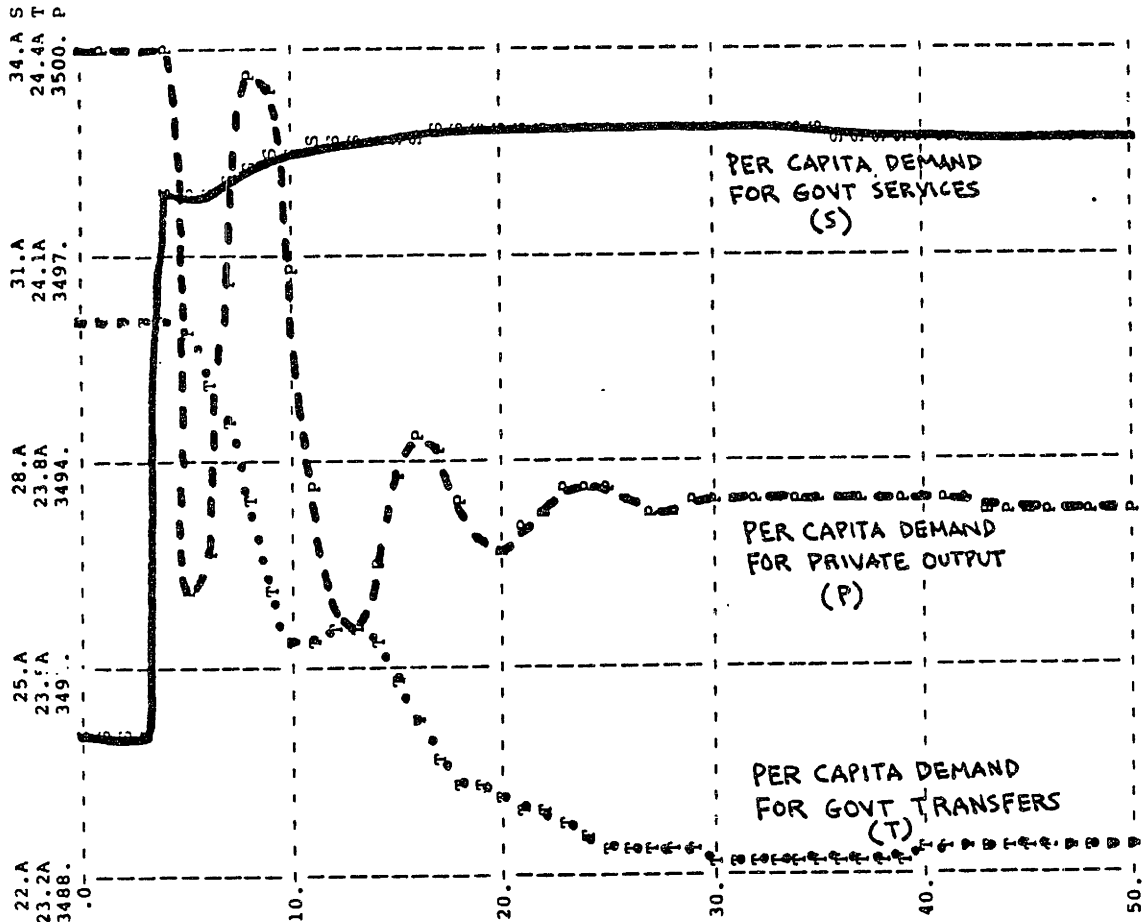


FIGURE 4-20. The Response of Societal Preferences for Private and Public Output to a 33% Increase in the Fraction of Children in the Population.

The shift in societal preferences revealed in Figures 4-19 and 4-20, makes itself felt through the model variable called Service Ratio SR. SR is the ratio of the level of government output currently being supplied to the level that is being demanded by the society. As Figure 4-21 indicates, the behavior of SR in response to both demographic changes is qualitatively similar. In each case, SR declines sharply following implementation of the test input and then rebounds, asymptotically approaching a lower equilibrium value.

The sharp drop in Service Ratio SR, is in both instances, due to the step-increase in the denominator terms of the ratio (i.e., Per Capita Demand for Government Transfers PCDGT and Per Capita Demand for Government Services PCDGS). The recovery of SR, in both cases, is caused by the increase in the output of government services and transfers which occurs as a consequence of the pressures generated by the initial drop in SR. When SR declines, public tolerance for government's tax burden increases. As a result, Acceptable Tax Rate ATR, and with some delay Tax Rate TR, rises.

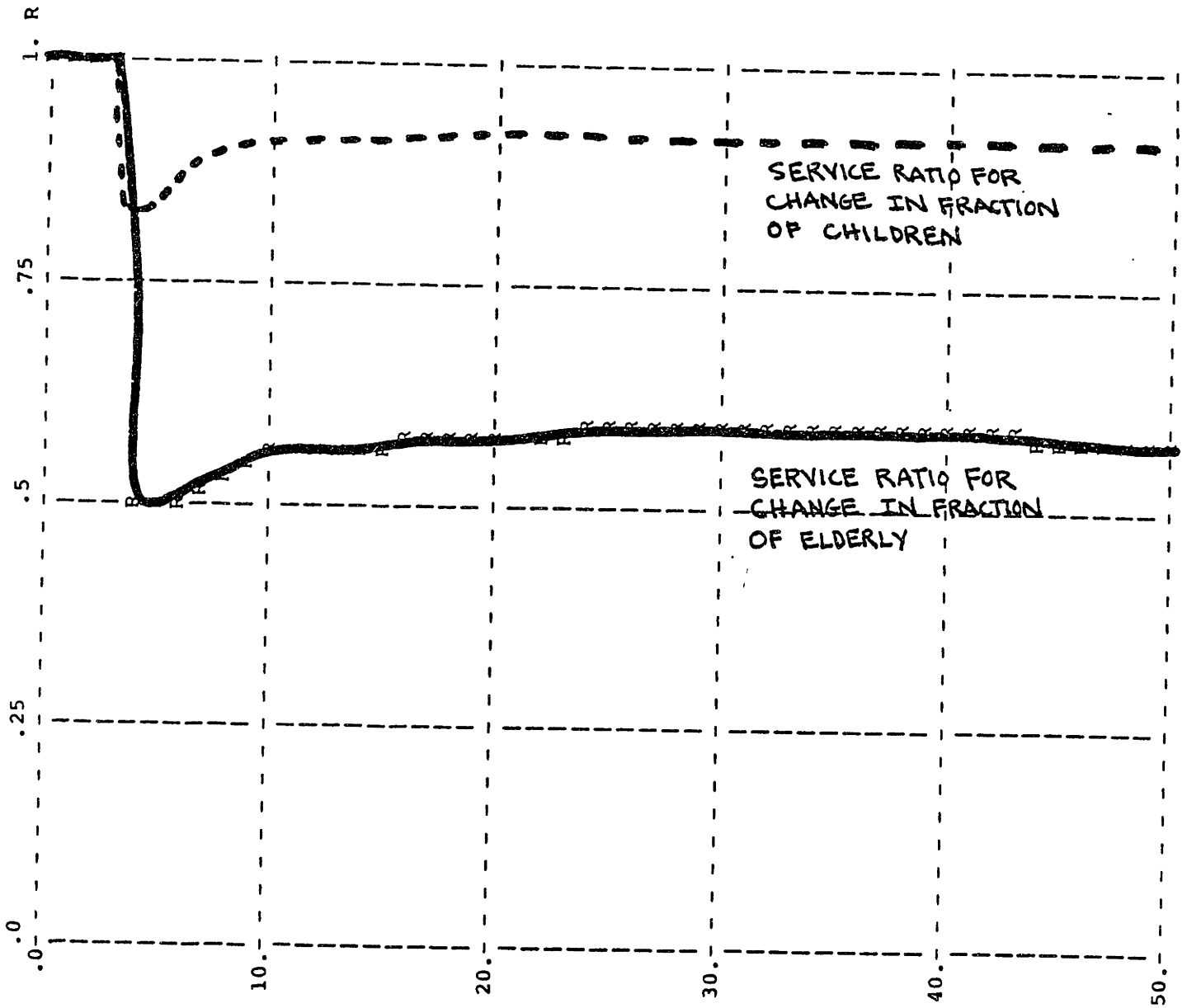


FIGURE 4-21. The Response of Service Ratio to Changes in the Fraction of Children and Elderly.

Figure 4-22 illustrates the relationships involved for the case in which the Fraction of Elderly FE is doubled. The behavior of corresponding model variables, for the case in which the Fraction of Children FC is increased, is qualitatively identical.

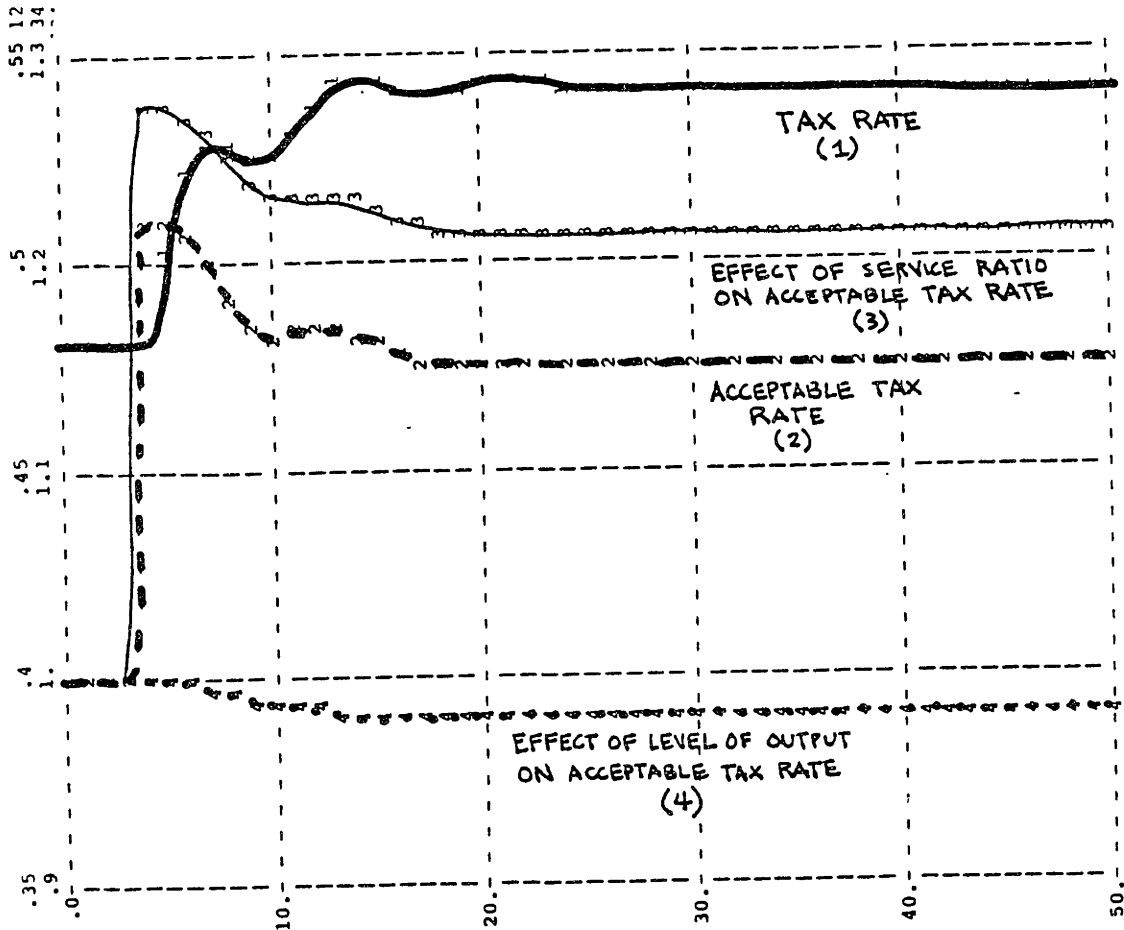


FIGURE 4-22. The Response of Taxation Variables to a Doubling of the Fraction of Elderly in the Population.

As Figure 4-22 indicates, Acceptable Tax Rate ATR steps-up following the demographic change because of the step-increase in upward pressure from the Effect of Service Ratio on Acceptable Tax Rate ESRATR; a pressure which results from the step-drop in SR. The step-increase in ATR relative to TR relaxes the downward pressure being exerted on TR from Fractional Change in Tax from Public

Sentiment FCTPS. This, in turn, allows the upward pressure generated by Fractional Change in Tax from Money Adequacy FCTMA to push TR up.

With higher TR, Tax Revenues TAXREV, and hence Government Money Adequacy GMA, is increased. With more money at its disposal, government can afford to acquire the labor and expand the services and transfers that the now older population is demanding. The expansion of output, in turn, causes SR to begin to recover, thereby progressively defusing the upward pressure on ATR being exerted by ESRATR. At the same time, because government has had to acquire the labor needed to expand its output from the private sector, private output declines. In addition, the fact that there are now more government employees relative to the total labor force means that the productivity of private employees is further depressed through the Effect of Government Regulation on Productivity EGRP. Lower productivity further compounds the depression of private output. Reduced private output, in turn, exerts a depressive influence on ATR through the Effect of Level of Output on Acceptable Tax Rate ELOATR.

An increasingly depressive ELOATR, and a decreasingly stimulative ESRATR, combine to cause Acceptable Tax Rate ATR to decline. A falling ATR and a rising TR ultimately cause Fractional Change in Tax from Public Sentiment FCTPS to rise high enough to, once again, counterbalance the upward pressure on Tax Rate TR from government's depressed money adequacy condition. As a result, TR ceases rising, settling at a new, higher equilibrium level.

Figure 4-23 shows the influence of Service Ratio SR on the Sale of Government Securities SGS, government's second means of

financing its expansion of output and employment. Again, only the variables for the test in which the Fraction of Elderly FE is increased are charted because the corresponding variables for the increase in Fraction of Children FC test are qualitatively similar.

As the Figure indicates, following implementation of the step-increase in the elderly population--and the consequent step-drop in Service Ratio SR--Market Response from Service Ratio MRSR steps up abruptly. The increase in MRSR, in combination with an improvement in government's default performance (due to rise in GMA), effectively neutralizes the Effect of Market Response on Desired Sale EMRDS. With no resistance from the market, government is able to sell as large a volume of securities as it desires. And, the combination of upward pressures exerted by Effect of Money Adequacy on Desired Sale EMADS and Effect of Debt Service to Tax Revenue Ratio EDSTRR causes Desired Sale of Government Securities DSGS to post a steady rise during the 40 years following implementation of the demographic change.

As government's Sale of Government Securities SCS continues to rise, however, its Debt Service to Tax Revenue Ratio DSTRR also continues to climb. As DSTRR continues to rise above what government considers to be a reasonable ratio, it exerts an increasingly depressive influence on DSGS, thereby slowing the increase of SGS. Ultimately, this influence becomes strong enough to limit any further expansion of DSGS, bringing SGS into balance at a new, higher level.

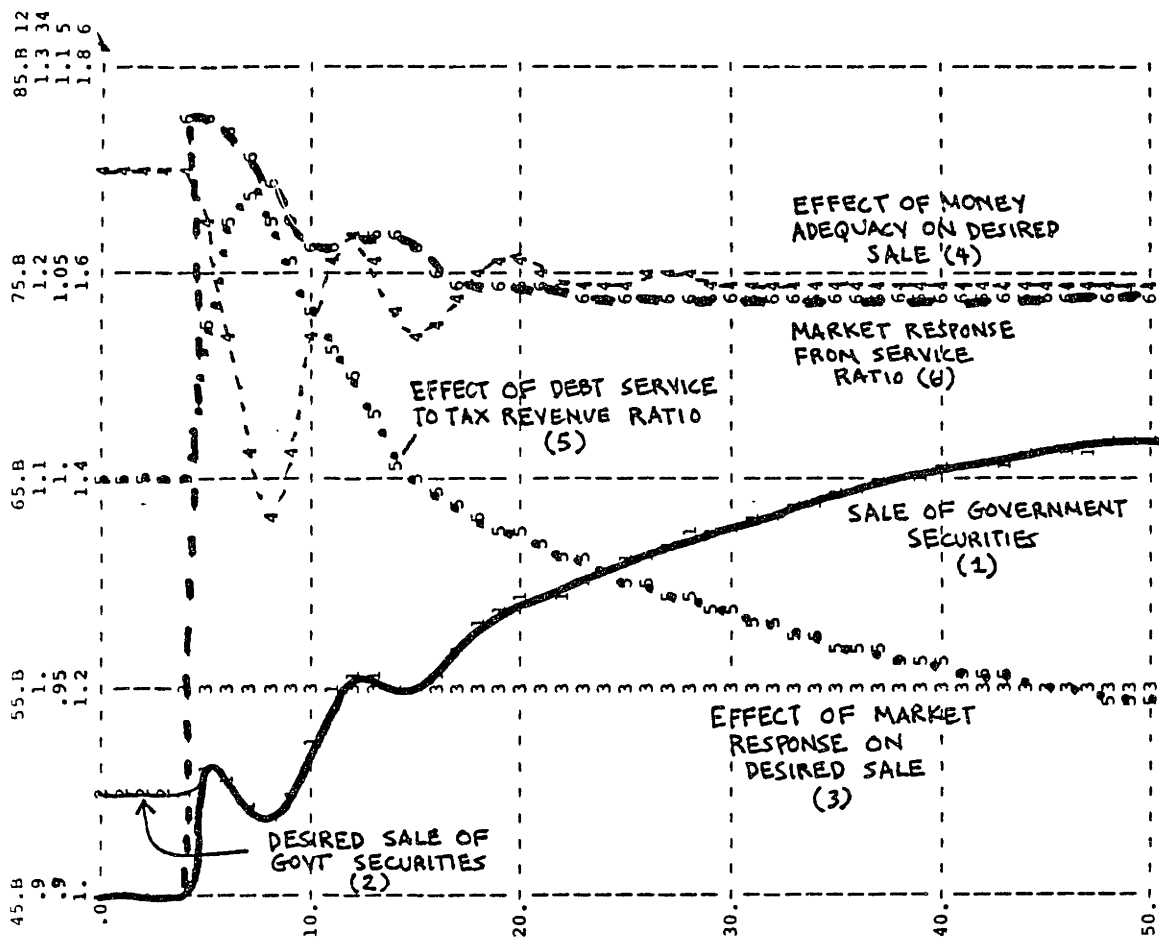


FIGURE 4-23. The Response of Government Debt Variables to a Doubling of the Fraction of Elderly in the Population.

Thus, demographic changes can produce a permanent change in the relative stature of government employment and production. An increase in the fraction of elderly and/or children in the population causes societal preferences for public output to increase relative to preferences for private output. The change in relative preferences

provides government with some additional "growing room." Government soon eclipses this room by using its newly acquired monies to absorb additional employees and expand production of services and transfers. Once again, however, the process of expansion, itself, generates counterpressures which ultimately make any further growth impossible. Thus, government again strikes a productive and employment balance with the private sector of the economy.

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CHAPTER 5

IMPLICATIONS AND NEXT STEPS

This Chapter draws the simulation results presented in Chapters 3 and 4 into a concluding focus by examining the implications of these results for the future growth of government in the American socioeconomy. It then goes on to suggest ways in which the present model should be extended in order to better address the question of government growth and the design of policies to moderate this growth in the desired manner.

5.1 IMPLICATIONS: The Prospects for Continued Relative Expansion

The simulation results presented in Chapter 3 suggest that the driving force behind the relative expansion of government is an inherent desire on the part of management personnel within government to increase the size and scope of the organizations that they manage. Simulations showed further, however, that such empire-building urges could not continue to run free forever. Government's ability to continue to absorb employees from the private sector, and to continue to expand spending programs was seen to ultimately be limited by society's tolerance for government's tax and debt burdens. Simulations presented in Chapter 4 indicated that society's tolerance for these burdens, and hence the relative stature achievable by government, could be permanently altered by technological advance and shifts in the age distribution of the population.

What, then, do the results presented in Chapters 3 and 4 portend for the future course of government expansion in the American socioeconomy? Before a limited answer to such a question can be put forth, it is necessary to look briefly at past and recent trends in the factors shown to be relevant determinants of the course of government expansion.

Recent work by Kaufman [1] suggests that the empire-building urges of government management personnel, theorized to be the driving force behind government expansion, have remained alive and well from 1789 to at least 1973. Kaufman's data, summarized in Figure 5-1, reflects what he calls the "staying power" of government organizations. Kaufman hypothesizes that this "staying power" is the result of efforts by survival-oriented government managers to keep their ships afloat.

To Kaufman's evidence, is added the fact that the advance of technology, which manifests in productivity growth, has continued in the American socioeconomy since such data were first recorded until at least the early '70's.

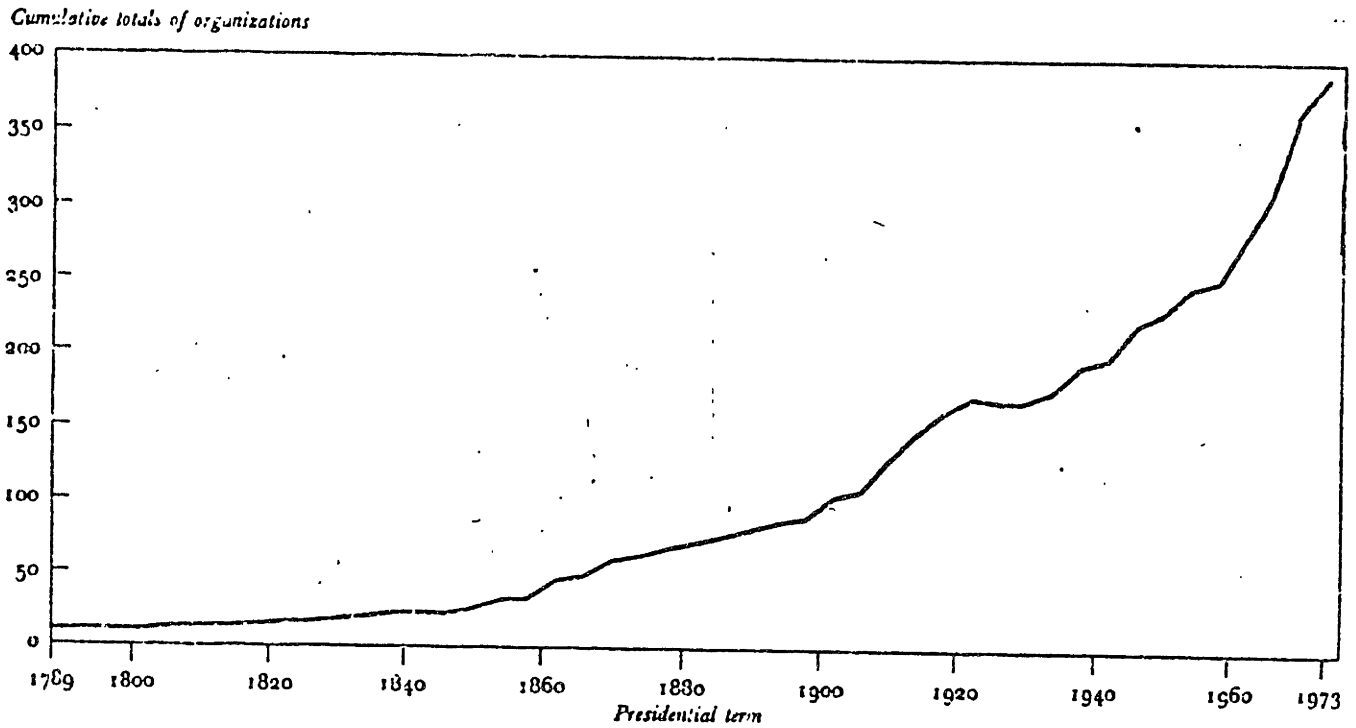


FIGURE 5-1. Cumulative Totals of Federal Government Organizations That Survived to 1973, by Presidential Term. Source: [1, p. 63]

One result of this steady technological advance has been a continuous shift of labor from the relatively more mechanized industries to the relatively less mechanized industries of the American economy; a shift predicted by Baumol's differential productivity hypothesis [2] discussed in Chapter 4. Figure 5-2 reveals this shift by charting the course of the relative size of the workforce employed in Agriculture, Goods and Service production in the American economy between 1920 and 1975.

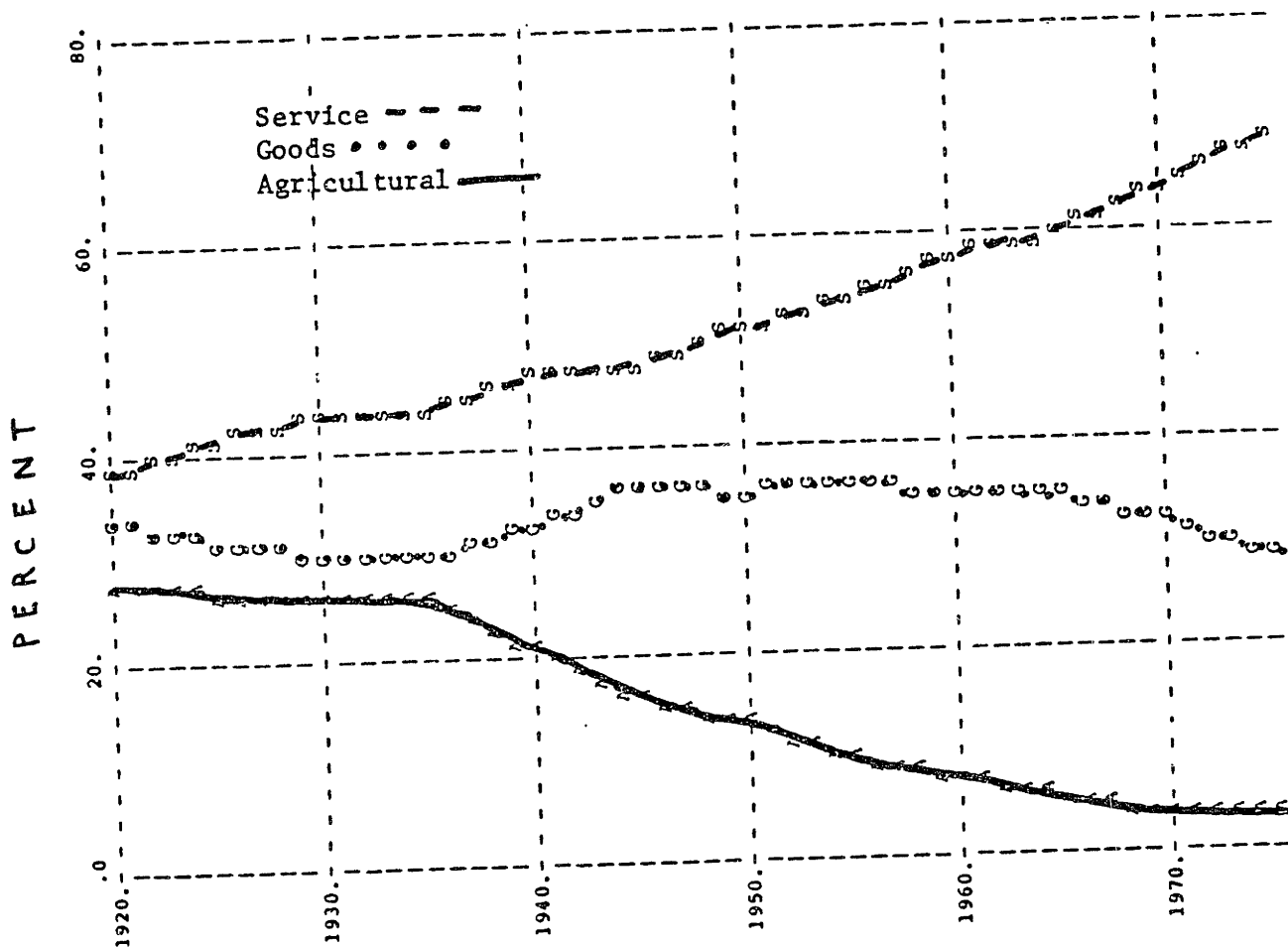


FIGURE 5-2. Farm, Goods and Service Employees as a Fraction of the Labor Force, 1920-1975.

Source: Employment and Earnings, United States, 1909-1975, Department of Labor, Bureau of Labor Statistics.

A second result of the steady advance in worker productivity has been an equally steady growth in real income. When incomes are rising, according to the model, public tolerance for government's tax and debt burdens likewise increases. As real income growth slows, or declines, public tolerance for these burdens is correspondingly reduced. Figure 5-3 charts the growth of real per capita income (or output) in the U.S. economy between 1870 and 1978. The Figure

indicates that real per capita income has been increasing since 1870. The rate of increase accelerated sharply following the depression of the 30's. And, in recent years, the rate of growth shows some sign of slowing.

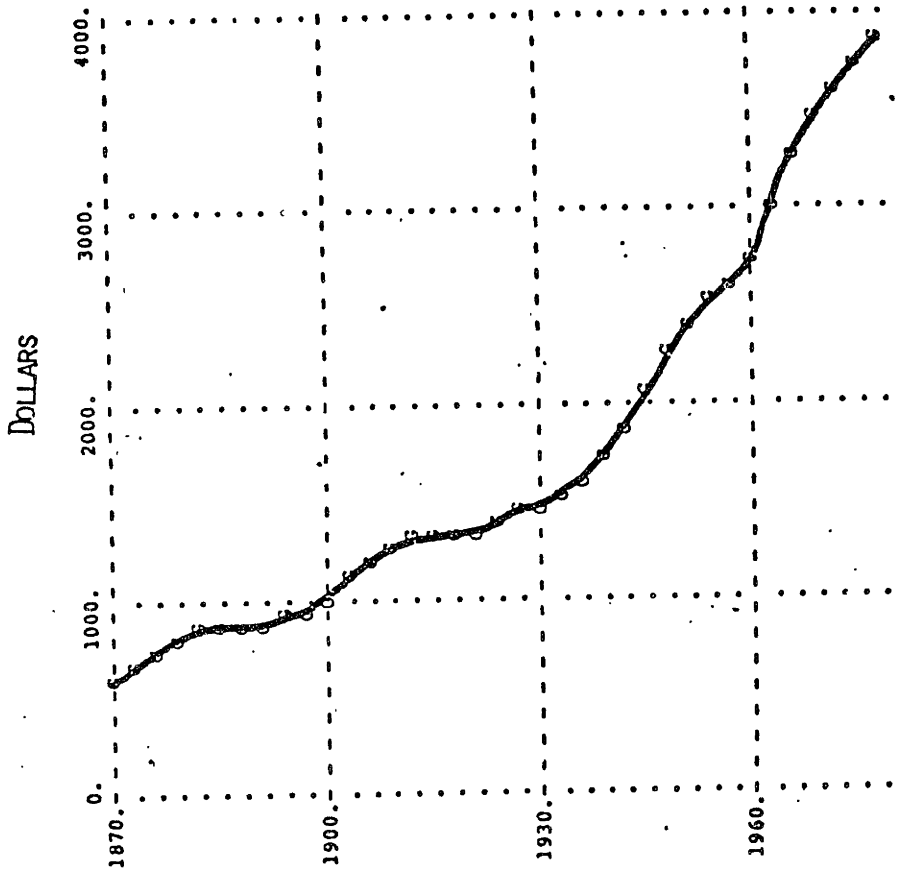


FIGURE 5-3. Real Per Capita GNP, 1870-1978.

Source: Historical Statistics of the U.S., p. 224.
Statistical Abstract, 1975, p. 429 and p. 5.
Survey of Current Business, January 1979, p. S-1.

Recent data presented by Denison [3] indicate that, within the last five years, productivity growth for the American workforce, as a whole, has indeed slackened substantially. As such, extrapolating a continuation of past trends in productivity and real income growth -- and hence a continued shift of workers into the

service sector--is open to some question.

The demographic data is less equivocal. As Figure 5-4 indicates, the median age of the American population has been steadily increasing, except for one interval, since 1800. The single interval during which the median age declined was the post World War II "baby boom" era. Thus, during the decade spanning from the late 50's to the late 60's the demand for government output was likely swollen both by a surge of younger Americans requiring educational services and a steadily growing contingent of elderly seeking expanded public services and income transfers. Following passage of the baby boom bubble through the population, the median age of the American population has resumed its century-and-a-half trend of increase.

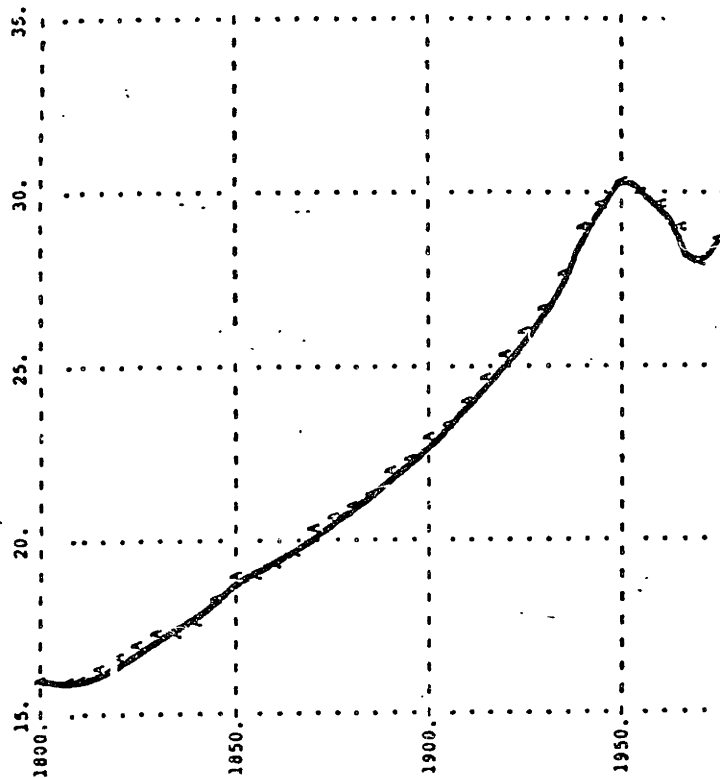


FIGURE 5-4. Median Age of the Population.

Source: Historical Statistics of the U.S., p. 19.
Statistical Abstract, 1976, p. 6.

Taken together, then, in light of the model employed in this analysis, the data paint a somewhat ambiguous picture of the future course of government expansion in the American socioeconomy.

The basic driving force underlying government expansion, i.e., empire-building urges, seems certain to continue as long as the U.S. continues to function as an institutional economy.

However, technological advance has slowed of late in the U.S. economy. And, with the combination of rising energy costs (favoring the return to a more labor-intensive production process), and a slowing of population growth (curtailing expansion of the labor force), it seems likely that government will encounter an employee availability constraint in the not-too-distant future. In addition, the slowing of growth in real income may also introduce a financial constraint to further government expansion by reducing the public's tolerance for government's tax and debt burdens.

Finally, demographically, the U.S. population is growing older; seemingly favoring an increase in the preference for public, relative to private, output. However, with fewer children, there will be less demand for public education; one of government's principal outputs at the state and local level.

All told, then, no clear prognosis about the future course of government expansion emerges from an examination of the limited array of considerations suggested by the model. And, as the universe of considerations is extended, the picture becomes even murkier.

5.2 EXTENDING THE MODEL

Two of the assumptions incorporated into the model substantially restrict its usefulness as a vehicle for assessing the future course of government expansion. The first is that the model functions only in a "real" mode. The second is that the economy always remains "mixed". The second assumption is the more restrictive of the two.

By restricting the model to a "real" mode of operation, money creation and inflation are eliminated as governmental financing options. This means that, in the model, government is always held directly accountable by the public for the financial resources that it absorbs in order to underwrite its expansion. Given the directness of the feedback characteristic of the "real" mode, government expansion is tightly controlled.

When government can create money, however, the directness of the growth-control is sharply reduced. For example, when the Treasury borrows money from the Federal Reserve, no constituency is forced to forego consumption. Similarly, when inflation plops wage-earners into higher marginal tax brackets, no Congressman has gone on record as favoring a tax increase; nor is any particular interest group slighted. Thus, as soon as a money supply is introduced into the economic system, the restrictions on government growth become considerably less stringent than those portrayed in the model.

The second assumption, that the economy remains "mixed", understates government's true growth potential in an even more

fundamental way. In reality, unlike the model, there is nothing that inherently prevents government from entering the business of producing material output. As the example set by Great Britain indicates, government is certainly capable of taking control of the productive apparatus of entire segments of the private economy. The reasons for, and mechanisms by which, such a takeover comes to pass, however, are not well understood. And, the model sheds no light on the subject.

Among those devoting scholarly attention to the questions of a shift toward a more collective economy, the analyses of J. A. Schumpeter [4] and Daniel Bell [5] [6] are the most insightful.

Schumpeter sees socialism and capitalism not as two distinct socioeconomic forms, but rather as temporally separated positions on a socioeconomy's life-cycle trajectory. According to Schumpeter, the very success of capitalism creates the pressures that ultimately lead to socialism. In particular, Schumpeter focuses on the dissolution of two standard bearers of the capitalist order: the entrepreneur and the family.

On the fate of the entrepreneur, Schumpeter argues:

"... Rising capitalism produced not only the mental attitude of modern science...but also the men and the means. By breaking up the feudal environment and disturbing the intellectual peace of manor and village, but especially by creating the social space for a new class (the entrepreneur) that stood upon individual achievement in the economic field, it in turn attracted to that field the strong wills and the strong intellects...The function of entrepreneurs is to reform or revolutionize the pattern of production by exploiting an invention or, more generally, an untried technological possibility for producing a new commodity or producing an old one in a new

way, by opening up a new source of supply of materials or a new outlet for products, by reorganizing an industry and so on...To undertake such new things is difficult and constitutes a distinct economic function...This function is already losing importance and is bound to lose it at an accelerating rate in the future...For, on the one hand, it is much easier now than it has been in the past to do things that lie outside familiar routine - innovation itself is being reduced to routine. Technological progress is increasingly becoming the business of teams of trained specialists who turn out what is required and make it work in predictable ways. The romance of earlier commercial adventure is rapidly wearing away, because so many more things can be strictly calculated than had of old to be visualized in a flash of genius...If capitalist evolution - 'progress' - either ceases or becomes completely automatic, the economic basis of the industrial bourgeoisie will be reduced eventually to wages such as are paid for current administrative work ... Since capitalist enterprise, by its very achievements, tends to automatize progress, we conclude that it tends to make itself superfluous ... the perfectly bureaucratized giant industrial unit not only ousts the small or medium size firm and 'expropriates' its owners, but in the end it also ousts the entrepreneur and expropriates the bourgeoisie as a class which in the process stands to lose not only its income, but also what is infinitely more important, its function." [4, p. 132-34]

The automatized and depersonalized atmosphere of the large-scale capitalist corporation leads to what Schumpeter calls an "evaporation of the Substance of Property." Without the sense of "physical property rights", the formerly entrepreneurial mind becomes socialized:

"The modern businessman is of the executive type. From the logic of his position he

acquires something of the psychology of the salaried employee working in a bureaucratic organization. Whether a stockholder or not, his will to fight and to hold on is not and cannot be what it was with the man who knew ownership and its responsibilities in the fullblooded sense of those words. His system of values and his conception of duty undergo a profound change ... Thus, the modern corporation, although the product of the capitalist process, socializes the bourgeois mind; it relentlessly narrows the scope of capitalist motivation; not only that, it will eventually kill its roots." [4, p. 156]

A second, more important, "internal cause" of capitalism's transition into socialism, according to Schumpeter, is the dissolution of the family: Keep in mind, when reading the following passage, that Schumpeter is writing in 1943:

"To men and women in modern capitalist societies, family life and parenthood mean less than they meant before and hence are less powerful molders of behavior...The weight of these facts is not impaired by our inability to measure them statistically...It does not matter how many marriages are dissolved by judicial decree - what matters is how many lack the content essential to the old pattern. If in our statistical age readers insist on a statistical measure, the proportion of marriages that produce no children or only one child, though still inadequate to quantify the phenomenon that I mean, might come as near as we can hope to come to indicating its numerical importance. The phenomenon by now extends to all classes...It is wholly attributable to the rationalization of everything in life, which we have seen is one of the effects of capitalist evolution. In fact, it is but one of the results of the spread of that rationalization to the sphere of private life...

As soon as men and women learn the utilitarian lesson and refuse to take for granted the traditional arrangements that their social environment makes for them, as soon as they acquire the habit of weighing the

individual advantages and disadvantages of any prospective course of action - or as we might put it, as soon as they introduce into their private life a sort of inarticulate system of cost accounting - they cannot fail to become aware of the heavy personal sacrifices that families and especially parenthood entail under modern conditions and of the fact that at the same time, children cease to be economic assets...

While the capitalist process, by virtue of the psychic attitudes it creates, progressively dims the values of family life, ...it at the same time implements new tastes ... Capitalist inventiveness reproduces contraceptive devices of ever-increasing efficiency while decreasing the desirability of, and providing alternatives to, the family home...

The average family tends to reduce the difficulties of running the big house by substituting for it small and mechanized establishments plus a maximum of outside service and outside life - hospitality in particular being shifted to the restaurant or club...

The Apartment house represents a rationalized type of abode and another style of life which when fully developed will no doubt meet the new situation and provide all the essentials of comfort and refinement. These establishments offer the facility of using to the full variety of modern enjoyments, of travel, of ready mobility, of shifting the load of the current little things of existence to the powerful shoulders of highly specialized organizations...

The passing of the spacious home - in which alone the rich life of a numerous family can unfold - and the increasing friction with which it functions supply another motive for avoiding the cares of parenthood; but the decline of philoprogenitiveness in turn renders the spacious home less worthwhile." [4, p. 158-60]

Schumpeter continues his discussion of the declining family by arguing that as the family declines, so does the incentive to save and invest, a driving force behind the capitalist order:

" The bourgeoisie worked primarily in order to invest, and it was not so much a standard of consumption as a standard of accumulation that the bourgeoisie struggled for and tried to defend against governments that took the short-run view. With the decline of the driving power supplied by the family motive, the businessman's time-horizon shrinks, roughly, to his life expectation. And, he might now be less willing to fulfill that function of earning, saving and investing...He drifts into an anti-saving frame of mind and accepts with an increasing readiness anti-saving theories that are indicative of a short-run philosophy." [4, p. 161]

The importance of Schumpeter's work is that it links the physical with the metaphysical. His analysis offers an explanation of how the physical processes and procedures of production can give rise to an attitudinal orientation that ultimately feeds back to alter its physical bases. Such a focus is important because it is society's prevailing attitudinal orientation that will either prevent or permit government's entry into the arena of material production.

Daniel Bell's work is more contemporary than Schumpeter's, and focuses even more explicitly on the attitudinal dimension. What Bell postulates is the gradual development, in America, of what he calls a "sense of rising entitlements." By this phrase, Bell is referring to a sense of being privileged; of being owed a living; of being entitled, not only to equality of opportunity, but to equality of outcome. According to Bell, and implicit in Schumpeter, such an attitude is a natural concomitant of "post-industrial" society; a society in which, as Schumpeter adumbrated, the family--having lost its functional significance--is fractionated down to isolated individuals and childless couples.

Given that such a "sense of entitlement" is in fact coming to characterize the attitudinal orientation of Americans, government will have a unique opportunity to become the purveyor of privilege. The burden of protecting increasingly self-seeking individuals from being violated by others of similar bent, falls logically upon government. As government more and more takes on the role of protector, adjudicator and regulator, its legitimacy as an actor in the socioeconomic arena will expand. A tradition of government as an active participant in socioeconomic affairs will as a consequence build up. And, the resulting growing legitimacy of governmental function may well serve to lubricate the physical transition from a capitalist to a socialist order.

The important arena of societal attitude formation is ignored by the current model. Yet, it is an arena that is likely to play a critical role in determining whether the U.S. economy will in fact make the transition to a socialist order. Therefore, a major priority for extension of the model is to explicitly portray the causal interface between the physical regimen of production in an economy and the consequent evolution of a society's attitudinal orientation. In particular, new feedback relationships, which provide an explicit representation of the mechanisms that enable government to expand the legitimacy of its role as an actor in the socioeconomic system, should be added to the model.

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APPENDIX I

DETAILED EQUATION DESCRIPTION

The detailed equation description that follows supplements the general discussion of model structure appearing in Chapter 2. A documented and non-documented listing of the model, an analyzer listing and a listing of the variable definition file are included in Appendix II. In this Appendix, the variables in each equation are defined and a justification for the form of each equation (including parameter values) is provided.

The overall architecture of the model is presented in Table A-1. As the Table indicates, the model consists of six major divisions of equations. The "meat" of the model is contained in the first two divisions: the government sector and the rest-of-the-socioeconomy sector. Both sectors are further subdivided into equation blocks. Each equation, in each block, is examined in sequence. To help in maintaining an integrated perspective when examining individual equations, a detailed flow diagram accompanies the discussion of each block of equations. Each flow diagram shows the interrelationship of all variables within the equation block, as well as inputs to the block from other blocks and outputs from the block to other blocks. Equation numbers referenced in the flow diagrams refer to the numbers given in the documentor equation listing (a complete copy of which appears in Appendix 2). Auxiliary variables that are used exclusively for testing purposes have been identified on the flow diagrams by a double, rather than a single, circle.

TABLE A1. OVERALL MODEL ARCHITECTURE

1. GOVERNMENT SECTOR	(Eqns 3 - 97)
Government Employment	(3 - 15)
Government Output	(16 - 30)
Government Money Balance	(31 - 52)
Government Debt	(53 - 75)
Government Tax Rate Setting	(75 - 97)
2. REST-OF-THE-SOCIOECONOMY SECTOR	(Eqns 99 - 150.3)
Population	(99 - 103)
Labor Force	(104 - 107.1)
Private Sector Employment	(108 - 120.1)
Demand For Government Services	(121 - 126.1)
Demand For Government Transfers	(127 - 131.1)
Demand For Private Output	(132 - 138)
Private Production & GNP	(139 - 144)
Productivity of Private Employees	(145 - 150.3)
3. PARAMETERS IN GOVERNMENT SECTOR	(Eqns 151.3 - 163.2)
4. TESTING EQUATIONS	(Eqns 165 - 190.2)
5. VARIABLES FOR PLOTTING	(Eqns 192 - 201)
6. SIMULATION CONTROL PARAMETERS	(Eqns 201.5 - 203.2)

In order to facilitate the description of the government sector equations, all of the parameters in the sector have been placed into a separate division which appears after the rest-of-the-socioeconomy equations. The Testing Equations follow the government sector parameters. These equations are used to conduct the variety of experiments discussed in Chapters 3 and 4. The division of equations entitled "Variables for Plotting" is just what it says. Variables in this division play no role in generating the behavior exhibited by the model, but are used for plotting purposes. The final division of equations in the model--Simulation Control Parameters--provide the specs that DYNAMO requires in order to execute the simulation.

A1.1 GOVERNMENT EMPLOYMENT

A flow diagram of the Government Employment equations appears as Figure A1-1. As the Figure indicates, the principal level variable in this block is Government Employees GE. Government draws its employees directly from, and discharges its employees directly into, a pool of unemployed U. The unemployed pool is, in turn, linked to a pool of Private Sector Employees PSE. The 3-level structure depicted in Figure A1-1 conserves employees. Because the model deals with a "fixed economy", there are no entrances into, or exits from, the labor force during model simulations. Hence, any member of the labor force is either employed by government or the private sector, or unemployed.

As equation 3 indicates, the level of Government Employees GE is augmented by Increase in Government Employees IGE and depleted by Decrease in Government Employees DGE.

GOVERNMENT EMPLOYMENT EQUATIONS

$$GE.K(LG) = GE.J(LG) + (DT) (IGE.JK(LG) - DGE.JK(LG)) \quad 3, L$$

GE - GOVERNMENT EMPLOYEES (PEOPLE)
LG - LEVEL OF GOVT
DT - SOLUTION INTERVAL (YEARS)
IGE - INCREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)
DGE - DECREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)

GE is initialized in equation 151.3 as Labor Force LF multiplied by Government Employment Fraction GEF and Initial Employees Per Level of Government Fraction IEPLGF. GEF is set equal to .15 in equation 151.4, in order to reflect the approximate current share of government employees in the U.S. labor force.

$$GE(1) = LF * GEF * IEPLGF(1) \quad 151.3, N$$
$$GEF = .15 \quad 151.4, C$$
$$IEPLGF(1) = 1 \quad 151.5, C$$

Increase in Government Employees IGE is formulated in equation 4 as the product of the current level of Government Employees GE and a Fractional Increase in Government Employees FIGE. In addition, IGE includes a term that allows for an instantaneous pulse-transfer of employees from the private sector to government. This latter term, Exogenous Transfer of Employees from Private Sector to Government ETEPG, is defined in equation 182 and used strictly for testing purposes.

$$IGE.K(LG) = (GE.K(LG) * FIGE.K(LG)) + ETEPG.K(LG) \quad 4, R$$

IGE - INCREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)
 LG - LEVEL OF GOVT
 GE - GOVERNMENT EMPLOYEES (PEOPLE)
 FIGE - FRACTIONAL INCREASE IN GOVT EMPLOYEES (1/YEAR)
 ETEPG - EXOGENOUS TRANSFER OF EMPLOYEES FROM PRIVATE TO GOVT SECTOR (PEOPLE/YEAR)

Fractional Increase in Government Employees FIGE is defined in equation 5 as a Normal Fractional Increase in Government Employees NFIGE moderated by the Effect of Government Money Adequacy on Fractional Increase EMAFI and the Effect of Availability of Employees on Fractional Increase in Government employees EAEFIG. Two additional influences, Effect of War on Fractional Increase EWFI (see equation 187) and Effect of Exogenous Change on Fractional Increase EECFI (see equation 186), allow NFIGE to be modified for testing purposes.

$$FIGE.K(LG) = NFIGE * EMAFI.K(LG) * EAEFIG.K * (EWFI.K * EECFI.K) \quad 5, A$$

FIGE - FRACTIONAL INCREASE IN GOVT EMPLOYEES (1/YEAR)
 LG - LEVEL OF GOVT
 NFIGE - NORMAL FRACTIONAL INCREASE IN GOVT EMPLOYEES (1/YEAR)
 EMAFI - EFFECT OF MONEY ADEQUACY ON FRACTIONAL INCREASE (DIM)
 EAEFIG - EFFECT OF AVAILABILITY OF EMPLOYEES ON FRACTIONAL INCREASE IN GOVT EMPLOYEES (DIM)
 EWFI - EFFECT OF WAR ON FRACTIONAL INCREASE (DIM)
 EECFI - EFFECT OF EXOGENOUS CHANGE ON FRACTIONAL INCREASE (DIM)

NFIGE is "normal" in the sense that it is the rate--expressed as a fraction per year of the existing level of employees--at which government is assumed to expand its labor force in the face of neutral

money adequacy and employee availability conditions. NFIGE is set equal, in equation 151.6, to 5%. Equation 5, then, says that if government has exactly enough money to cover current desired spending commitments, and unemployment is at comfortable levels (defined, as discussed subsequently, as 5% of the labor force), government will bring on employees at 5% per year.

The inclusion of such an inherent growth bias is a reflection of the assumption that empire-building forces are at work within government. Such forces are described by Downs [1], Niskanen [2], Kaufman [3] and Von Mises [4], as referenced in Chapter 2. The selection of 5% as the "normal" growth bias is somewhat, though not completely, arbitrary. Assimilating new employees at a rate too much in excess of 5% per year is likely to cause those doing the empire-building to lose control of their empires. For this reason, one would expect the rate of assimilation of employees to be voluntarily restrained by government bureaucrats at a level not too far in excess of 5% per year. On the other hand, fractional growth rates too far below 5% do not yield the benefits of expanded security power, responsibility and prestige which are assumed to underlie the empire-building urges of government entrepreneurs. Thus, the selection of 5% as the "normal" growth fraction appears to strike a reasonable compromise between too little and too much growth bias. As equation 6, and its associated Table Function (see Figure A1-2) indicate, when government's money adequacy rises above 1.0, Effect of Money Adequacy on Fractional Increase EMAFI likewise rises above 1.0, indicating that government is stepping-up the rate at which it is

acquiring employees. And, conversely, government money adequacy below 1.0 depresses EMAFI and hence government's hiring rate.

EMAFI.K(LG)=TABLE(TEMAFI,GMA.K(LG),0,2,.25) 5, A
EMAFI - EFFECT OF MONEY ADEQUACY ON FRACTIONAL INCREASE (DIM)
LG - LEVEL OF GOVT
TABLE - TABLE LOOK-UP FUNCTION
TEMAFI - TABLE OF EFFECT OF MONEY ADEQUACY ON FRACTIONAL INCREASE
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

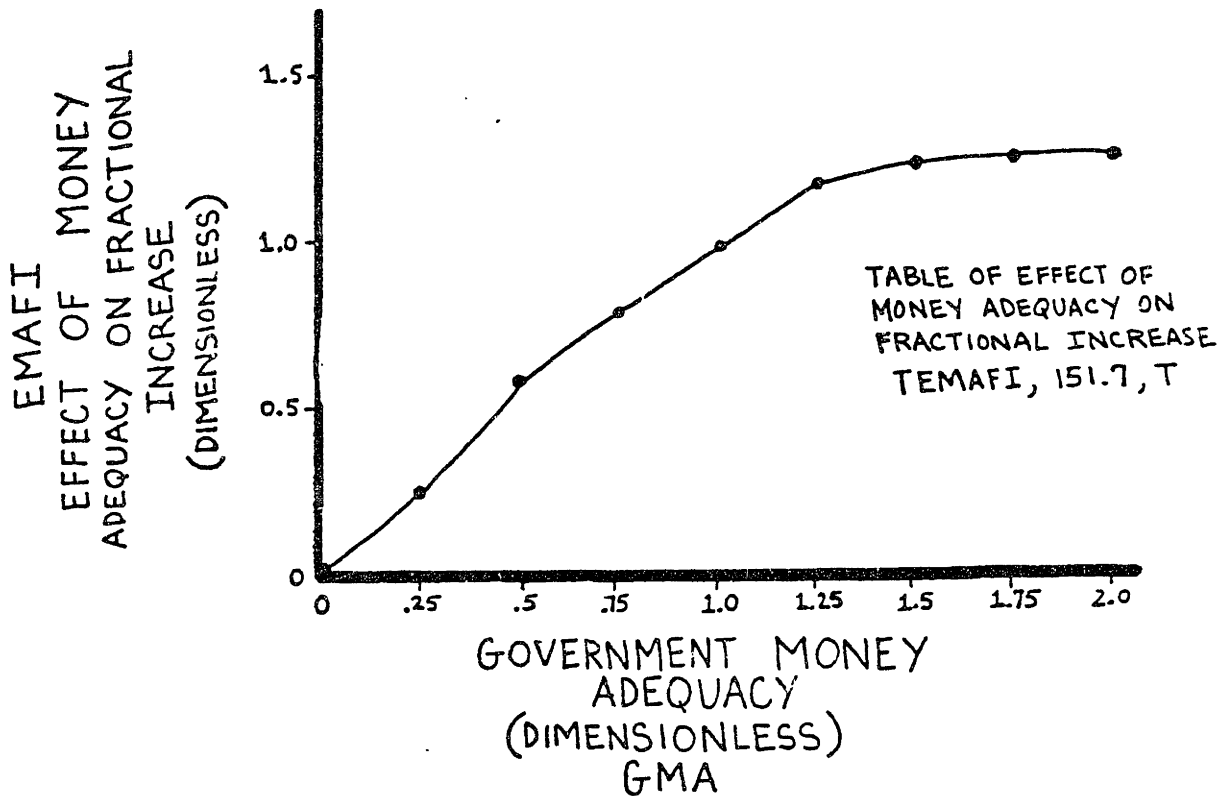


FIGURE A1-2 The Effect of Government Money Adequacy on the Fractional Increase in Government Employees.

Government Money Adequacy GMA is defined in equation 48 (and discussed subsequently) as the ratio of Government Money Balance GMB to its Average Desired Payments ADPAY multiplied by its Desired Money Coverage DMCOV. GMA thus measures government's current money stock relative to the stock that is needed to meet a specified time frame's worth of desired spending obligations. When GMA equals 1.0, government has just enough money on hand to service the desired number of years' worth of desired spending obligations. Under these conditions, EMAFI is assumed to exert a neutral pressure on NFIGE. As GMA rises above 1.0, EMAFI likewise rises, stimulating the assimilation of government employees. However, as Figure A1-2 indicates, the effect is less than proportional. A 25% increase in GMA above its neutral point causes a 20% increase, other things equal, in FIGE. Further increases in GMA have an increasingly diminishing stimulative effect on FIGE. And, no matter how high Government Money Adequacy rises, it is assumed that EMAFI never climbs above 1.3. Thus, in the absence of availability considerations, Money Adequacy conditions can push FIGE up to a maximum of 6.5% per year. The saturation of EMAFI with rising money adequacy reflects the aforementioned assumption of a fear, on the part of government empire-builders, that too rapid a rate of growth could result in a loss of control.

As Figure A1-2 indicates, a 50% reduction in Government Money Adequacy below the neutral point cuts the fractional rate of growth--other things equal--by only 40%. This less than proportional effect reflects the assumption that "empire-building" urges are

reluctantly restrained. However, as GMA drops below 0.5, it is assumed that government employers have little choice but to reduce hiring in proportion to prevailing money adequacy conditions. Ultimately, when GMA = 0, EMAFI takes on a value of 0, thereby driving FIGE to 0.

The second influence on NFIGE is the Effect of Availability of Employees on Fractional Increase in Government employees EAEFIG, formulated in equation 7. The associated Table Function appears in Figure A1-3.

$EAEFIG.K = TABHL(TEAEFG, U.K/MU.K, 0, 7, .5)$ 7, A
 EAEFIG - EFFECT OF AVAILABILITY OF EMPLOYEES ON FRACTIONAL INCREASE IN GOVT EMPLOYEES (DIM)
 TABHL - TABLE LOOK-UP FUNCTION
 TEAEFG - TABLE OF EFFECT OF AVAILABILITY OF EMPLOYEES ON FRACTIONAL INCREASE IN GOVT EMPLOYEES
 U - UNEMPLOYED (PEOPLE)
 MU - MINIMUM UNEMPLOYED (PEOPLE)

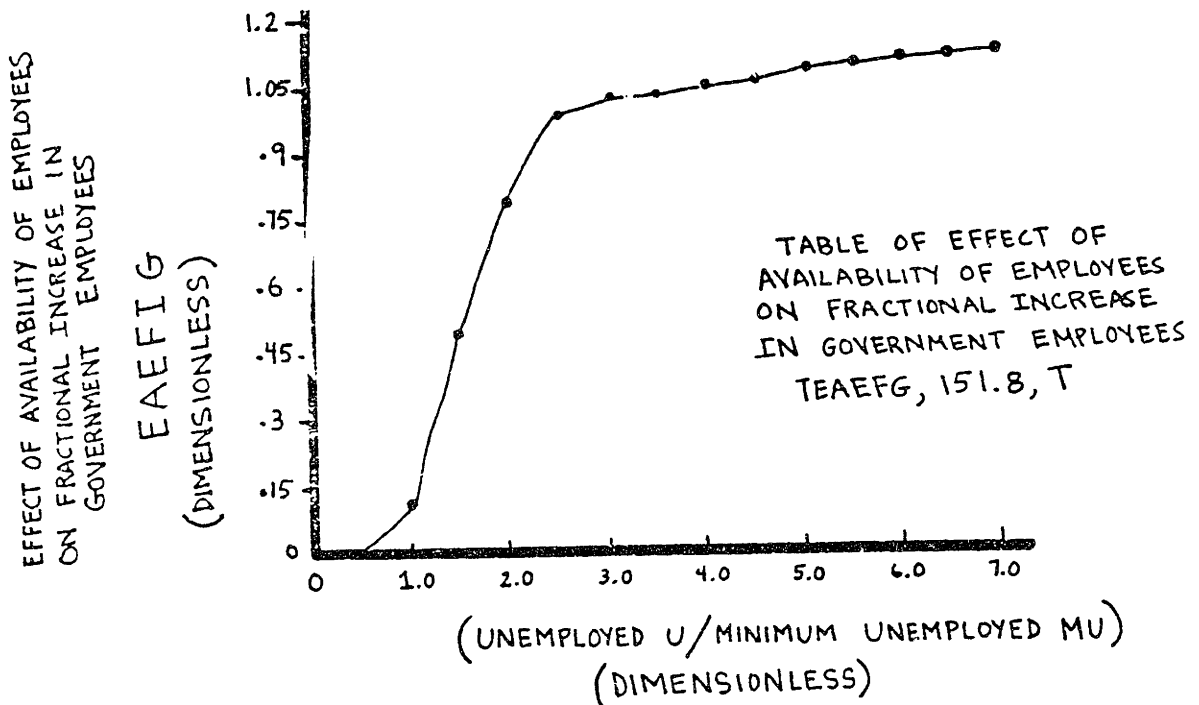


FIGURE A1-3. The Effect of Availability of Employees on the Fractional Increase in Government Employees.

Because government draws its employees directly from the pool of unemployed (see Figure A1-1), EAEFIG depends upon the level of Unemployed U relative to some level of Minimum Unemployed MU . Minimum Unemployed is defined in Equation 107 as 2% of the existing labor force. MU represents a level of unemployed below which it would be extremely difficult in practice to go. Included in this so-called "frictional" level are workers who are between jobs, those voluntarily taking some time off, the hard core unemployed and those who are temporarily laid off. Any economy will necessarily always have some of each of these types of people, and will therefore necessarily have some bare minimum level of unemployed.

AS Figure A1-3 indicates, when U is equal to MU , EAEFIG takes on a value of .1, restricting government hiring to 10% of what would prevail under "normal" conditions. This reflects the previously discussed fact that at the frictional level of unemployment, it is extremely difficult for government to continue drawing in employees. At a level of unemployed equal to one-half MU , government hiring is assumed to be shut down completely. As U rises above MU , the depressive effect of availability continues to diminish until U reaches 2.5 times the frictional level (or, 5% in the model). At this point, EAEFIG exerts a neutral impact on FIGE. Levels of Unemployment in excess of 5% are assumed to stimulate government hiring. The stimulative effect climbs steeply at first, and then saturates. The saturation reflects, again, the assumption that government, under no conditions, wants employment to grow too rapidly (leading to a possible loss of management control).

The assumption of a stimulative impact at higher levels of unemployment reflects both supply and demand-side considerations. On the demand side, high unemployment would cause wages to decline, (not explicitly represented in the model) making it increasingly attractive, from government's standpoint, to hire additional employees. In addition, with high unemployed levels it will be relatively easier for government to claim the relatively high-skill level employees that it would like. On the supply side, with jobs hard to come by, government employment (with a reputation for relatively high job security) begins to appear increasingly attractive, creating a pressure to seek government jobs.

In equation 8, decrease in Government Employees DGE is formulated, in a manner analogous to IGE, as the product of Government Employees GE and a Fractional Decrease in Government Employees FDGE. Again, a term that allows for an Exogenous Transfer of Employees from Government to the Private Sector ETEGP (see equation 165) is included for testing purposes.

$$DGE.KL(LG) = (GE.K(LG) * FDGE.K(LG)) + ETEGP.K(LG) \quad 8, R$$

DGE - DECREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)
LG - LEVEL OF GOVT
GE - GOVERNMENT EMPLOYEES (PEOPLE)
FDGE - FRACTIONAL DECREASE IN GOVERNMENT EMPLOYEES
(1/YEAR)
ETEGP - EXOGENOUS TRANSFER OF EMPLOYEES FROM GOVT
TO PRIVATE SECTOR (PEOPLE/YEAR)

Fractional Decrease in Government Employees FDGE is modeled in equation 9 as the sum of two fractional decreases: Fractional Decrease from Private Sector Demand FDPD, which is moderated by the Effect of

Availability of Government Employees EAGE, and Fractional Decrease from Money Adequacy FDMA.

$$\text{FDGE.K(LG)} = (\text{FDPSD.K} * \text{EAGE.K(LG)}) + \text{FDMA.K(LG)} \quad 9, A$$

FDGE - FRACTIONAL DECREASE IN GOVERNMENT EMPLOYEES (1/YEAR)
LG - LEVEL OF GOVT
FDPSD - FRACTIONAL DECREASE FROM PRIVATE SECTOR DEMAND (1/YEAR)
EAGE - EFFECT OF AVAILABILITY OF GOVT EMPLOYEES (DIMENSIONLESS)
FDMA - FRACTIONAL DECREASE FROM MONEY ADEQUACY (1/YEAR)

As equation 10 indicates, FDPSD represents the pull on government employees that emanates from the need for workers in the private sector, moderated by prevailing unemployment conditions.

$$\text{FDPSD.K} = \text{FDPSED.K} * \text{EUCFD.K} \quad 10, A$$

FDPSD - FRACTIONAL DECREASE FROM PRIVATE SECTOR DEMAND (1/YEAR)
FDPSED - FRACTIONAL DECREASE FROM PRIVATE SECTOR EMPLOYMENT DISCREPANCY (1/YEAR)
EUCFD - EFFECT OF UNEMPLOYMENT CONDITIONS ON FRACTIONAL DECREASE (DIM)

The strength of the pull on government employees to leave government for work on the private sector is seen, in equation 11 and Figure A1-4, to be inversely related to the ratio of Private Sector Employees PSE to Desired Private Sector Employees DESPSE. PSE is defined in equation 108 as the current stock of workers employed in the private sector. DESPSE is defined in equation 114 as the number of employees, at prevailing productivity levels, required to produce the level of private output currently being demanded by the society. If PSE is greater than or equal to DESPSE, no pressure for government

employees to move to the private sector is generated from the FDPSED component of FDGE. However, as Figure A1-4 shows, when the stock of PSE dips below that which is needed to produce the desired level of output, the pull on government employees exerted by the private sector rises sharply.

FDPSED.K=TABHL(TFDPSD,PSE.K/DESPSE.K,0,1,.25) 11, A
 FDPSED - FRACTIONAL DECREASE FROM PRIVATE SECTOR
 EMPLOYMENT DISCREPANCY (1/YEAR)
 TABHL - TABLE LOOK-UP FUNCTION
 TFDPSD - TABLE OF FRACTIONAL DECREASE FROM PRIVATE
 SECTOR DEMAND
 PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)
 DESPSE - DESIRED PRIVATE SECTOR EMPLOYEES (PEOPLE)

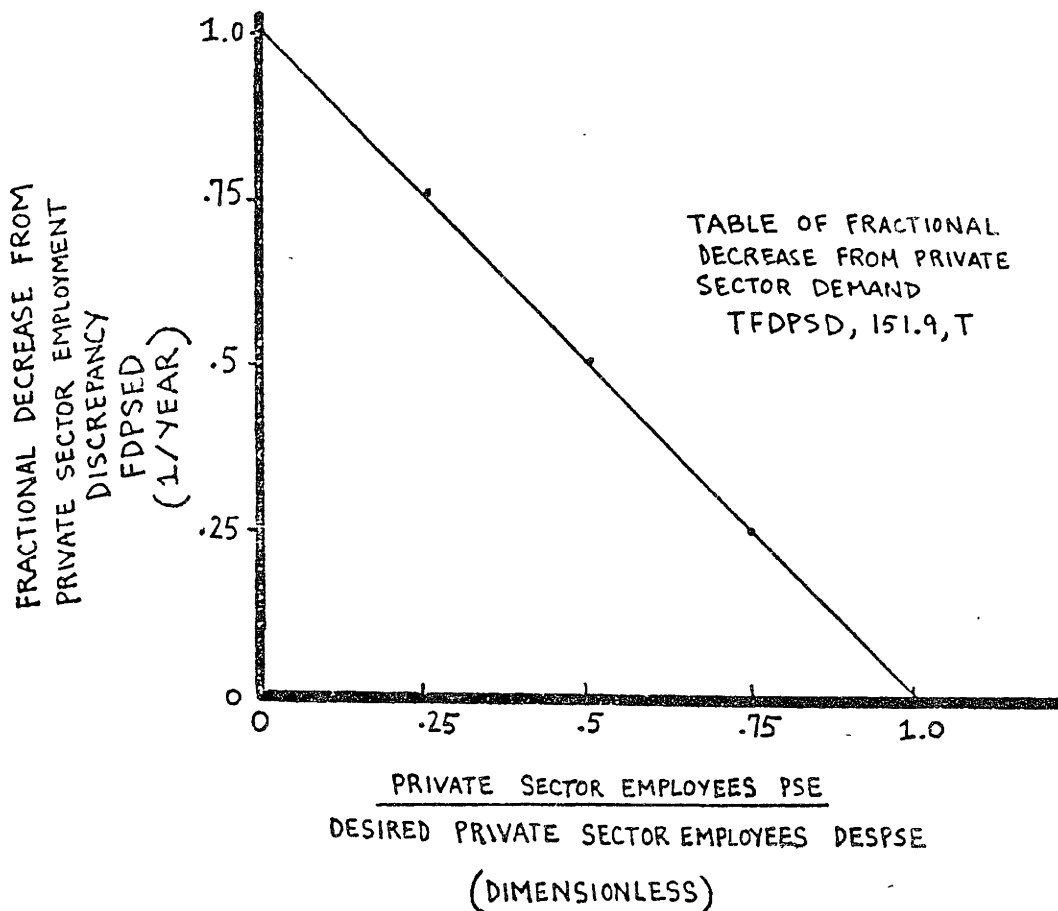


FIGURE A1-4. The Relationship Between Private Sector Employment Discrepancy and Fractional Decrease in Government Employees.

When PSE is 25% below DESPSE, FDPSED takes on a value of .25. A fractional decrease of .25 means that, other things equal, about 63% of the current stock of government employees would be depleted in $(1/.25)$, or 4, years. If the ratio of PSE to DESPSE falls to .5, FDPSED climbs to .5. If this rate of decrease were to prevail, other things equal, only 2 years would be required to achieve the 63% depletion. The rapid depletion of government employees in response to employment discrepancies in the private sector implied by the slope of the relationship depicted in Figure A1-4, reflects the assumption that private production takes priority over government production when the former is considered inadequate by society. The assumed priority results from the fact that government, in the model, does not produce any of the material essentials of survival (e.g., food, clothing, or shelter). As a result, it is necessary that the private sector (which does produce these items) be able to acquire employees from government when it needs them. The high responsiveness of FDPSED to private sector employment discrepancies helps to ensure that this is so.

FDPSED is moderated by the Effect of Unemployment Conditions on Fractional decrease EUCFD, as equation 10 indicates. EUCFD is seen to depend upon the ratio of Unemployed U to Minimum Unemployed MU in equation 12.

EUCFD.K=TABHL (TEUCFD,U.K/MU.K,0,4,1) 12, A
EUCFD - EFFECT OF UNEMPLOYMENT CONDITIONS ON
FRACTIONAL DECREASE (DIM)
TABHL - TABLE LOOK-UP FUNCTION
TEUCFD - TABLE OF EFFECT OF UNEMPLOYMENT CONDITIONS
ON FRACTIONAL DECREASE
U - UNEMPLOYED (PEOPLE)
MU - MINIMUM UNEMPLOYED (PEOPLE)

EUCFD serves to reduce the pull exerted by the private sector upon government employees when the unemployment pool is already swollen. As Figure A1-5 indicates, when the unemployed pool is completely empty, EUCFD takes on a neutral value of 1.0, meaning that the full effect of FDPSED will be reflected in FDPSED; i.e., employees will be drawn directly out of government. As the unemployed pool rises, relative to Minimum Unemployed MU, an increasingly smaller portion of FDPSED is passed on to FDPSED. The logic here is that, if abundant employees are available in the unemployed pool, the private sector would have little need (or ability) to draw employees out of government to meet its needs.

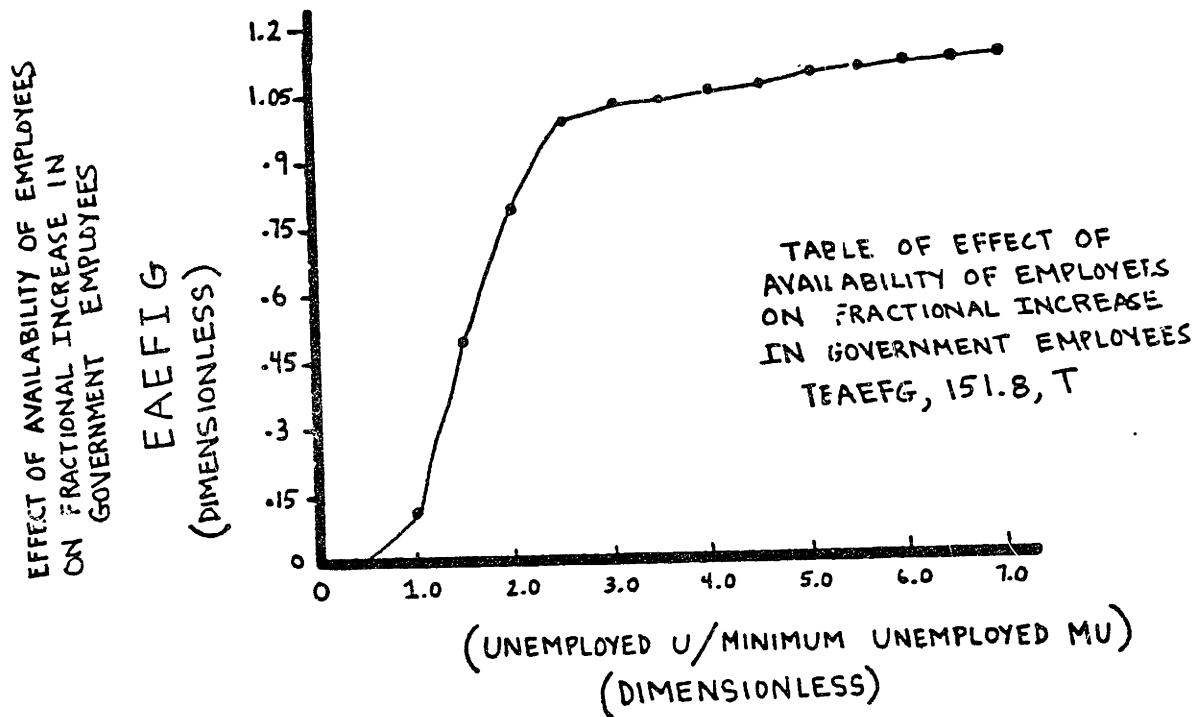


FIGURE A1-5. The Relationship Between Unemployment Conditions and the Pull of Private Sector Employment Discrepancies on Government Employees.

A second moderating influence on the drawing power of the private sector on government employees is the Effect of Availability of Government Employees EAGE. EAGE constitutes a direct counter-pressure that opposes the pull on government employees emanating from private sector employment discrepancies. As equation 14 indicates, EAGE depends upon the ratio of Government Employees GE to the Required Level of Government Employees RLGE.

$$EAGE.K(LG) = TABHL(TEAGE, GE.K(LG)/RLGE.K(LG), .4, 1.2, 14, A$$

- .1)
- EAGE - EFFECT OF AVAILABILITY OF GOVT EMPLOYEES (DIMENSIONLESS)
 - LG - LEVEL OF GOVT
 - TABHL - TABLE LOOK-UP FUNCTION
 - TEAGE - TABLE OF EFFECT OF AVAILABILITY OF GOVT EMPLOYEES
 - GE - GOVERNMENT EMPLOYEES (PEOPLE)
 - RLGE - REQUIRED LEVEL OF GOVT EMPLOYEES (PEOPLE)

As equation 15 indicates, RLGE is structurally analogous to DESPSE in that it represents the amount of employees--at current productivity levels--that government must have in order to generate the levels of output of government services and transfers that are currently being demanded.

$$RLGE.K(LG) = (DEGS.K(LG)/PGEPS.K) + (DGT.K(LG)/PGEPT.K) \quad 15, A$$

- RLGE - REQUIRED LEVEL OF GOVT EMPLOYEES (PEOPLE)
- LG - LEVEL OF GOVT
- DEGS - DEMAND FOR GOVT SERVICES (OUTPUT UNITS/YEAR)
- PGEPS - PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING SERVICES (OUTPUT UNITS/PERSON/YEAR)
- DGT - DEMAND FOR GOVT TRANSFERS (OUTPUT UNITS/YEAR)
- PGEPT - PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING TRANSFERS (OUTPUT UNITS/PERSON/YEAR)

However, because of the priority assigned to private output, RLGE will "lose out" in any tug-of-war with DESPSE. As such, EAGE serves as more of a physical (i.e., availability) counterpressure than a counterpressure which can be intentionally maintained by government entrepreneurs seeking to retain their employees.

As Figure A1-6 indicates, when the level of Government Employees GE is just equal to the Required Level of Government Employees RLGE, a neutral moderating pressure is assumed to be brought to bear on Fractional Decrease from Private Sector Demand FDPD.

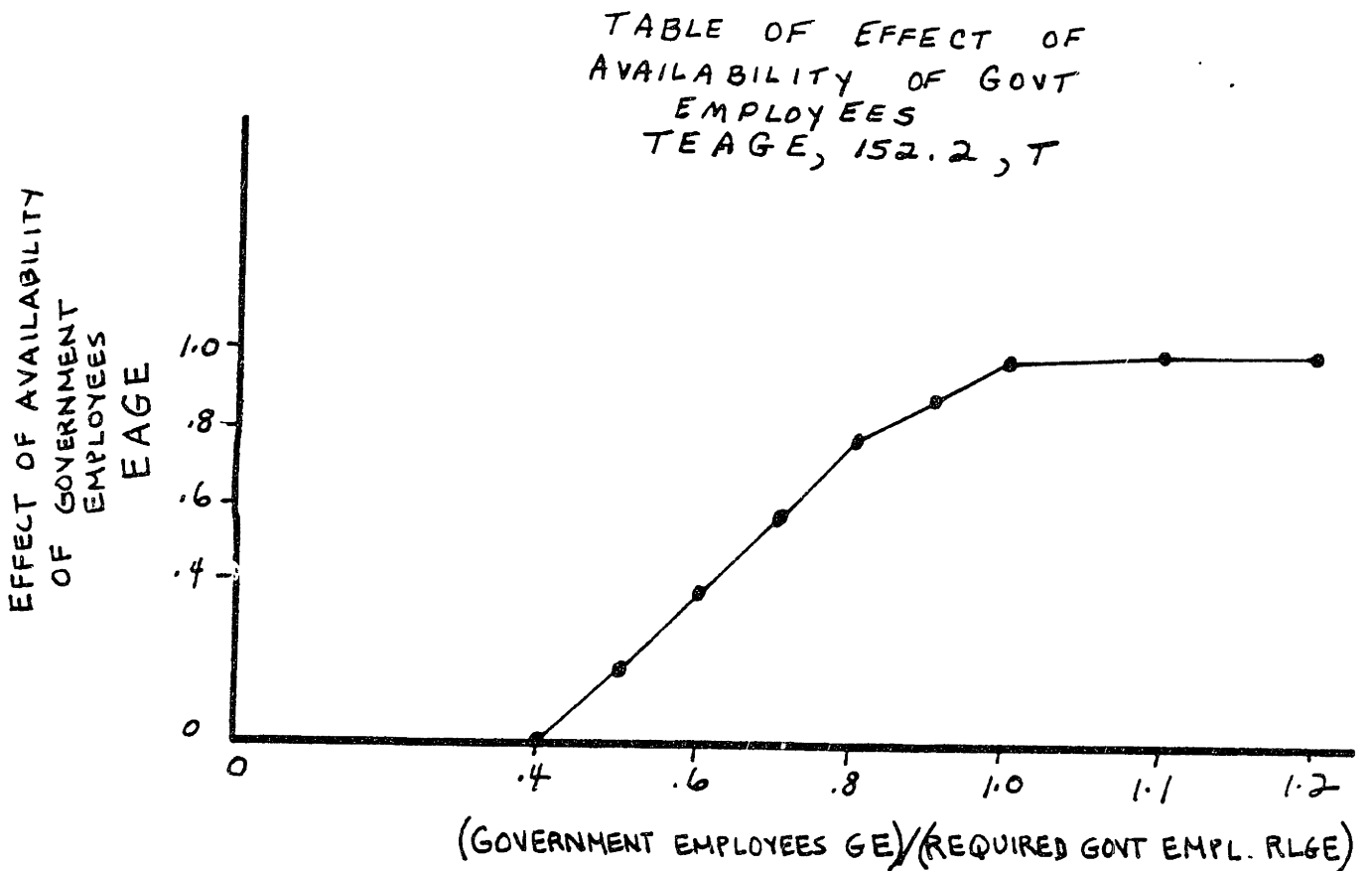


FIGURE A1-6. The Constraining Influence of Availability of Government Employees on Decrease in Government Employees.

As levels of Government Employment GE rise above RLGE, only a very slight pressure to discharge employees arises. A 20% overage, in fact, results in only a 1% increase in the rate at which government discharges employees. An overage of 40% or more generates only an additional 5% of pressure to discharge employees. Government is thus assumed to be disposed to "find work" for temporarily extra employees, rather than discharging them.

As Government Employees GE fall below RLGE, the constraining influence on Fractional Decrease from Private Sector Demand FDPD is proportional at first. With continued declines in GE relative to RLGE, the depressive effect of EAGE on FDPD becomes quite severe. If Government Employees GE fall to 40% of their required level, all decreases in government employees generated by private sector demand are extinguished. Such a condition could only prevail, however, in a period of relative abundance of private sector output (otherwise, RLGE would be continually declining). And, in such a period, the private sector would have all the employees that it could get. Therefore, any pull on government employees from the private sector would be counterbalanced by a maintainable pull from government itself.

The second additive component of Fractional Decrease in Government Employees FDGE (equation 9) is Fractional Decrease from Money Adequacy FDMA. FDMA, as indicated in equation 13 and Figure A1-7, depends upon Government Money Adequacy GMA.

FDMA.K(LG) = TABHL(TFDMA, GMA.K(LG), 0, 1, .25) 13, A
FDMA - FRACTIONAL DECREASE FROM MONEY ADEQUACY (1/
YEAR)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TFDMA - TABLE OF FRACTIONAL DECREASE FROM MONEY
ADEQUACY
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

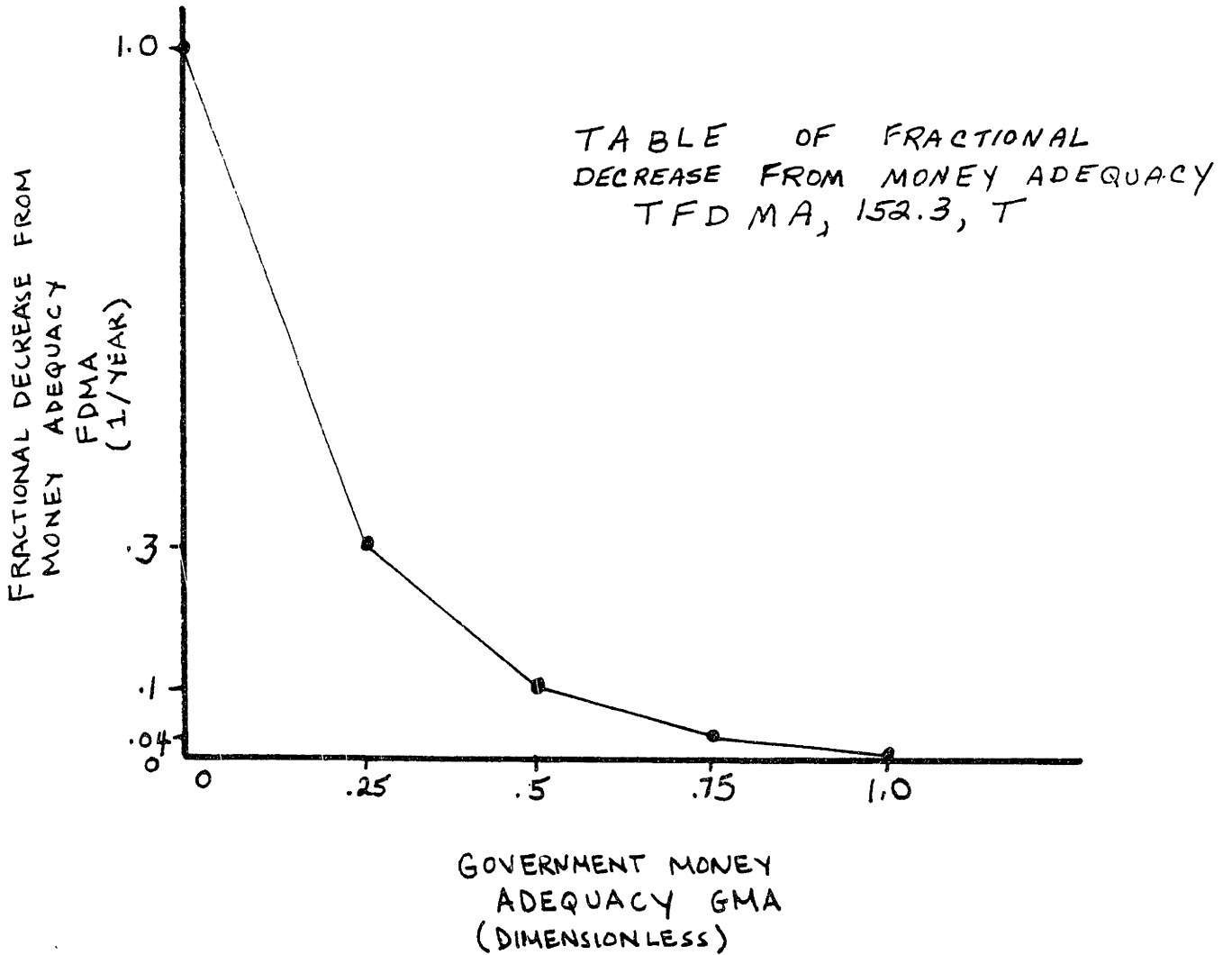


FIGURE A1-7. The Effect of Money Adequacy on Fractional Decrease in Government Employees.

When GMA is 1.0, or greater, indicating that government has ample money to cover its desired spending commitments, FDMA contributes nothing to the Fractional Decrease in Government Employees FDGE. As GMA declines below 1.0, pressure to discharge employees grows. At first, as Figure A1-7 indicates, government is assumed to resist pressures to discharge employees from money adequacy considerations. A 25% money shortfall, other things equal, results in only a 4% rate of discharge. And, a 50% shortfall generates only a 10% fractional decrease. However, as GMA declines below .25--reflecting a serious money shortfall--government is assumed to have little choice but to cut back employment sharply in order to reduce spending.

A1.2 GOVERNMENT OUTPUT

Government, in the model, produces two kinds of output: services and transfers. Figure A1-8 details the structure of the equations used to generate government output.

Output of Government Services Per Capita OGSP, defined in equation 16, is simply Output of Government Services OGS--denominated in output units/year--divided by Population POP.

GOVT OUTPUT

1. OUTPUT OF GOVT SERVICES

OGSP.K(LG)=OGS.K(LG)/POP.K 16, A
OGSP - OUTPUT OF GOVT SERVICES PER CAPITA (OUTPUT
UNITS/PERSON/YEAR)
LG - LEVEL OF GOVT
OGS - OUTPUT OF GOVT SERVICES (OUTPUT UNITS/YEAR)
POP - POPULATION (PEOPLE)

Output of Government Services OGSi is formulated as the product of Government Employees Producing Services GEPS and Productivity of Government Employees Producing Services PGEPS.

$$\text{OGS.K(LG)} = \text{GEPS.K(LG)} * \text{PGEPS.K} \quad 17, A$$

OGS - OUTPUT OF GOVT SERVICES (OUTPUT UNITS/YEAR)
LG - LEVEL OF GOVT
GEPS - GOVERNMENT EMPLOYEES PRODUCING SERVICES (PEOPLE)
PGEPS - PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING SERVICES (OUTPUT UNITS/PERSON/YEAR)

Government Employees Producing Services GEPS is, in turn, defined as GE multiplied by the Fraction of Government Employees Allocated Service Production FGEASP.

$$\text{GEPS.K(LG)} = \text{GE.K(LG)} * \text{FGEASP.K(LG)} \quad 18, A$$

GEPS - GOVERNMENT EMPLOYEES PRODUCING SERVICES (PEOPLE)
LG - LEVEL OF GOVT
GE - GOVERNMENT EMPLOYEES (PEOPLE)
FGEASP - FRACTION OF GOVT EMPLOYEES ALLOCATED TO SERVICE PRODUCTION (DIM)

FGEASP, as defined in equation 19, is determined as the ratio of the number of employees (per capita) required to produce the level of government services currently being demanded, relative to the number of employees (per capita) required to produce the level of

total government output currently being demanded. The number of employees (per capita) required to produce the currently demanded level of government services is determined by dividing the Standard Output of Government Services Per capita SOGSP by the productivity of Government Employees Producing Services PGEPS. The number of employees required to produce the level of total government output currently being demanded is calculated as the sum of Standard Output of Government Services Per capita SOGSP and Standard Output of Government Transfers Per capita SOGTP each divided by the respective productivities of government employees engaged in producing each output. FGEASP thus ensures that the total quantity of Government Employees GE will be allocated to service and transfer production in proportion to the respective demands for each output in relation to the respective productivities of employees engaged in each activity.

$$FGEASP.K(LG) = ((SOGSP.K(LG)/PGEPS.K) / ((SOGSP.K(LG)/19, A PGEPS.K) + (SOGTP.K(LG)/PGEPT.K)))$$

FGEASP - FRACTION OF GOVT EMPLOYEES ALLOCATED TO SERVICE PRODUCTION (DIM)

LG - LEVEL OF GOVT

SOGSP - STANDARD OUTPUT OF GOVT SERVICES PER PERSON (OUTPUT UNITS/PERSON/YEAR)

PGEPS - PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING SERVICES (OUTPUT UNITS/PERSON/YEAR)

SOGTP - STANDARD OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT UNITS/PERSON/YEAR)

PGEPT - PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING TRANSFERS (OUTPUT UNITS/PERSON/YEAR)

SOGSP is an exponential average of OGSP. It is intended to represent a society-wide average level of per capita output of government service that the public has gotten used to, and therefore come to anticipate.

$SOGSP.K(LG) = SOGSP.J(LG) + (DT/TESOGS.J(LG))$ 20, L
($OGSP.J(LG) - SOGSP.J(LG) - ERSOGS.J(LG)$)
SOGSP - STANDARD OUTPUT OF GOVT SERVICES PER PERSON
(OUTPUT UNITS/PERSON/YEAR)
LG - LEVEL OF GOVT
DT - SOLUTION INTERVAL (YEARS)
TESOGS - TIME TO ESTABLISH STANDARD OUTPUT OF GOVT
SERVICES (YEARS)
OGSP - OUTPUT OF GOVT SERVICES PER CAPITA (OUTPUT
UNITS/PERSON/YEAR)
ERSOGS - EXOGENOUS REDUCTION IN STANDARD OUTPUT OF
GOVT SERVICES PER CAPITA (OUTPUT UNITS/
PERSON/YEAR)

It is assumed that people will quickly accomodate to any increase in the level of per capita output of government services, but will resist service cut-backs.

$TESOGS.K(LG) = TABHL(TTESGO, OGSP.K(LG)/SOGSP.K(LG))$ 21, A
(.95, 1, .05)
TESOGS - TIME TO ESTABLISH STANDARD OUTPUT OF GOVT
SERVICES (YEARS)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TTESGO - TABLE OF TIME TO ESTABLISH TRADITIONAL
STANDARD OF GOVT OUTPUT PER CAPITA
OGSP - OUTPUT OF GOVT SERVICES PER CAPITA (OUTPUT
UNITS/PERSON/YEAR)
SOGSP - STANDARD OUTPUT OF GOVT SERVICES PER PERSON
(OUTPUT UNITS/PERSON/YEAR)

In order to reflect this assumption, the averaging time--Time to Establish Standard Output of Government Services TESOGS--used to establish SOGSP from OGSP is made a highly non-linear function of OGSP relative to SOGSP.

As indicated in Figure A1-9, when OGSP is greater than or equal to SOGSP, TESOGS takes on a value of one year. However, when OGSP falls even slightly below SOGSP, TESOGS jumps to 15 years. The use of a variable averaging time enables SOGSP to reflect the "slippery upward, sticky downward" assumption about societal standard formation.

TABLE OF TIME TO ESTABLISH
TRADITIONAL STANDARD OF GOVT
OUTPUT PER CAPITA
TTESGO, 153.5, T

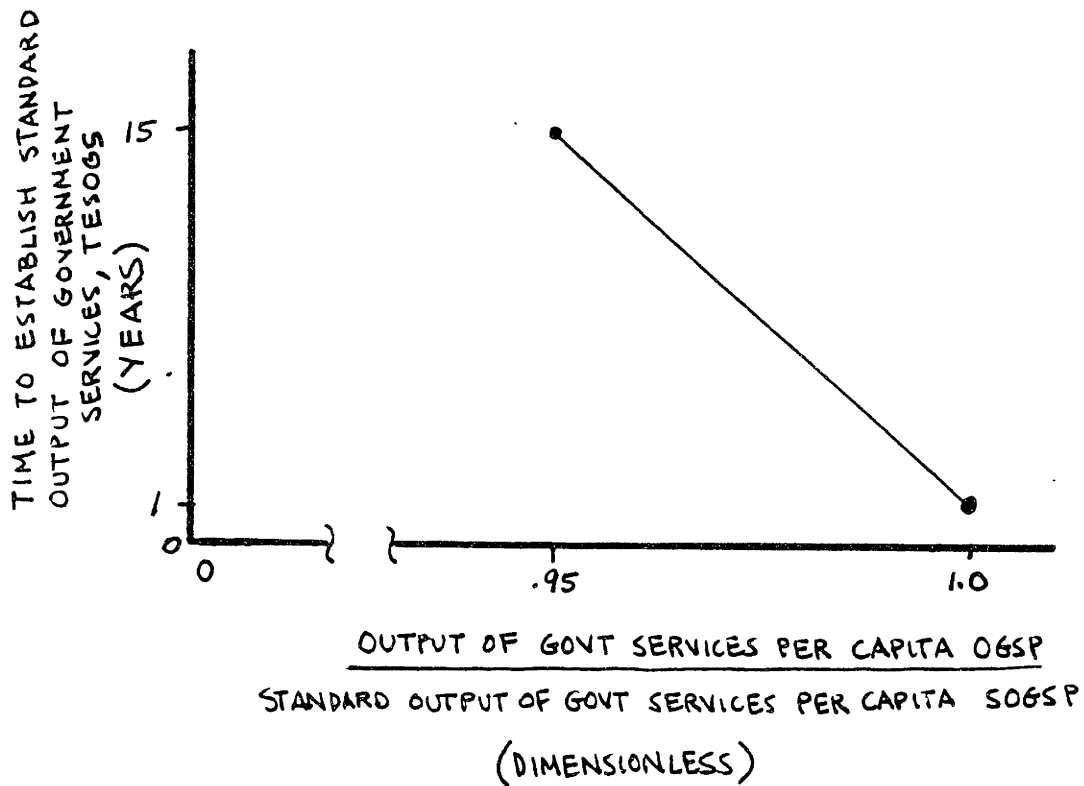


Figure A1-9. Time to Establish Standard Output of Government Services as a Function of OGSP Relative to SOGSP.

Productivity of Government Employees Producing Services PGEPS is formulated in equation 22 as a Reference Productivity of Government Employees Producing Services RPGEPS moderated by the Effect of Technology on the Productivity of Government Employees Producing Services ETPGES.

PGEPS.K=RPGEPS*ETPGES.K 22, A
PGEPS - PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
SERVICES (OUTPUT UNITS/PERSON/YEAR)
RPGEPS - REFERENCE PRODUCTIVITY OF GOVT EMPLOYEES
PRODUCING SERVICES (OUTPUT UNITS/PERSON/
YEAR)
ETPGES - EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF
GOVT EMPLOYEES IN SERVICES (DIM)

RPGEPS is the average productivity of government employees engaged in the production of government services that prevails in the equilibrium condition in which the model is initialized.

ETPGES depends upon the level of Technology T, relative to the Reference Level of Technology RLT; where the latter is, again, the level that prevails in the particular equilibrium balance in which the model is initialized. Technology T, defined in equation 150, is an index that amalgamates higher education, advances in work processes, and sophistication of plant and equipment. T is assumed constant in the model except during testing when it is subjected to one-time step-changes.

ETPGES.K=TABLE(TETPGS,T.K/RLT,0,1.5,.25) 23, A
ETPGES - EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF
GOVT EMPLOYEES IN SERVICES (DIM)
TABLE - TABLE LOOK-UP FUNCTION
TETPGS - TABLE OF EFFECT OF TECHNOLOGY ON
PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
SERVICES
T - INDEX OF TECHNOLOGY (DIMENSIONLESS)
RLT - REFERENCE LEVEL OF TECHNOLOGY (DIM)

As Figure A1-10 indicates, increases in T above RLT result in increases in PGEPS, although the effect is less than proportional.

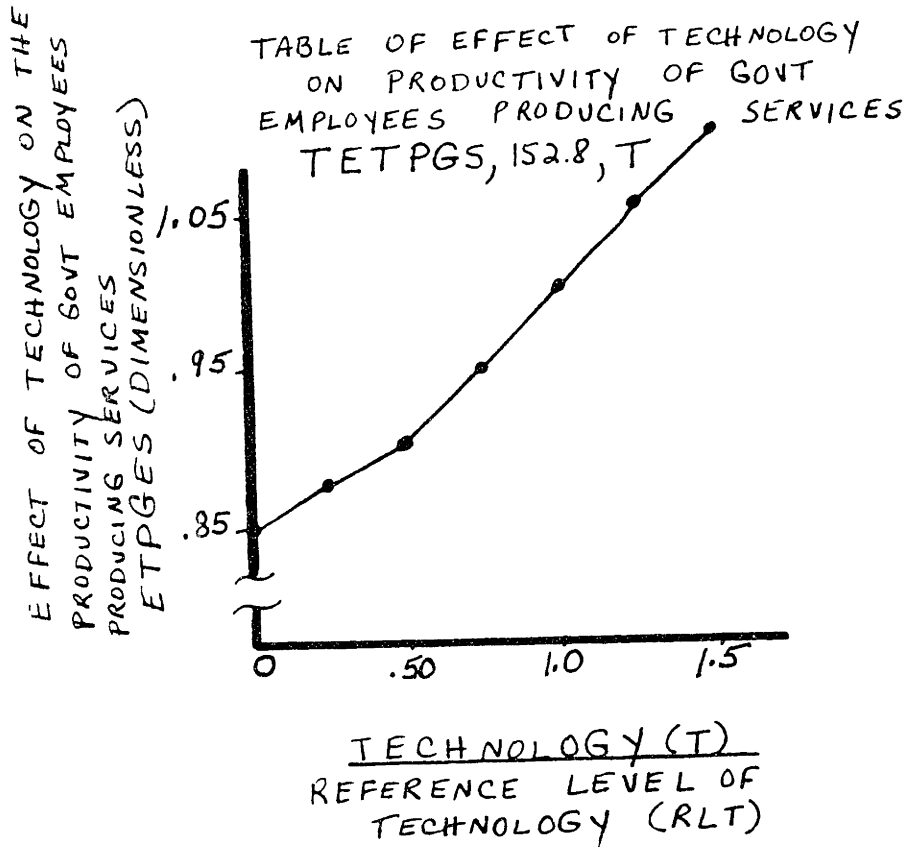


FIGURE A1-10 The Relationship Between Technology and the Productivity of Government Employees Producing Services.

A 25% increase in T above RLT increases PGEPS by only 5%. And a 50% (or more) increase in T above RLT causes PGEPS to increase only 10%. The assumption of a less than proportional effect derives from the fact that the production of government services is highly labor-intensive. As such, technological advances do not increase the productivity of government service-producing employees as much as they do in a more capital-intensive producing sector. By the same token,

however, reductions in the level of technology below the reference level do not exact proportional decreases in the productivity of government employees producing services either. As Figure A1-10 indicates, a reduction in T to a level 50% below RLT is assumed to result in only a 10% decline in productivity below the reference level.

Equations 24 through 30 detail the production of government transfers. These equations are exactly analogous to those describing the production of government services, with two exceptions. The equations are therefore presented as a block with only the exceptions discussed in detail.

2. OUTPUT OF GOVT TRANSFERS

$$\text{OGTP.K(LG)} = \text{OGT.K(LG)} / \text{POP.K} \quad 24, A$$

OGTP - OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT UNITS/PERSON/YEAR)

LG - LEVEL OF GOVT

OGT - OUTPUT OF GOVT TRANSFERS (OUTPUT UNITS/YEAR)

POP - POPULATION (PEOPLE)

$$\text{OGT.K(LG)} = \text{GEPT.K(LG)} * \text{PGEPT.K} \quad 25, A$$

OGT - OUTPUT OF GOVT TRANSFERS (OUTPUT UNITS/YEAR)

LG - LEVEL OF GOVT

GEPT - GOVT EMPLOYEES PRODUCING TRANSFERS (PEOPLE)

PGEPT - PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING TRANSFERS (OUTPUT UNITS/PERSON/YEAR)

$$\text{GEPT.K(LG)} = \text{GE.K(LG)} * ((1 - \text{FGEASP.K(LG)})) \quad 26, A$$

GEPT - GOVT EMPLOYEES PRODUCING TRANSFERS (PEOPLE)

LG - LEVEL OF GOVT

GE - GOVERNMENT EMPLOYEES (PEOPLE)

FGEASP - FRACTION OF GOVT EMPLOYEES ALLOCATED TO SERVICE PRODUCTION (DIM)

$$\text{SOGTP.K(LG)} = \text{SOGTP.J(LG)} + (\text{DT}/\text{TESOGT.J(LG)}) \quad 27, \text{ L}$$
$$(\text{OGTP.J(LG)} - \text{SOGTP.J(LG)} - \text{ERSOGT.J(LG)})$$

- SOGTP - STANDARD OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT UNITS/PERSON/YEAR)
- LG - LEVEL OF GOVT
- DT - SOLUTION INTERVAL (YEARS)
- TESOGT - TIME TO ESTABLISH STANDARD OUTPUT OF GOVT TRANSFERS PER CAPITA (YEARS)
- OGTP - OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT UNITS/PERSON/YEAR)
- ERSOGT - EXOGENOUS REDUCTION IN STANDARD OUTPUT OF GOVT TRANSFERS PER CAPITA (OUTPUT UNITS/PERSON/YEAR)

$$\text{TESOGT.K(LG)} = \text{TABHL}(\text{TTESGO}, \text{OGTP.K(LG)}/\text{SOGTP.K(LG)}, .95, 1, .05) \quad 28, \text{ A}$$

- TESOGT - TIME TO ESTABLISH STANDARD OUTPUT OF GOVT TRANSFERS PER CAPITA (YEARS)
- LG - LEVEL OF GOVT
- TABHL - TABLE LOOK-UP FUNCTION
- TTESGO - TABLE OF TIME TO ESTABLISH TRADITIONAL STANDARD OF GOVT OUTPUT PER CAPITA
- OGTP - OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT UNITS/PERSON/YEAR)
- SOGTP - STANDARD OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT UNITS/PERSON/YEAR)

$$\text{PGEPT.K} = \text{RPGEPT} * \text{ETPGET.K} \quad 29, \text{ A}$$

- PGEPT - PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING TRANSFERS (OUTPUT UNITS/PERSON/YEAR)
- RPGEPT - REFERENCE PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING TRANSFERS (OUTPUT UNITS/PERSON/YEAR)
- ETPGET - EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF GOVT EMPLOYEES IN TRANSFERS (DIM)

$$\text{ETPGET.K} = \text{TABLE}(\text{TETPGT}, \text{T.K}/\text{RLT}, 0, 1.5, .25) \quad 30, \text{ A}$$

- ETPGET - EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF GOVT EMPLOYEES IN TRANSFERS (DIM)
- TABLE - TABLE LOOK-UP FUNCTION
- TETPGT - TABLE OF EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING TRANSFERS
- T - INDEX OF TECHNOLOGY (DIMENSIONLESS)
- RLT - REFERENCE LEVEL OF TECHNOLOGY (DIM)

The first difference between the equations for production of services versus those for production of transfers is that in generating Government Employees Producing Transfers GEPT (see equation 26), the compliment of Fraction of Government Employees Allocated to Service Production FGEASP is used rather than FGEASP itself. This is an obvious modification designed to ensure that the entire pool of government employees is, in fact, allocated to producing either services or transfers.

The second difference between the two sets of equations is that Technology T is assumed to have a greater impact on the productivity of government employees engaged in the production of government transfers than on employees producing services. However, the impact is still less than the assumed impact of Technology on the

productivity of private sector employees, as is discussed subsequently (see equation 149).

Figure A1-11 details the assumed impact of Technology T on the productivity of government employees engaged in the production of transfers. The Figure can be compared directly to Figure A1-10.

TABLE OF EFFECT OF TECHNOLOGY
ON PRODUCTIVITY OF GOVT EMPLOYEES
PRODUCING TRANSFERS
 $TETPGT, 153.1, T$

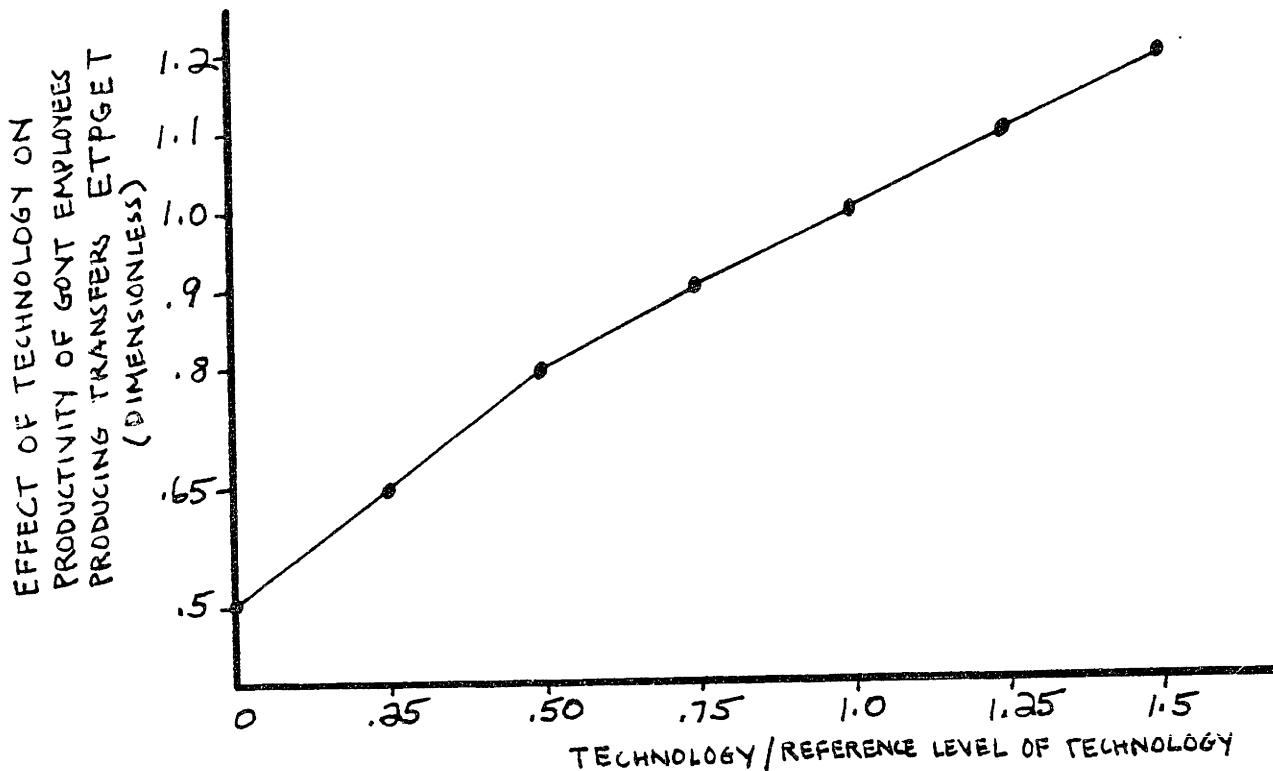


Figure A1-11. The Impact of Technology on the Productivity of Government Employees Producing Transfers.

As Figure A1-11 indicates, increases in T above RLT are assumed to have twice the impact on government employees producing transfers that they have on government employees producing services. Decreases in T below RLT are assumed to have an even more pronounced relative effect on transfer-producing employees than as service-producing employees.

The justification for the relatively greater impact of technology on transfer-producing government employees is that transfer payment production is an inherently more capital-intensive process than service production. For example, an advance in computer technology may enable a single government worker to process many more social security or welfare checks. However, such an advance is unlikely to significantly reduce the teacher-pupil ratio in elementary schools, or to radically decrease the number of policemen required to service a given neighborhood.

A1.3 GOVERNMENT MONEY BALANCE

A flow diagram of the Government Money Balance block of equations appears in Figure A1-12. The central level in this block is Government Money Balance GMB.

Government Money Balance GMB is augmented by Increase in Money Balance IMB and depleted by Decrease in Money Balance DMB and by an Exogenous Reduction in Government Money Balance ERGMB: the latter functioning only under test conditions.

GOVERNMENT MONEY BALANCE

$$\text{GMB.K(LG)} = \text{GMB.J(LG)} + (\text{DT}) (\text{IMB.JK(LG)} - \text{DMB.JK(LG)} - \text{ERGMB.J(LG)}) \quad 31, \text{ L}$$

- GMB - GOVT MONEY BALANCE (DOLLARS)
- LG - LEVEL OF GOVT
- DT - SOLUTION INTERVAL (YEARS)
- IMB - INCREASE IN MONEY BALANCE (\$/YEAR)
- DMB - DECREASE IN MONEY BALANCE (\$/YEAR)
- ERGMB - EXOGENOUS REDUCTION IN GOVT MONEY BALANCE (\$/YEAR)

IMB equation 32, is formulated as the sum of Tax Revenues TAXREV and Sale of Government Securities SGS, both of which are generated in other equation blocks. TAXREV, defined in equation 95, is the dollar inflow that results from levying a government-generated tax rate on a fixed fraction of the total income generated by the economy. SGS, defined in equation 54, is the dollar inflow resulting from the sale of government securities to private corporations and the public.

$$\text{IMB.KL(LG)} = \text{TAXREV.K(LG)} + \text{SGS.JK(LG)} \quad 32, \text{ R}$$

- IMB - INCREASE IN MONEY BALANCE (\$/YEAR)
- LG - LEVEL OF GOVT
- TAXREV - TAX REVENUES (\$/YEAR)
- SGS - SALE OF GOVT SECURITIES (\$/YEAR)

Decrease in Money Balance DMB, equation 33, is the sum of four components: Payments to Factors of Government Production PFGP, Transfer Payments TP, Interest on Government Securities Outstanding IGSO, and Retirement of Government Securities RGS.

$$\text{DMB.KL(LG)} = \text{PFGP.K(LG)} + \text{TP.K(LG)} + \text{IGSO.K(LG)} + \text{RGS.JK(LG)} \quad 33, R$$

DMB - DECREASE IN MONEY BALANCE (\$/YEAR)
LG - LEVEL OF GOVT
PFGP - PAYMENTS TO FACTORS OF GOVT PRODUCTION (\$/YEAR)
TP - TRANSFER PAYMENTS (\$/YEAR)
IGSO - INTEREST ON GOVT SECURITIES OUTSTANDING (\$/YEAR)
RGS - RETIREMENT OF GOVT SECURITIES (\$/YEAR)

Payments to Factors of Government Production PFGP consists of the wages, salaries and benefits paid to factors (employees) producing government output. PFGP is taken, following standard National Income Accounting procedure [5], as government's contribution to GNP (see equation 139 and 144). PFGP is formulated in equation 34 as the product of Government Employees GE and Factor Payment per Government Employee FPGE.

$$\text{PFGP.K(LG)} = \text{GE.K(LG)} * \text{FPGE.K(LG)} \quad 34, A$$

PFGP - PAYMENTS TO FACTORS OF GOVT PRODUCTION (\$/YEAR)
LG - LEVEL OF GOVT
GE - GOVERNMENT EMPLOYEES (PEOPLE)
FPGE - FACTOR PAYMENTS PER GOVT EMPLOYEE (\$/PERSON/YEAR)

FPGE is, in turn, modeled as a Reference Factor Payment per Government Employee RFPGE moderated by the Effect of Money Adequacy on Factor Payments per Employee EMAFPE.

$$\text{FPGE.K(LG)} = \text{RFPGE(LG)} * \text{EMAFPE.K(LG)} \quad 35, A$$

FPGE - FACTOR PAYMENTS PER GOVT EMPLOYEE (\$/PERSON/YEAR)
LG - LEVEL OF GOVT
RFPGE - REFERENCE FACTOR PAYMENT PER GOVT EMPLOYEE (\$/PERSON/YEAR)
EMAFPE - EFFECT OF MONEY ADEQUACY ON FACTOR PAYMENTS PER EMPLOYEE (DIM)

Because PFGP is government's contribution to GNP, RFPGE is defined in equation 154.2 as the dollar amount that, when paid to the reference number of Government Employees, will generate the reference level of government contribution to GNP.

$$\begin{aligned} \text{RFPGE}(1) &= ((\text{RTO} - \text{RPPGS}) * \text{FRGOLG}(1)) / \text{GE}(1) / \text{EMAFPE}(1) && 154.2, \text{ N} \\ \text{FRGOLG}(1) &= 1 && 154.3, \text{ C} \end{aligned}$$

RFPGE - REFERENCE FACTOR PAYMENT PER GOVT EMPLOYEE
(\$/PERSON/YEAR)

RTO - REFERENCE TOTAL OUTPUT (\$/YEAR)

RPPGS - REFERENCE PRIVATE PRODUCTION OF GOODS &
SERVICES (\$/YEAR)

FRGOLG - FRACTION OF REFERENCE GOVT OUTPUT BY LEVEL
OF GOVT (DIM)

The reference level of government contribution to GNP is determined by subtracting the Reference level of Private Production of Goods and Services RPPGS from the Reference level of Total Output RTO. Values for RTO and RPPGS were specified so as to approximate (their) current magnitudes in the American economy (see equations 139.2 and 141.2, respectively). Because there is only one level of government in this configuration of the model, Fraction of Reference Government Output by Level of Government FRGOLG is set equal to 1.0 in equation 154.2. If there were two or more levels of government being modeled, the sum of FRGOLG across all levels of government would equal to 1.0. Government's reference contribution to GNP is then divided by the reference level of government employees GE, so that when multiplied by GE in equation 35, GE will cancel. Finally, the Effect of Money Adequacy on Factor Payments per Employee EMAFPE is neutralized in equation 35 dividing through by EMAFPE in equation 154.1. Initializing RFPGE in this manner ensures that government's contribution to GNP (i.e., PFGP) in the reference equilibrium will be the desired amount.

In determining Factor Payments per Government Employee FPGE, RFPGE is modulated by the Effect of Money Adequacy on Factor Payments per Employee EMAFPE. As equation 36 indicates, EMAFPE depends upon Government Money Adequacy GMA.

EMAFPE.K(LG)=TABLE(TEMAFP,GMA.K(LG),0,2,.25) 36, A
EMAFPE - EFFECT OF MONEY ADEQUACY ON FACTOR PAYMENTS
PER EMPLOYEE (DIM)
LG - LEVEL OF GOVT
TABLE - TABLE LOOK-UP FUNCTION
TEMAFP - TABLE OF EFFECT OF MONEY ADEQUACY ON FACTOR
PAYMENTS
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

As Figure A1-13 shows, government is assumed to respond asymmetrically to its money adequacy position. When GMA rises above 1.0, FPGE increases linearly. When GMA dips below 1.0, however, the depressive effect on FPGE is assumed to be nonlinear. A 25% decline in GMA below 1.0 yields only a 10% reduction in FPGE. A 50% decline yields only a 30% reduction. When GMA dips another 25%, however, FPGE is assumed to be cut by 80%. Thus, at low levels of GMA, the depressive effect on FPGE is assumed to be quite severe.

TABLE OF EFFECT OF MONEY ADEQUACY ON FACTOR PAYMENTS TEM AFP, 154.4, T

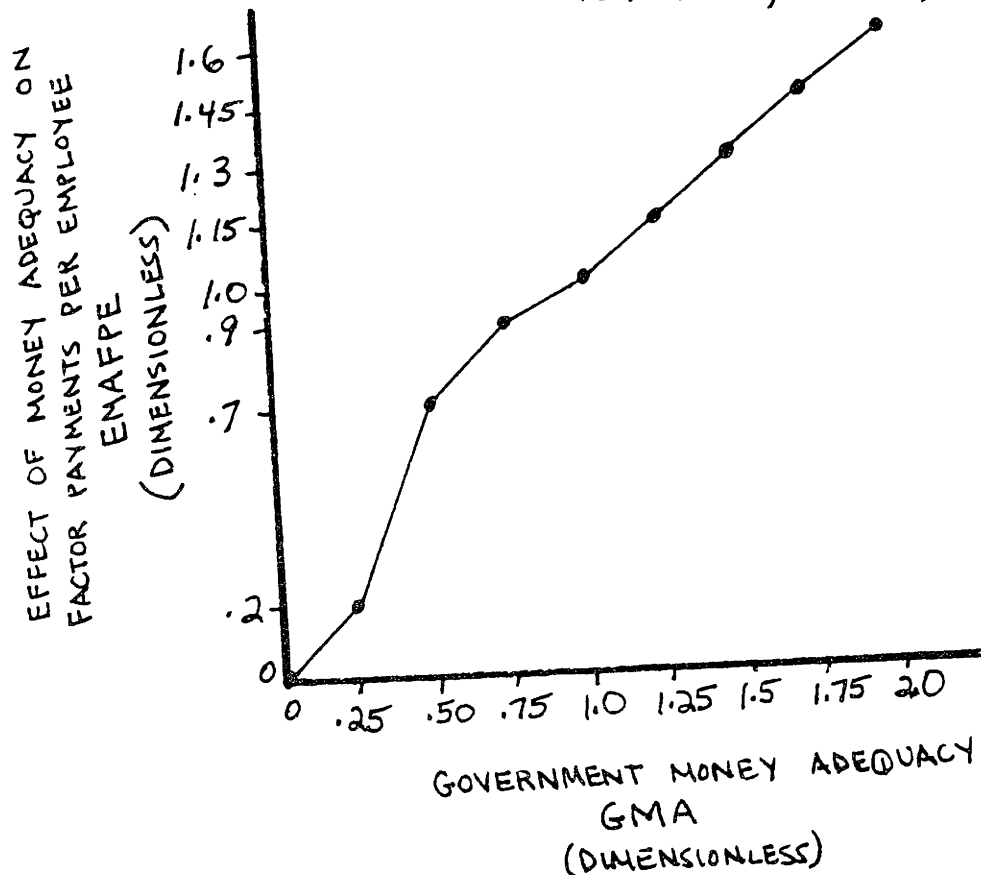


FIGURE A1-13. The Effect of Government Money Adequacy on Factor Payments per Government Employee.

The asymmetry in government's response to its money adequacy position reflects an assumption that government is considerably more willing (and able) to increase wages and salaries than to cut them back. Only when money adequacy becomes very low will government, perforce take the steps necessary to render itself financially solvent.

Transfer Payments TP are the second component of Decrease in Money Balance DMB. TP, equation 37, consists of the sum of Payments for Other than Unemployment POU and Payments for Unemployment PU.

37, A

$$TP.K(LG) = POU.K(LG) + PU.K(LG)$$

TP - TRANSFER PAYMENTS (\$/YEAR)
 LG - LEVEL OF GOVT
 POU - PAYMENTS FOR OTHER THAN UNEMPLOYMENT (\$/YEAR)
 PU - PAYMENTS FOR UNEMPLOYMENT (\$/YEAR)

POU consists of all transfer payments other than unemployment compensation. Included in this category, in reality, are payments like Social Security, Aid for Dependent Children, and Food Stamps. POU is formulated, in equation 38, as the product of Output of Government Transfers OGT and Compensation per Output Unit COU.

38, A

$$POU.K(LG) = OGT.K(LG) * COU.K(LG)$$

POU - PAYMENTS FOR OTHER THAN UNEMPLOYMENT (\$/YEAR)
 LG - LEVEL OF GOVT
 OGT - OUTPUT OF GOVT TRANSFERS (OUTPUT UNITS/YEAR)
 COU - COMPENSATION PER OUTPUT UNIT (\$/OUTPUT UNIT)

This formulation ties the payment of non-unemployment compensation to the output of Government Transfers OGT. This ensures that under the extreme condition of zero employees engaged in the production of government transfers, no compensation will be paid. In addition, it obviates a more complex formulation in which various recipient classes would have to be disaggregated. Such classes might be: those aged 65 or older; single-parent, unemployed households; those with incomes below the poverty-line; etc. Output of Government Transfers OGT is dimensioned in output units/year. Therefore, when

Transfer Payments TP are the second component of Decrease in Money Balance DMB. TP, equation 37, consists of the sum of Payments for Other than Unemployment POU and Payments for Unemployment PU.

$$TP.K(LG) = POU.K(LG) + PU.K(LG) \quad 37, A$$

TP - TRANSFER PAYMENTS (\$/YEAR)
LG - LEVEL OF GOVT
POU - PAYMENTS FOR OTHER THAN UNEMPLOYMENT (\$/YEAR)
PU - PAYMENTS FOR UNEMPLOYMENT (\$/YEAR)

POU consists of all transfer payments other than unemployment compensation. Included in this category, in reality, are payments like Social Security, Aid for Dependent Children, and Food Stamps. POU is formulated, in equation 38, as the product of Output of Government Transfers OGT and Compensation per Output Unit COU.

$$POU.K(LG) = OGT.K(LG) * COU.K(LG) \quad 38, A$$

POU - PAYMENTS FOR OTHER THAN UNEMPLOYMENT (\$/YEAR)
LG - LEVEL OF GOVT
OGT - OUTPUT OF GOVT TRANSFERS (OUTPUT UNITS/YEAR)
COU - COMPENSATION PER OUTPUT UNIT (\$/OUTPUT UNIT)

This formulation ties the payment of non-unemployment compensation to the output of Government Transfers OGT. This ensures that under the extreme condition of zero employees engaged in the production of government transfers, no compensation will be paid. In addition, it obviates a more complex formulation in which various recipient classes would have to be disaggregated. Such classes might be: those aged 65 or older; single-parent, unemployed households; those with incomes below the poverty-line; etc. Output of Government Transfers OGT is dimensioned in output units/year. Therefore, when

multiplied by Compensation per Other than Unemployment COU, dimensioned as \$/Output Unit, the resulting product, POU, is dimensioned as \$/year.

Compensation per Output Unit COU is defined in equation 39 as a Base Compensation per Output Unit BCOU moderated by the Effect of Money Adequacy on Transfer Payment Compensation EMATPC.

$$\text{COU.K(LG)} = \text{BCOU.K(LG)} * \text{EMATPC.K(LG)} \quad 39, A$$

COU - COMPENSATION PER OUTPUT UNIT (\$/OUTPUT UNIT)
LG - LEVEL OF GOVT
BCOU - BASE COMPENSATION PER OUTPUT UNIT (\$/OUTPUT UNIT)
EMATPC - EFFECT OF MONEY ADEQUACY ON TRANSFER PAYMENT COMPENSATION (DIM)

BCOU is the total dollar amount of compensation for other than unemployment that government will pay out, per output unit of government transfers produced, under conditions of neutral money adequacy. As equation 40 indicates, BCOU is formulated as the product of a Reference Compensation per Output Unit RCOU and a ratio of Average Private Production of Goods and Services Per capita APPGSP to the Reference Level of Private Production Per capital RLPPP.

$$\text{BCOU.K(LG)} = \text{RCOU(LG)} * \text{APPGSP.K/RLPPP} \quad 40, A$$

BCOU - BASE COMPENSATION PER OUTPUT UNIT (\$/OUTPUT UNIT)
LG - LEVEL OF GOVT
RCOU - REFERENCE COMPENSATION PER OUTPUT UNIT (\$/OUTPUT UNIT)
APPGSP - AVERAGE PRIVATE PRODUCTION OF GOODS AND SERVICES PER CAPITA (\$/PERSON/YEAR)
RLPPP - REFERENCE LEVEL OF PRIVATE PRODUCTION PER CAPITA (\$/PERSON/YEAR)

RCOU is the amount of compensation for other than unemployment per output unit of government transfers being produced in the reference equilibrium condition. RCOU is defined, in equation 154.5, as Payments for Unemployment PU times a Ratio of Payments for Other than Unemployment to Payments for Unemployment RPOUPU. RPOUPU is set equal to 4 in equation 154.6. This means that in the reference equilibrium condition government is paying out 4 times as much in non-unemployment compensation as it is in unemployment compensation.

$$\begin{aligned} \text{RCOU}(1) &= (\text{PU}(1) * \text{RPOUPU}(1)) / \text{OGT}(1) && 154.5, \text{ N} \\ \text{RPOUPU}(1) &= 4 && 154.6, \text{ C} \end{aligned}$$

- RCOU - REFERENCE COMPENSATION PER OUTPUT UNIT (\$/ OUTPUT UNIT)
- PU - PAYMENTS FOR UNEMPLOYMENT (\$/YEAR)
- RPOUPU - RATIO OF PAYMENTS FOR OTHER THAN UNEMPLOYMENT COMPENSATION TO PAYMENTS FOR UNEMPLOYMENT COMPENSATION (DIM)

The product of U and RPOUPU is then divided by Output of Government Transfers OGT. As a result, when COU is multiplied by OGT (in equation 38) to yield POU, OGT cancels.

As equation 40 indicates, COU is directly indexed to the average level of private output. Indexing reflects the assumption that the level of transfer payments required by individuals is tied to the standard of living of the society at large; the latter assumed to be determined by the average yearly level of private output of goods and services per capita.

Compensation per Output Unit COU will equal BCOU under conditions of neutral Government Money adequacy. However, when money adequacy departs from 1.0, it is assumed that such departures will be reflected in COU via changes in the Effect of Money Adequacy on Transfer Payment Compensation EMATPC. EMATPC is defined in equation 41 and depicted in Figure A1-14.

EMATPC.K(LG)=TABLE(TEMAC,GMA.K(LG),0,2,.25) 41, A
EMATPC - EFFECT OF MONEY ADEQUACY ON TRANSFER
PAYMENT COMPENSATION (DIM)
LG - LEVEL OF GOVT
TABLE - TABLE LOOK-UP FUNCTION
TEMAC - TABLE OF EFFECT OF MONEY ADEQUACY ON
COMPENSATION
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

TABLE OF EFFECT OF MONEY
ADEQUACY ON COMPENSATION
TEMAC, 154.7, T

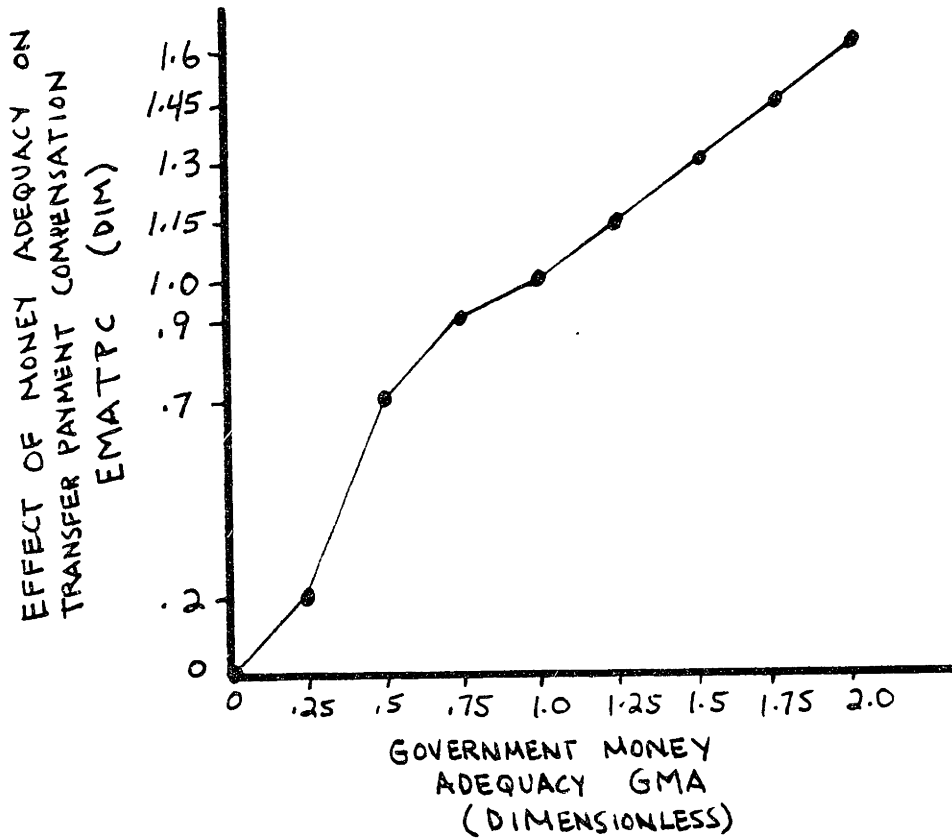


FIGURE A1-14. The Effect of Money Adequacy on Transfer Payment Compensation.

As a comparison of Figures A1-13 and A1-14 reveals, Government Money Adequacy GMA is assumed to have the same impact on both factor payments and transfer payment compensation. Thus, as with factor payment compensation, government is assumed to respond asymmetrically to money adequacy in establishing transfer payment compensation. As GMA rises above 1.0, transfer payment compensation rises linearly. As GMA falls below 1.0, there is an initial downward stickiness to transfer payment compensation followed by a sharp reaction at low levels of GMA. The justification for the non-linearity is the same as discussed for EMAPPE.

Payments for Unemployment PU is the second component of Transfer Payments TP. PU is defined in equation 42 as the product of Eligible Unemployed EU and Compensation per Unemployed CU.

$$PU.K(LG) = EU.K(LG) * CU.K(LG) \quad 42, A$$

PU - PAYMENTS FOR UNEMPLOYMENT (\$/YEAR)
LG - LEVEL OF GOVT
EU - ELIGIBLE UNEMPLOYED (PEOPLE)
CU - COMPENSATION PER UNEMPLOYED (\$/PERSON/YEAR)

EU is the number of unemployed who are actually eligible for unemployment benefits from government. EU is formulated, in equation 43, as Unemployed U times the Fraction of Unemployed who are Eligible by Level of Government FUELG.

$$EU.K(LG) = U.K * FUELG.K(LG) \quad 43, A$$

EU - ELIGIBLE UNEMPLOYED (PEOPLE)
LG - LEVEL OF GOVT
U - UNEMPLOYED (PEOPLE)
FUELG - FRACTION OF UNEMPLOYED ELIGIBLE BY LEVEL OF GOVT (DIM)

U (see equation 106) is the number of people in the labor force who are not employed either by government or by the private sector. FUELG is the fraction of unemployed who are actually eligible for government unemployment compensation at each level of government. FUELG is defined in equation 44 as a Reference Fraction of Unemployed Eligible by Level of Government RFUELG modulated by the Effect of Money Adequacy on the Population of Eligible Unemployed EMAPEU.

$$\text{FUELG.K(LG)} = \text{RFUELG(LG)} * \text{EMAPEU.K(LG)} \quad 44, A$$

FUELG - FRACTION OF UNEMPLOYED ELIGIBLE BY LEVEL OF GOVT (DIM)
LG - LEVEL OF GOVT
RFUELG - REFERENCE FRACTION OF UNEMPLOYED ELIGIBLE BY LEVEL OF GOVT (DIM)
EMAPEU - EFFECT OF MONEY ADEQUACY ON POPULATION OF ELIGIBLE UNEMPLOYED (DIM)

RFUELG is set (in equation 154.8) equal to .8, meaning that under neutral money adequacy conditions, 20% of those in the unemployed pool receive no government unemployment compensation. The 20% figure is reasonable in view of the following: (1) some people who are unemployed do not know about possible government benefit programs, (2) some unemployed people do not wish to be on the "public dole", (3) some people who are unemployed are not really unemployed, but rather "between jobs" and (4) some unemployed are covered by non-government unemployment compensation. All of these factors combine to make the fraction of unemployed receiving unemployment compensation from government less than 1.0.

As equation 44 indicates, RFUELG is moderated by the Effect of Money Adequacy on the Population of Eligible Unemployed EMAPEU. EMAPEU, defined in equation 45, depends upon GMA.

EMAPEU.K(LG)=TABHL(TEMAEP,GMA.K(LG),0,2,.25) 45, A
EMAPEU - EFFECT OF MONEY ADEQUACY ON POPULATION OF
ELIGIBLE UNEMPLOYED (DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TEMAEP - TABLE OF EFFECT OF MONEY ADEQUACY ON
ELIGIBLE POPULATION
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

As Figure A1-15 shows, under conditions of neutral money adequacy, EMAPEU takes on a value of 1.0. As GMA rises above 1.0, EMAPEU rises steeply at first and then saturates at a value of GMA of 2.0. The saturation reflects the fact that it will never be possible (for reasons previously discussed) for government, irrespective of its money adequacy, to provide every unemployed person with unemployment compensation. At GMA equal to 2.0 EMAPEU takes on a value of 1.21, which, when multiplied by RFUELG (which equals .8) yields a value for FUELG of .968. Thus, the best that government can do, in the model, is to pay unemployment compensation to 97% of those who are unemployed.

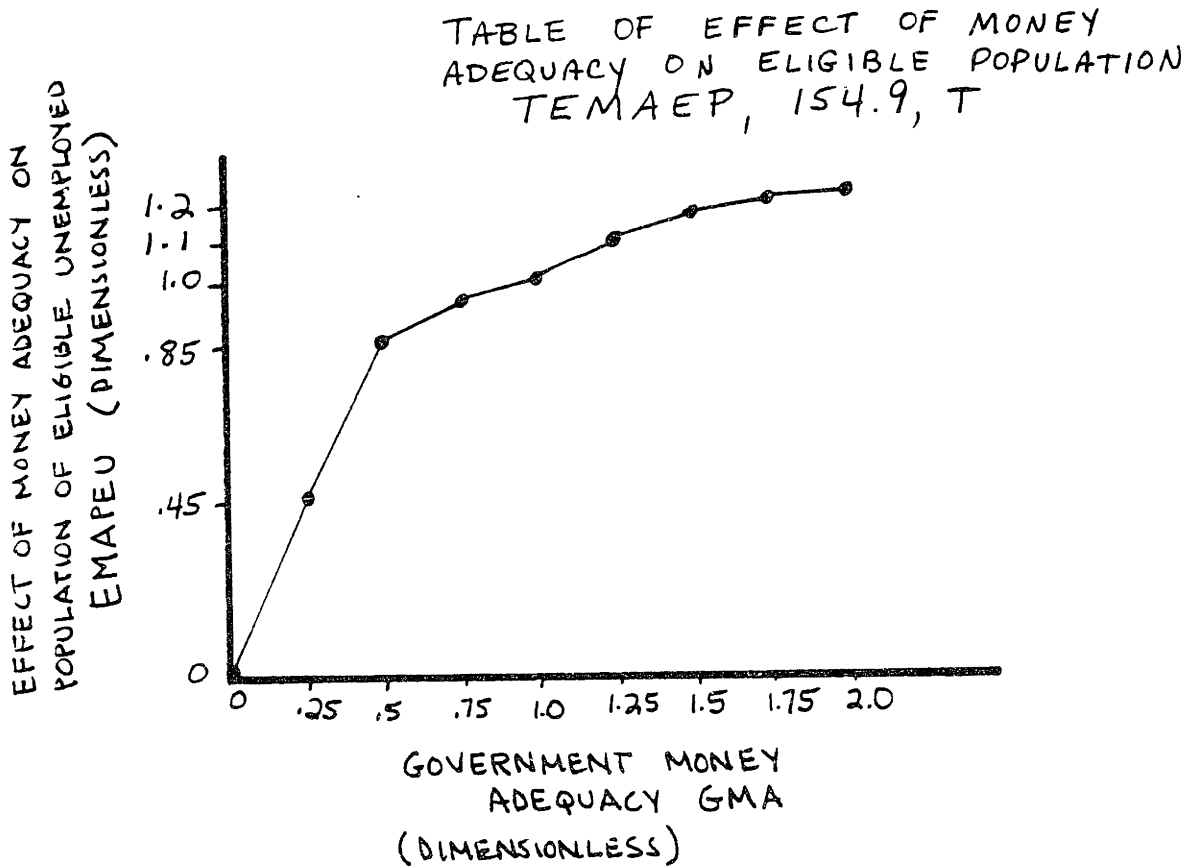


FIGURE A1-15. The Effect of Money Adequacy on the Population of Eligible Unemployed.

When GMA dips below 1.0, Figure A1-15 indicates that a downward stickiness is again assumed to exist. A 25% reduction in GMA below the neutral point causes only slightly more than a 6% cutback in eligibility for unemployment compensation. A 50% reduction in GMA gives rise to only a 15% rollback of eligibility. However, as GMA falls to .25 and lower, the cutback in eligibility is very severe.

Here again, then, the assumption is that it is in government's best interests to expand, or to at least maintain, any level of services or transfers that is currently in existence.

The second component of Payments for Unemployment (equation 42) is Compensation per Unemployed CU. Compensation per Unemployed CU is the average yearly dollar amount allocated to those receiving government unemployment compensation. CU is formulated, in equation 46, in a manner exactly analogous to non-unemployment compensation.

$$CU.K(LG) = BCU.K * EMATPC.K(LG) \quad 46, A$$

CU - COMPENSATION PER UNEMPLOYED (\$/PERSON/YEAR)
LG - LEVEL OF GOVT
BCU - BASE COMPENSATION PER UNEMPLOYED (\$/PERSON/YEAR)
EMATPC - EFFECT OF MONEY ADEQUACY ON TRANSFER PAYMENT COMPENSATION (DIM)

CU is the product of a Base Compensation per Unemployed BCU and the Effect of Money Adequacy on Transfer Payment Compensation EMATPC. The second term has already been described (see equation 41). As is evident from an examination of equation 47, Base Compensation per Unemployed BCU, like its non-unemployment analogue Base Compensation per Output Unit BCOU, is directly indexed to the level of private output.

$$BCU.K = APPGSP.K * UCFPP \quad 47, A$$

BCU - BASE COMPENSATION PER UNEMPLOYED (\$/PERSON/YEAR)
APPGSP - AVERAGE PRIVATE PRODUCTION OF GOODS AND SERVICES PER CAPITA (\$/PERSON/YEAR)
UCFPP - UNEMPLOMENT COMPENSATION AS A FRACTION OF PRIVATE PRODUCTION (DIM)

BCU is simply the product of Average Private Production of Goods and Services Per capita APPGSP and Unemployment Compensation as a Fraction of Private Production UCFPP. The assumption in indexing unemployment compensation to the level of private output is that the amount of money that an unemployed person requires in order to survive, must be pegged to the level of economic activity.

Government Money Adequacy GMA is the final major concept in the Money Balance block. GMA is government's measure of how much money it has relative to how much it needs to meet a desired stream of spending obligations. Thus, equation 48 defines GMA as the ratio of Government Money Balance GMB to the product of Average Desired Payments ADPAY and Desired Money Coverage DMCOV.

$$\text{GMA.K(LG)} = \text{GMB.K(LG)} / (\text{ADPAY.K(LG)} * \text{DMCOV}) \quad 48, A$$

GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)
LG - LEVEL OF GOVT
GMB - GOVT MONEY BALANCE (DOLLARS)
ADPAY - AVERAGE DESIRED PAYMENTS (\$/YEAR)
DMCOV - DESIRED MONEY COVERAGE (YEARS)

Government Money Balance GMB (see equation 31) is the accumulated net of government's money inflows and outflows. Average Desired Payments ADPAY is simply a short-term average of Desired Payments DPAY, which are, in turn, an indication of what government would like to be spending if its Money Adequacy were neutral and therefore permitted it to spend as it wished, Desired Money Coverage DMCOV indicates how many years worth of desired payments government would like to have on hand in its money balance. GMA is thus best thought of as a ratio of money to desired money.

ADPAY is defined in equation 49 as an exponential average of Desired Payments DPAY.

$$\text{ADPAY.K(LG)} = \text{ADPAY.J(LG)} + (\text{DT/TADP}) (\text{DPAY.J(LG)} - \text{ADPAY.J(LG)} - \text{ERADPY.J(LG)}) \quad 49, L$$

ADPAY - AVERAGE DESIRED PAYMENTS (\$/YEAR)
LG - LEVEL OF GOVT
DT - SOLUTION INTERVAL (YEARS)
TADP - TIME TO AVERAGE DESIRED PAYMENTS (YEARS)
DPAY - DESIRED PAYMENTS (\$/YEAR)
ERADPY - EXOGENOUS REDUCTION IN AVERAGE DESIRED PAYMENTS (\$/YEAR)

Desired Payments DPAY is, in turn, formulated in equation 50 as the product of Average Decrease in Money Balance ADMB and the Effect of Money Adequacy on Desired Payments EMADP.

$$\text{DPAY.K(LG)} = \text{ADMB.K(LG)} * \text{EMADP.K(LG)} \quad 50, A$$

DPAY - DESIRED PAYMENTS (\$/YEAR)
LG - LEVEL OF GOVT
ADMB - AVERAGE DECREASE IN MONEY BALANCE (\$/YEAR)
EMADP - EFFECT OF MONEY ADEQUACY ON DESIRED PAYMENTS (DIM)

ADMB is a short-term exponential average of Decrease in Money Balance DMB.

$$\text{ADMB.K(LG)} = \text{ADMB.J(LG)} + (\text{DT/TADMB}) (\text{DMB.JK(LG)} - \text{ADMB.J(LG)} - \text{ERDMB.J(LG)}) \quad 51, L$$

ADMB - AVERAGE DECREASE IN MONEY BALANCE (\$/YEAR)
LG - LEVEL OF GOVT
DT - SOLUTION INTERVAL (YEARS)
TADMB - TIME TO AVERAGE DECREASE IN MONEY BALANCE (YEARS)
DMB - DECREASE IN MONEY BALANCE (\$/YEAR)
ERDMB - EXOGENOUS REDUCTION IN DECREASE IN MONEY BALANCE (\$/YEAR)

ADMB is multiplied by EMADP in calculating Desired Payments DPAY in order to eliminate the possibility of a downward spiral. Such a spiral could come about if low Money Adequacy were depressing DMB which would, in turn, depress DPAY thereby upholding GMA and, as a consequence, defusing pressures that would otherwise seek to restore GMB to a level that could support the true desired level of government

spending. The inclusion of EMADP prevents this reinforcing process from operating. When GMA depresses ADMB, it also inflates EMADP, as indicated in equation 52 and Figure A1-16.

EMADP.K(LG)=TABHL(TEMADP,GMA.K(LG),0,1,.25) 52, A
EMADP - EFFECT OF MONEY ADEQUACY ON DESIRED PAYMENTS (DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TEMADP - TABLE OF EFFECT OF MONEY ADEQUACY ON DESIRED PAYMENTS
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

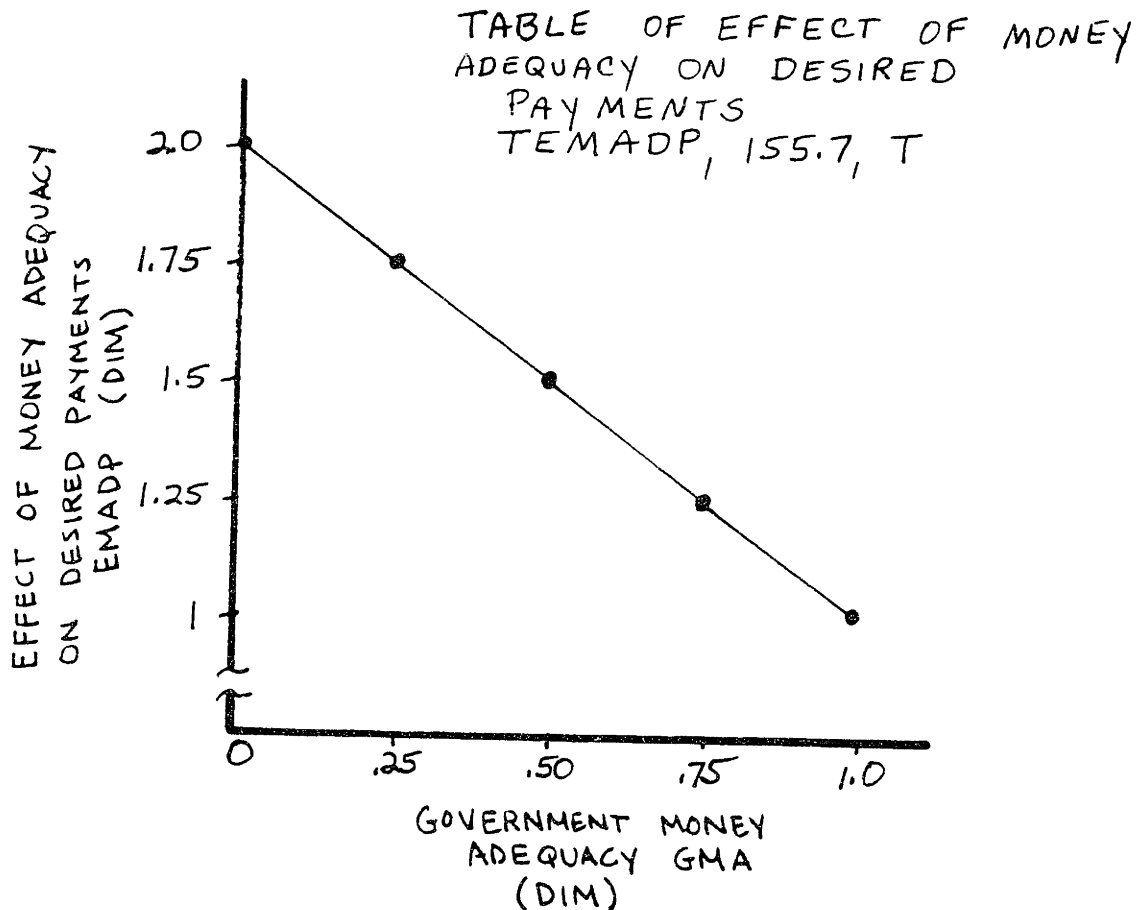


FIGURE A1-16. The Effect of Money Adequacy on Desired Payments.

When GMA declines by 25% below its neutral point, EMADP rises 25%. 50% and 75% dips in GMA give rise to similarly proportional increases in EMADP. As a consequence, the depressive effect of GMA on AICMB is offset by the stimulative effect on EMADP. As a result, Desired Payments DPAY (equation 50) hold up in the face of a Money Shortfall. And, because DPAY holds up, GMA remains at a low level and in doing so gives rise to pressures (such as these to increase tax rates, lay off employees, cut services and sell more securities) to restore Government Money Balance GMB.

A1.4 GOVERNMENT DEBT

A flow diagram of the Government Debt equation block appears in Figure A1-17. As the Figure indicates, the principal accumulation in this block is the level of Outstanding Government Securities OGSY.

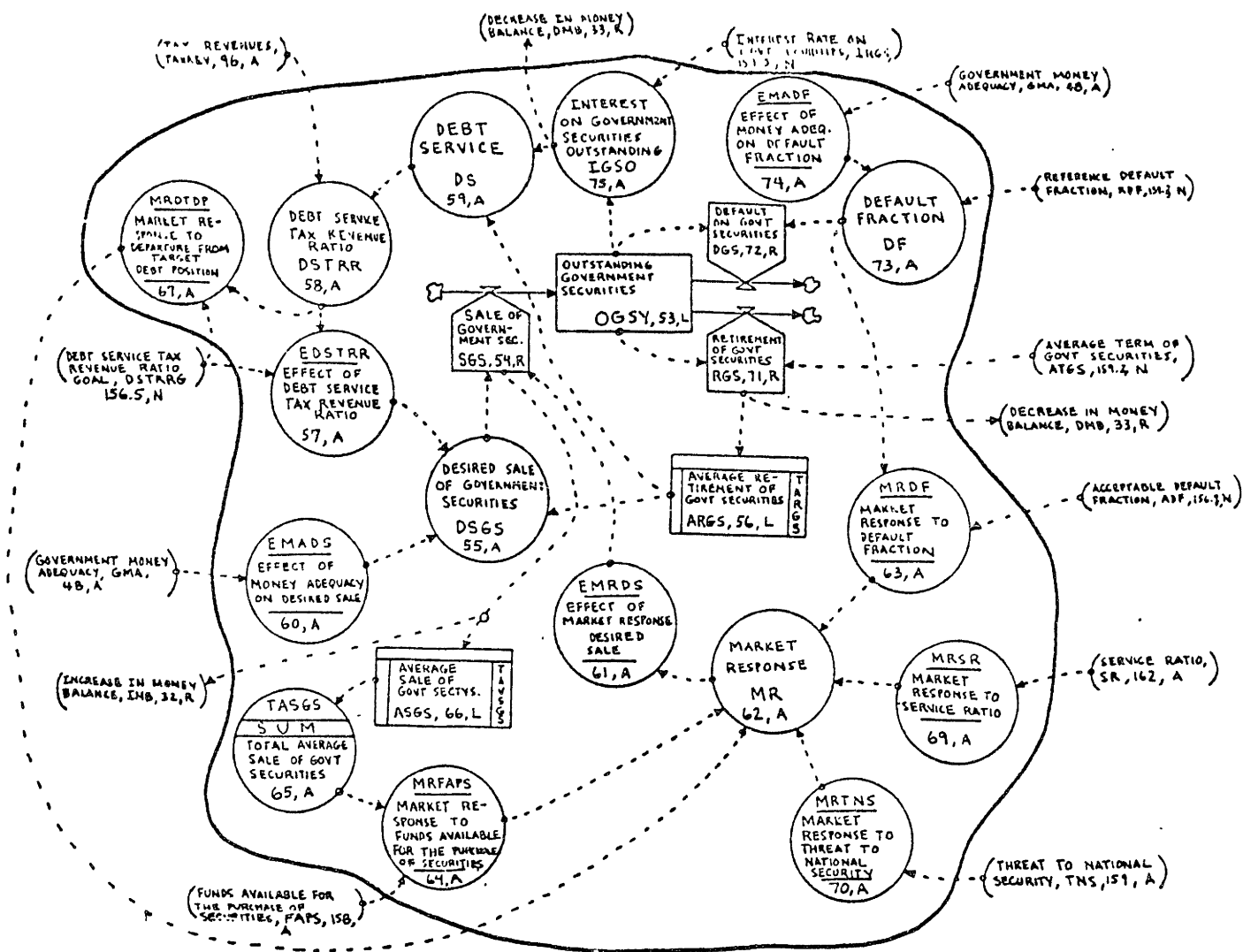


FIGURE A1-17. A Flow Diagram of the Government Debt Equation Block.

OGSY is the total dollar value of government securities that are outstanding at any point in time. OGSY, defined in equation 53, is increased by the Sale of Government Securities SGS and depleted by the Retirement of Government Securities RGS and the Default on Government Securities DGS. In addition, an Exogenous Decrease in Government Securities EDGS is included. EDGS functions only as a testing input (see equation 176). EDGS does not appear in the flow diagram because of space considerations.

GOVERNMENT DEBT EQUATIONS

$$\text{OGSY.K(LG)} = \text{OGSY.J(LG)} + (\text{DT})(\text{SGS.JK(LG)} - \text{RGS.JK(LG)} - \text{DGS.JK(LG)} - \text{EDGS.J(LG)}) \quad 53, L$$

OGSY - OUTSTANDING GOVT SECURITIES (\$)
LG - LEVEL OF GOVT
DT - SOLUTION INTERVAL (YEARS)
SGS - SALE OF GOVT SECURITIES (\$/YEAR)
RGS - RETIREMENT OF GOVT SECURITIES (\$/YEAR)
DGS - DEFAULT ON GOVT SECURITIES (\$/YEAR)
EDGS - EXOGENOUS DECREASE IN GOVT SECURITIES (\$/YEAR)

Sale of Government Securities SGS is the dollar proceeds that government derives from the sale of its securities. SGS is formulated in equation 54 as equal to the Desired Sale of Government Securities DSGS moderated by the Effect of Market Response to Desired Sale EMRDS.

$$\text{SGS.KL(LG)} = \text{DSGS.K(LG)} * \text{EMRDS.K(LG)} \quad 54, R$$

SGS - SALE OF GOVT SECURITIES (\$/YEAR)
LG - LEVEL OF GOVT
DSGS - DESIRED SALE OF GOVT SECURITIES (\$/YEAR)
EMRDS - EFFECT OF MARKET RESPONSE TO DESIRED SALE (DIM)

Desired Sale of Government Securities DSGS is the yearly dollar volume that government would like to derive from the sale of its securities. DSGS, defined in equation 55, is equal to the Average

Retirement of Government Securities ARGS modulated by the Effect of Debt Service to Tax Revenue Ratio EDSTRR and the Effect of Money Adequacy on Desired Sale EMADS.

$$\text{DSGS.K(LG)} = \text{ARGS.K(LG)} * \text{EDSTRR.K(LG)} * \text{EMADS.K(LG)} \quad 55, A$$

DSGS - DESIRED SALE OF GOVT SECURITIES (\$/YEAR)
LG - LEVEL OF GOVT
ARGS - AVERAGE RETIREMENT OF GOVT SECURITIES (\$/YEAR)
EDSTRR - EFFECT OF DEBT SERVICE TAX REVENUE RATIO (DIM)
EMADS - EFFECT OF MONEY ADEQUACY ON DESIRED SALE (DIM)

The equaton for DSGS thus essentially says that under neutral conditions, government would like to sell securities in an amount equal to what is, on average, being retired. Neutral conditions, as will be discussed in detail subsequently, are defined as those in which the ratio of government's debt service to its tax revenues is on target and in which government's money adequacy is equal to 1.0.

Average Retirement of Government Securities ARGS is a short-term exponential average of Retirement of Government Securities, as indicated in equation 56. The averaging smooths out random fluctuations in RGS, thereby establishing a more stable standard upon which to base DSGS.

$$\text{ARGS.K(LG)} = \text{ARGS.J(LG)} + (\text{DT/TARGS}) (\text{RGS.JK(LG)} - \text{ARGS.J(LG)}) \quad 56, L$$

ARGS - AVERAGE RETIREMENT OF GOVT SECURITIES (\$/YEAR)
LG - LEVEL OF GOVT
DT - SOLUTION INTERVAL (YEARS)
TARGS - TIME TO AVERAGE RETIREMENT OF GOVT SECURITIES (YEARS)
RGS - RETIREMENT OF GOVT SECURITIES (\$/YEAR)

Effect of Debt Service Tax Revenue Ratio EDSTRR is modeled, in equation 57, as a function of Debt Service Tax Revenue Ratio DSTRR relative to Debt Service Tax Revenue Ratio Goal DSTRRG.

$$EDSTRR.K(LG) = \text{TABHL}(\text{TEDSTR}, \text{DSTRR.K}(LG) / \text{DSTRRG}(LG), 0, 57', A 2.5, .25)$$

- EDSTRR - EFFECT OF DEBT SERVICE TAX REVENUE RATIO (DIM)
- LG - LEVEL OF GOVT
- TABHL - TABLE LOOK-UP FUNCTION
- TEDSTR - TABLE OF EFFECT OF DEBT SERVICE TAX REVENUE RATIO
- DSTRR - DEBT SERVICE TAX REVENUE RATIO (DIM)
- DSTRRG - DEBT SERVICE TAX REVENUE RATIO GOAL (DIM)

The assumption here is that government will, other things equal, seek to maintain its debt service obligations in line with its incoming tax revenue stream. Such a policy, if adhered to, would help to prevent government from over-leveraging itself and thereby running the risk of defaulting on its obligations.

As Figure A1-18 indicates, when DSTRR is equal to DSTRRG, no pressure to either increase or decrease the Desired Sale of Government Securities DSGS relative to the Average Retirement of Government Securities ARGS arises.

TABLE OF EFFECT OF
DEBT SERVICE TAX
REVENUE RATIO
TEDSTR, 156.5, T

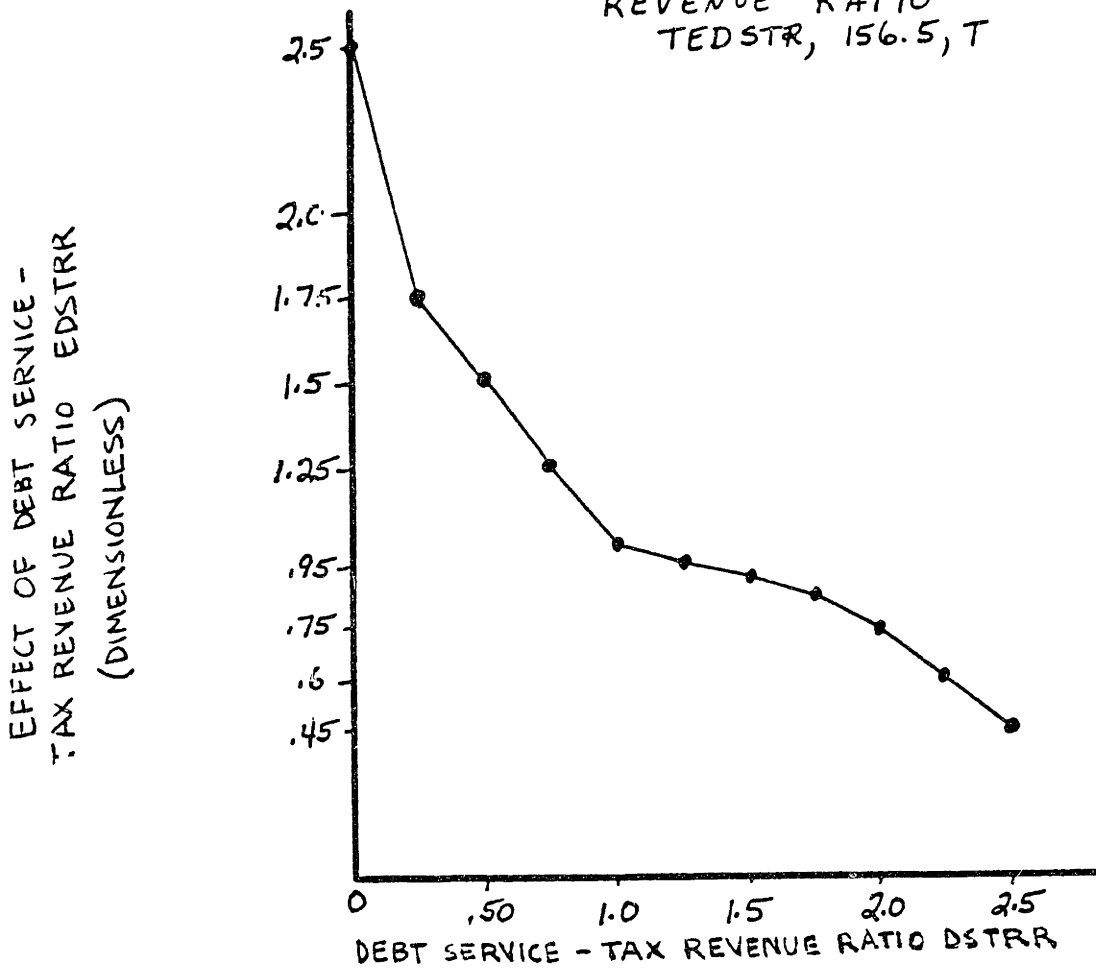


FIGURE A1-18. The Effect of Debt Service to Tax Revenue Ratio on Desired Sale of Government Securities.

As DSTRR rises relative to DSTRRG, increasing pressure to reduce DSGS relative to ARGS is generated. When the ratio of DSTRR to DSTRRG reaches 1.25, EDSTRR takes on a value of .95, meaning that government wants to sell 5% less securities than it is retiring. The effect increases linearly until the ratio rises above 1.75. At this point, the response of EDSTRR to the ratio of DSTRR to DSTRRG becomes increasingly severe.

EDSTRR is more responsive to the ratio of actual to goal below the neutral point. For example, if DSTRR dips to 75% of DSTRRG, EDSTRR takes on a value of 1.25. This indicates that, all else equal, government will try to sell 25% more securities than it is retiring. The relatively high responsiveness of EDSTRR to the ratio of DSTRR to DSTRRG below the 1.0 point continues over the remainder of the range, as Figure A1-18 indicates. The assumptions embodied in this asymmetry are that: (1) government will be reluctant to give up debt capacity once it has been acquired, and (2) when government finds that it can justifiably take a higher leverage position, it will very rapidly do so.

Debt Service Tax Revenue Ratio DSTRR is formulated in equation 58 as the ratio of Debt Service DS to Tax Revenues TAXREV.

$$\text{DSTRR.K(LG)} = \text{DS.K(LG)} / \text{TAXREV.K(LG)} \quad 58, A$$

DSTRR - DEBT SERVICE TAX REVENUE RATIO (DIM)
LG - LEVEL OF GOVT
DS - DEBT SERVICE (\$/YEAR)
TAXREV - TAX REVENUES (\$/YEAR)

Debt Service DS is, in turn, defined in equation 59 as the sum of Interest on Government Securities Outstanding IGSO and Average Retirement of Government Securities ARGS. Debt thus generates two costs: interest and maturity.

$$\text{DS.K(LG)} = (\text{IGSO.K(LG)} + \text{ARGS.K(LG)}) \quad 59, A$$

DS - DEBT SERVICE (\$/YEAR)
LG - LEVEL OF GOVT
IGSO - INTEREST ON GOVT SECURITIES OUTSTANDING (\$/ YEAR)
ARGS - AVERAGE RETIREMENT OF GOVT SECURITIES (\$/ YEAR)

Interest on Government Securities Outstanding IGSO, defined subsequently, (see equation 75), is the yearly dollar amount that government must pay to holders of government securities for use of their money.

The second moderating influence bearing on the determination of Desired Sale of Government Securities DSGS (see equation 55) is the Effect of Money Adequacy on Desired Sale EMADS, formulated in equation 60.

```
EMADS.K(LG)=TABLE(TEMADS,GMA.K(LG),0,2,.25)          50, A
EMADS - EFFECT OF MONEY ADEQUACY ON DESIRED SALE
        (DIM)
LG      - LEVEL OF GOVT
TABLE  - TABLE LOOK-UP FUNCTION
TEMADS - TABLE OF EFFECT OF MONEY ADEQUACY ON
        DESIRED SALE
GMA    - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)
```

As Figure A1-19 indicates, when Government's money adequacy is below what it desires, EMADS causes government--other things equal--to desire to sell a volume of securities in excess of the average retirement rate. And, when government money adequacy rises above 1.0, EMADS causes DSGS, other things equal--to fall below ARGs.

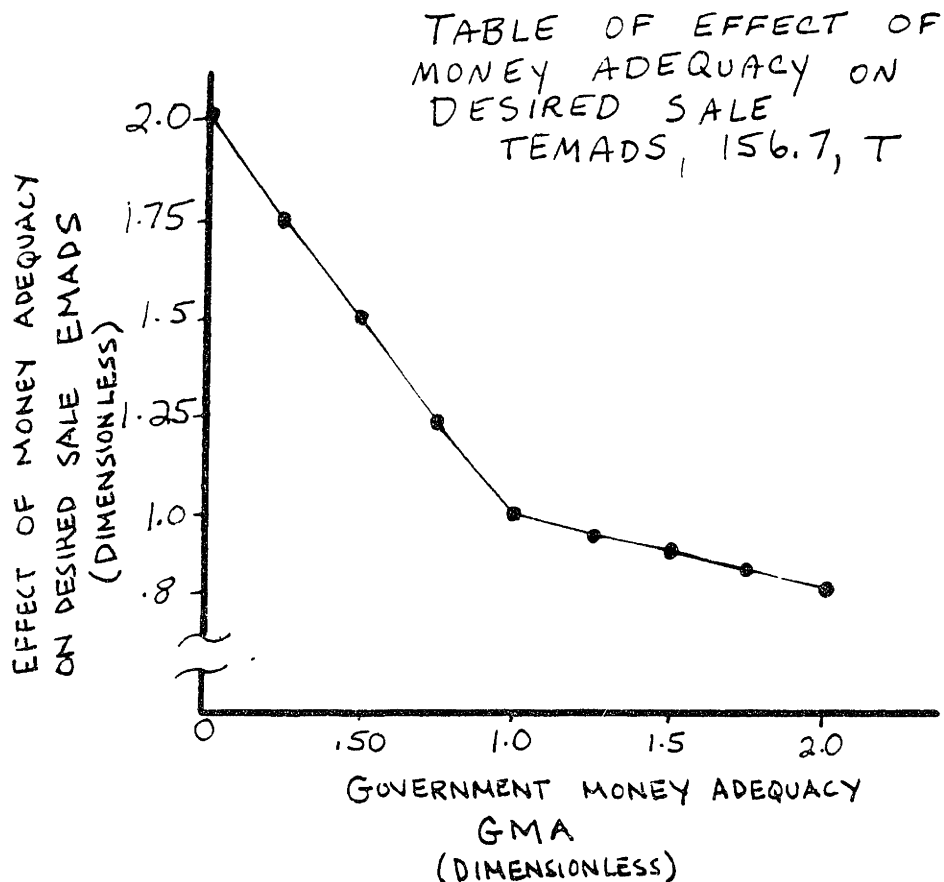


FIGURE A1-19. The Effect of Money Adequacy on Desired Sale of Government Securities.

Here again, as seen in previous money adequacy dependent table functions, government is assumed to respond in an asymmetrical manner to its money adequacy position. A 25% decline in GMA below the neutral point causes government, other things equal, to desire to sell 25% more securities than it is, on average, retiring. The effect remains proportional down to a money adequacy of .25 when it becomes even more pronounced. Above the 1.0 point, the responsiveness of

EMADS to GMA is assumed to be much less pronounced. When GMA rises to 1.25, it is assumed that government, other things, equal, would desire to sell only 5% less securities than it is retiring. GMA of 2.0 or more is assumed to cause government to desire to sell only 20% less securities than it is, on average, retiring.

The justification for such an asymmetry is based on the assumption that there are strong pressures within government for an expansion of the current level of activity. Thus, when GMA dips below 1.0, government is strongly motivated to restore its money position in order to at least maintain its current level of spending. And, when GMA rises above 1.0, it is assumed that government will use the excess to expand its activities. The alternative would be to assume that government will use the excess to reduce the level of outstanding government securities; i.e., by selling less securities than government is, on average retiring.

Once government has determined its Desired Sale of Government Securities DSGS, the market then decides how much of the volume of securities that government wishes to sell, it will actually purchase. The market response has its influence through the variable Effect of Market Response to Desired Sale EMRDS, defined in equation 61.

EMRDS.K(LG)=TABHL(TEMRDS,MR.K(LG),0,1,.2) 61, A
EMRDS - EFFECT OF MARKET RESPONSE TO DESIRED SALE
(DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TEMRDS - TABLE OF EFFECT OF MARKET RESPONSE ON
DESIRED SALE
MR - MARKET RESPONSE (DIM)

EMRDS depends upon Market Response MR which is an index of the market's willingness to purchase government securities. As Figure A1-20 indicates, Market Response MR ranges Between 0 and 1.

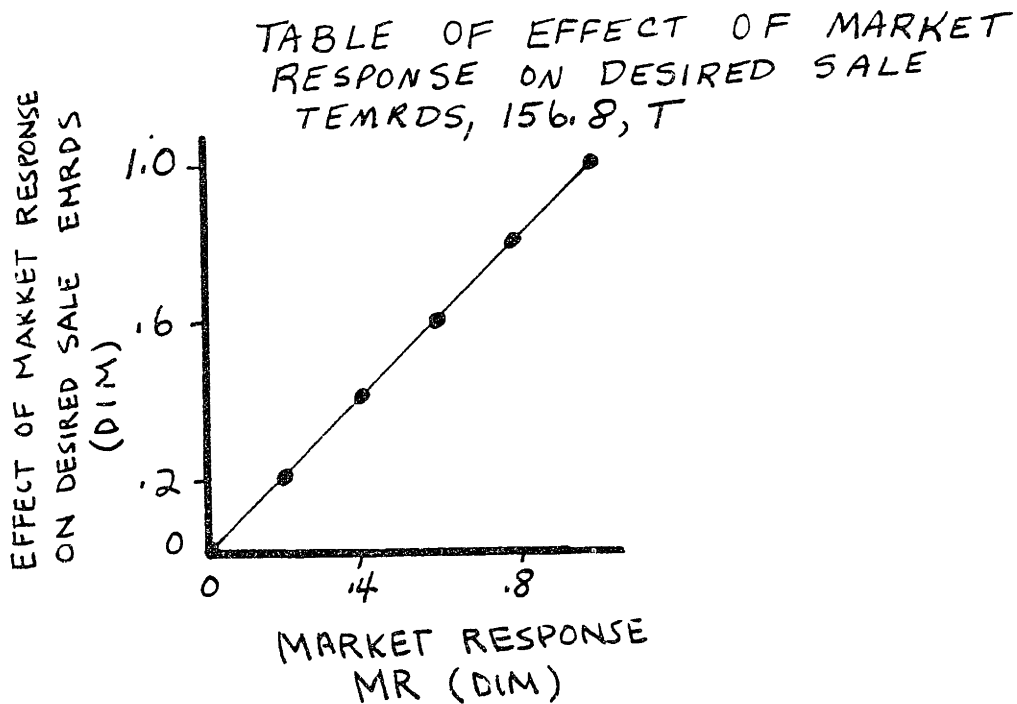


FIGURE A1-20. The Effect of Market Response to Desired Sale of Government Securities.

When MR takes on a value of 0, it indicates that the market is not willing to absorb any government securities. When MR equals 1.0, it indicates that the market will absorb all of the securities that government is willing to sell. The effect is assumed to be linear between these extremes.

Market Response MR is defined, in equation 62, as an amalgamation of five separate influences: Market Response to Default Fraction MRDF, Market Response to Funds Available for the Purchase of Securities MRFAPS, Market Response to Departure from Target Debt Position MRDTDP, Market Response to Service Ratio; MRSR and Market Response to Threat to National Security MRTNS.

$$\text{MR.K(LG)} = (\text{MRDF.K(LG)} * \text{MRFAPS.K} * \text{MRDTDP.K(LG)} * \text{MRSR.K(LG)}) + \text{MRTNS.K(LG)} \quad 62, A$$

MR - MARKET RESPONSE (DIM)
LG - LEVEL OF GOVT
MRDF - MARKET RESPONSE TO DEFAULT FRACTION (DIM)
MRFAPS - MARKET RESPONSE TO FUNDS AVAIIABLE TO PURCHASE SECURITIES (DIM)
MRDTDP - MARKET RESPONSE TO DEPARTURE FROM TARGET DEBT POSITION (DIM)
MRSR - MARKET RESPONSE TO SERVICE RATIO (DIM)
MRTNS - MARKET RESPONSE TO THREAT TO NATIONAL SECURITY (DIM)

The first four components of Market Response MR interact multiplicatively. As such, any one of these influences can dominate MR. For example, if any one of the four takes on a value of zero, the product of the entire chain is zero. The multiplicative form seems appropriate in view of the fact that investors, in considering a

purchase of securities, react along a number of dimensions. If behavior along any one of the dimensions is extremely poor, it is likely to be enough to dissuade an investor from making the purchase despite favorable behavior along other dimensions. The fifth component of MR, Market Response to Threat to National security MRTNS, is added to the product of the other four components. As will be discussed, allowing MRTNS to couple additively to the others enables it to supercede the combined effect of the other four. During times of threat to National security, government (at least at the Federal level) has, for the most part, a carte blanche to sell as many securities as it wishes. Under such conditions, the normal "rules of the game" are suspended. The additive formulation for MRTNS included in equation 62, allows for such a suspension.

The first component of MR, Market Response to Default Fraction MRDF captures the market's reaction to government's default performance. MRDF (equation 63) depends upon the ratio of government's Default Fraction DF (see equation 73) relative to what the market considers an Acceptable Default Fraction ADF.

$MRDF.K(LG) = TABHL(TMRDF, DF.K(LG)/ADF(LG), 1, 3, .25)$ 63, A
MRDF - MARKET RESPONSE TO DEFAULT FRACTION (DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TMRDF - TABLE OF MARKET RESPONSE TO DEFAULT
FRACTION
DF - DEFAULT FRACTION (DIM)
ADF - ACCEPTABLE DEFAULT FRACTION (DIM)

Default Fraction DF, is the amount of defaults--expressed as a fraction of the stock of outstanding government securities--that government records per year. ADF is the amount of defaults--also

expressed fractionally--that the market considers "normal" and is therefore willing to tolerate without reprisal in the form of reluctance to purchase. ADF is set, in equation 156.9, equal to one-half of the Reference Default Fraction RDF (which is initialized at 4%).

As figure A1-21 indicates, any value of DF at, or below, ADF maintains market willingness to absorb government securities, from this source, at 1.0.

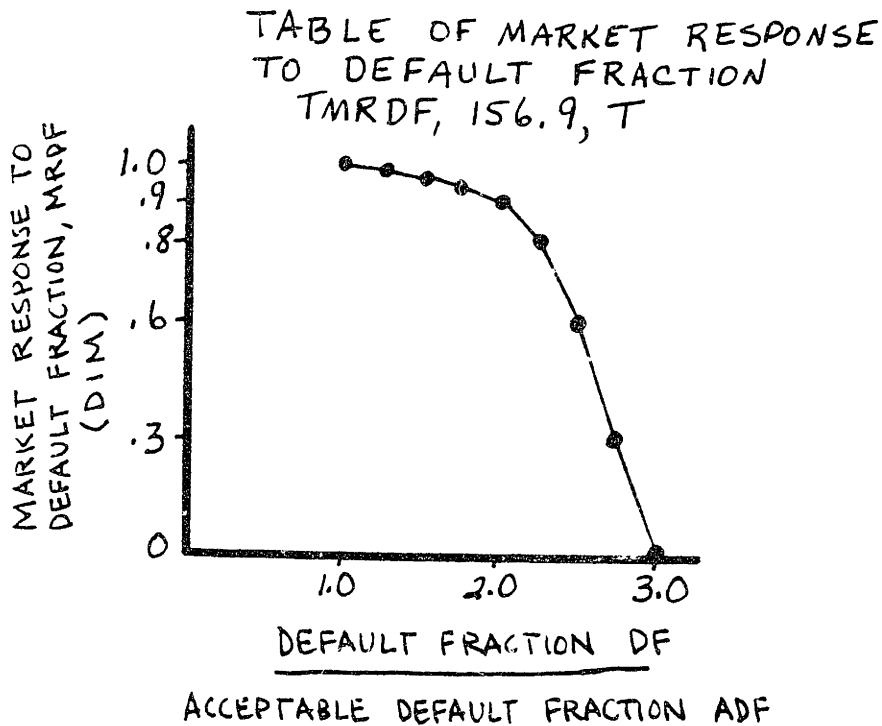


FIGURE A1-21. Market Response to Government's Default Fraction.

When DF rises above ADF, the market's willingness to purchase government securities declines. As the relationship depicted in Figure A1-21 indicates, the market is assumed to tolerate relatively minor excursions in government's Default Fraction DF above ADF without any very serious contraction of its purchasing of government securities. A doubling of DF over ADF causes only a 10% reduction in the market's absorption of government securities. As DF begins to approach three times ADF, however, the market is assumed to become very reluctant to purchase government securities. And, when the ratio of DF to ADF has reached, or exceeded, 3.0, the market is assumed, other things equal, to be unwilling to purchase any government securities.

The second component of MR is Market Response to Funds Available for Purchase of Securities MRFAPS. MRFAPS reflects the market's response to government's position in the money markets. If, for example, too high a fraction of the funds available for the purchase of securities are being taken up by the purchase of government securities, investors are apt to become wary (irrespective of interest rates). Wariness will result from the public's uncertainty about whether government will be able to make good on its obligations. In addition, as portfolios begin to consist largely, or exclusively, of government securities money managers will seek other financial instruments to reduce their risk.

In reflection of these considerations, MRFAPS is formulated in equation 64 as dependent upon the ratio of Total Average Sale of Government Securities TASGS to Funds Available for the Purchase of Securities FAPS.

MRFAPS.K=TABLE(TMRFAP,TASGS.K/FAPS.K,0,1,.2) 64, A
MRFAPS - MARKET RESPONSE TO FUNDS AVAILABLE TO
PURCHASE SECURITIES (DIM)
TABLE - TABLE LOOK-UP FUNCTION
TMRFAP - TABLE OF MARKET RESPONSE TO FUNDS AVAILABLE
FOR THE PURCHASE OF SECURITIES
TASGS - TOTAL AVERAGE SALE OF GOVT SECURITIES (\$/
YEAR)
FAPS - FUNDS AVAILABLE FOR THE PURCHASE OF
SECURITIES (\$/YEAR)

TASGS is defined in equation 65 as the sum of the Average
Sale of Government Securities ASGS by all levels of government.

TASGS.K=SUM(ASGS.K) 65, A
TASGS - TOTAL AVERAGE SALE OF GOVT SECURITIES (\$/
YEAR)
SUM. - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
ASGS - AVERAGE SALE OF GOVT SECURITIES (\$/YEAR)

ASGS is formulated, in equation 66, as a short-term (i.e.,
one year) exponential average of Sale of Government Securities SGS.
The averaging of SGS reflect both the time that it takes for the
market to perceive the volume of securities that government is
actually selling, and a smoothing of very short-term random
fluctuations in SGS.

ASGS.K(LG)=ASGS.J(LG)+(DT/TAVSGS)(SGS.JK(LG)- 66, L
ASGS.J(LG))
ASGS - AVERAGE SALE OF GOVT SECURITIES (\$/YEAR)
LG - LEVEL OF GOVT
DT - SOLUTION INTERVAL (YEARS)
TAVSGS - TIME TO AVERAGE SALE OF GOVT SECURITIES
(YEARS)
SGS - SALE OF GOVT SECURITIES (\$/YEAR)

Funds Available for the Purchase of Securities FAPS (defined
in equation 158, discussed later) represents the aggregate amount of
each year's income that is available for the purchase of all financial
instruments (including government securities).

As Figure A1-22 indicates, MRFAPS, like MRDF, is an extremely non-linear function.

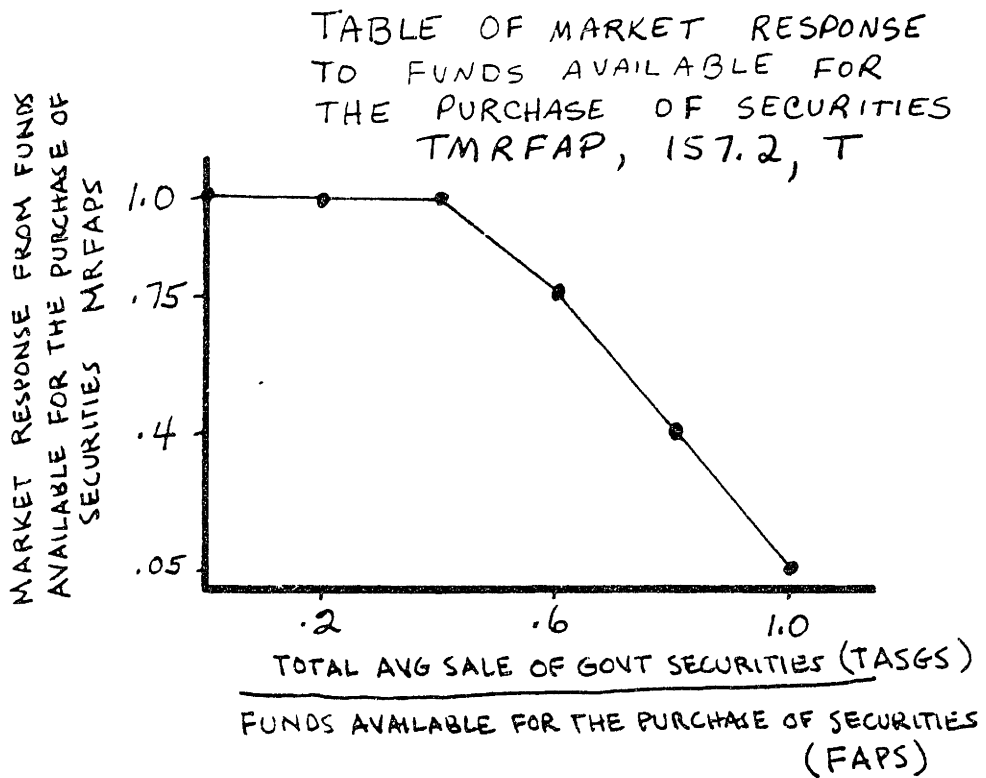


FIGURE A1-22. The Effect of Funds Available for the Purchase of Securities on Market Response to the Desired Sale of Government Securities.

It is assumed that government can claim up to 40% of the funds available for the purchase of securities without generating any reaction from the market. When the ratio of TASGS to FAPS rises to .6, however, the market is assumed to reject, other things equal, 25% of the volume of securities that government would like to sell. The market is assumed to reject 60% at a ratio of .8, and to reject 95% if government is seeking to claim all of what is available.

The extreme non-linearity of this, and other market response table functions, reflects an assumption that, within some range, investors have confidence that government "knows what it is doing". And because it is further assumed that people want to believe that government is in fact in control of the situation, they will be willing to allow government to go quite far in exercising its financial options. However, if government perogatives continue beyond a certian point, it is assumed that public confidence will erode very quickly. People will abandon the belief that government is "in control" and react sharply to any further governmental initiatives.

The third component of Market Response MR is Market Response to the Departure from Target Debt Positon MRDTP. This influence compliments the second component of MR (i.e., MRFAPS). MRDTP captures the market's assessment of government's ability to service its obligations. As equations 67 and 68 indicate, the assessment is based on a comparison of government's current Debt Service to Tax Revenue Ratio DSTRR to a Debt Service to Tax Revenue Ratio Target DSTRRG.

$MRDTDP.K(LG) = TABHL(TMRDTP, DTDP.K(LG), 1, 3, .25)$ 67, A
MRDTDP - MARKET RESPONSE TO DEPARTURE FROM TARGET
DEBT POSITION (DIM)

LG - LEVEL OF GOVT

TABHL - TABLE LOOK-UP FUNCTION

TMRDTP - TABLE OF MARKET RESPONSE TO DEPARTURE FROM
TRADITIONAL DEBT POSITION

DTDP - DEPARTURE FROM TRADITIONAL DEBT POSITION
(DIM)

$DTDP.K(LG) = DSTRR.K(LG) / DSTRRG(LG)$ 68, A
DTDP - DEPARTURE FROM TRADITIONAL DEBT POSITION
(DIM)

LG - LEVEL OF GOVT

DSTRR - DEBT SERVICE TAX REVENUE RATIO (DIM)

DSTRRG - DEBT SERVICE TAX REVENUE RATIO GOAL (DIM)

DSTRR, as previously defined in equation 58, is the ratio of government's payments for interest and maturity to its tax take. The ratio serves as a barometer of how well financially equipped government is to service its current stream of debt obligations. DSTRRG, also previously discussed (see equation 156), is a goal for the ratio.

Notice that DSTRRG is being used as a fixed set-point against which to benchmark government's debt stature, by both government and the market. This is a simplifying assumption which can be easily relaxed in subsequent versions of the model. Government's target is apt to be "floating" (i.e., a moving average) rather than fixed. Then, for example, as it becomes more difficult to raise tax rates, and government comes to lean more heavily on the debt channel (with the actual ratio of debt service to tax revenues rising as a consequence), government will over time accommodate to this new

higher-leverage operating point. The market's standard may also have some tendency to "drift". However, the market standard is likely to have a relatively higher fixed-to-floating composition than government's standard and therefore more closely approximates the current formulation.

Figure A1-23 details MRDTDP as it depends upon DSTRR relative to DSTRRG.

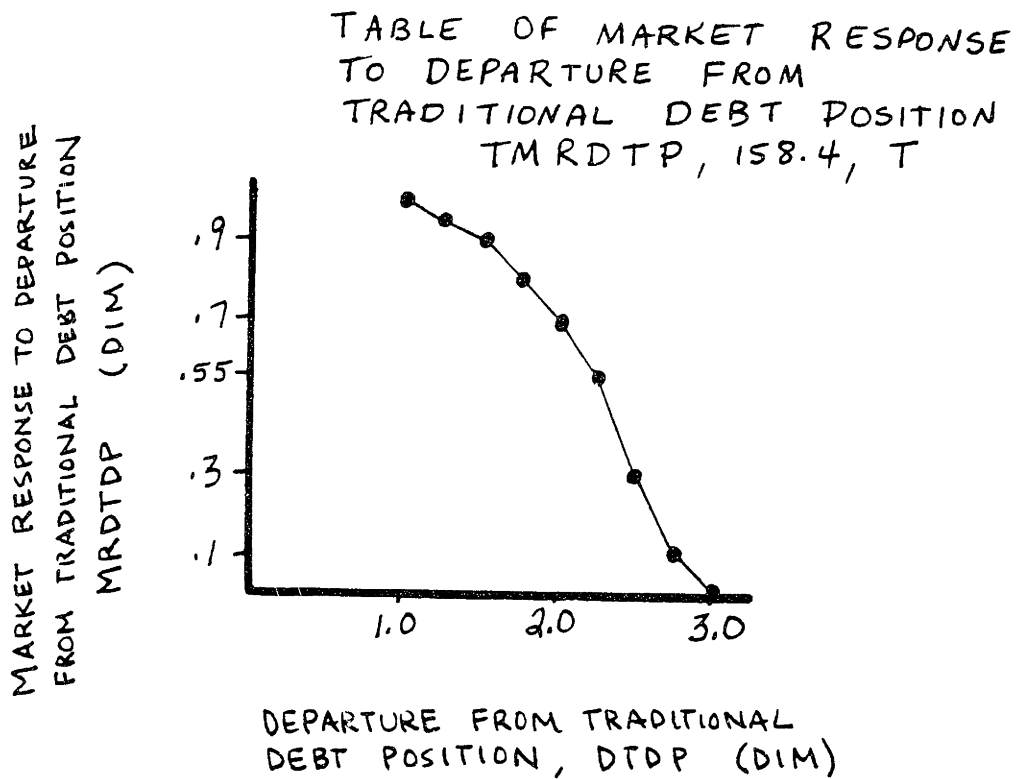


FIGURE A1-23. Market Response to Departure from Target Debt Position.

Here again, the previously encountered "crisis-of-confidence" non-linearity in market response is evident, though not as extreme. As long as DSTRR remains at or below DSTRRG, the market's purchase decision is unaffected, from this source. As the ratio of DSTRR to DSTRRG climbs above 1.0, the market's willingness to absorb government's security offerings declines. At first, the response is relatively mild. A doubling of government's leverage position relative to the fixed standard other things equal, creates only a 30% decline in market willingness to absorb government offerings. A second doubling, however, is enough to completely extinguish the market's absorption willingness.

MRDTDP can become an important control on debt issuance under economic crisis conditions. Suppose, for example, that a Depression occurs. Private output (income) declines. Government's tax base, as a consequence, erodes. And, unless government raises tax rates--which was tried, with disastrous consequences in the early years of the Depression of the 1930's--it will experience a decline in tax revenues. If government does not reduce its debt load at a rate commensurate with the decline in tax revenues, DSTRR will climb relative to the fixed standard DSTRRG. When this occurs, market sanctions will force government to contract its stock of outstanding obligations. This relationship suggests that in order for government to avoid exacerbating an economic downturn, it is essential that government rely upon non-market financing channels (such as monetized debt; i.e., Treasury borrowing from the Fed, or high-powered money creation).

The fourth, and final multiplicative, component of Market Response MR is Market Response from Service Ratio MRSR. MRSR, formulated in equation 69, is different from the three previously discussed influences. Rather than acting to constrain the sale of government securities, MRSR can serve to stimulate the market's willingness to take on government obligations.

$$\text{MRSR.K(LG)} = \text{TABHL}(\text{TMRSR}, \text{SR.K(LG)}, 0, 1, .25) \quad 59, A$$

MRSR - MARKET RESPONSE TO SERVICE RATIO (DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TMRSR - TABLE OF MARKET RESPONSE TO SERVICE RATIO
SR - SERVICE RATIO (DIM)

As equation 69 indicates, MRSR depends upon Service Ratio SR (defined in equation 162). SR is a ratio of the current level of government output relative to the level that people have come to accept and anticipate. When the ratio decreases, (i.e., people are experiencing cutbacks in the level of government services and/or transfers), people are assumed, other things equal, to be more accomodative to the purchase of government obligations. For example, if a town discovers that its high school will have to begin split-session because of inadequate facilities, town members are likely, other things equal, to be more receptive to the flotation of a bond issue than they would be without the threat of such a reduction of government service. MRSR is intended to capture such effects.

Figure A1-24 portrays the response of MRSR to movements in Service Ratio SR.

TABLE OF MARKET RESPONSE
TO SERVICE RATIO
MRSR, 158.5, T

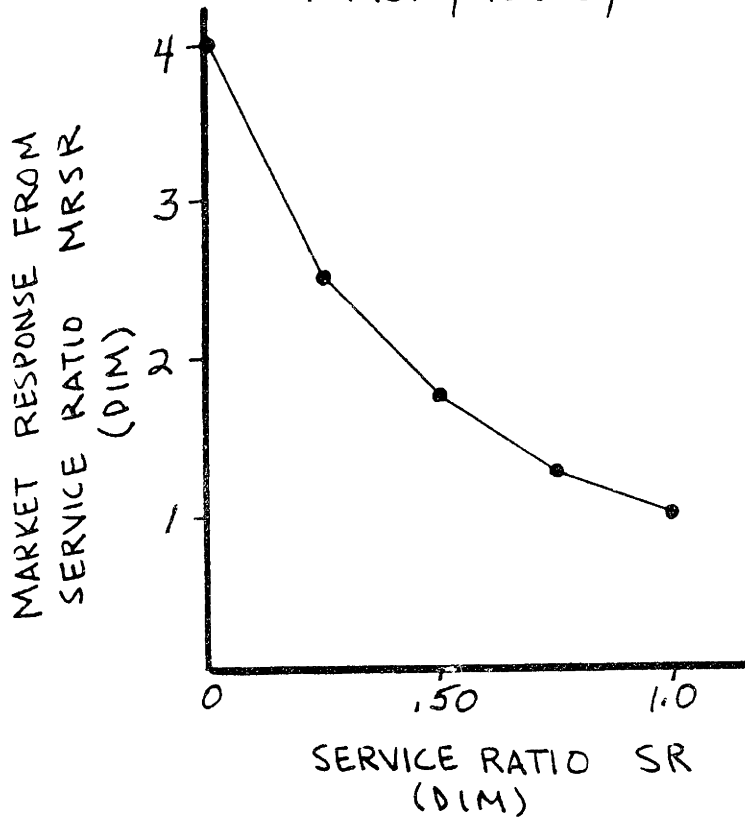


FIGURE A1-24. Market Response to Service Ratio.

As the Figure indicates, MRSR is highly responsive to SR over its entire range. A 25% cutback in government services calls forth a 25% increase in MRSR. A 50% cutback results in a 75% response, while a 75% reduction stimulates a 250% reaction. At the extreme, MRSR takes on a value of 4.0 when government output falls to zero.

By itself, the responsiveness of MRSR might appear too high relative to the other three components of MR. However, remember that the four components interact multiplicatively. Thus, in order for

MRSR to be an effective counterpressure to the combined impact of the other three, it is essential that it be quite responsive. To see this, suppose that MRDF, MRFAPS, and MRDTDP all took on values of .8, not a very extreme value if each effect were considered individually. However, the combined impact of the three influences is $.8^3$, or approximately .5. In order for MRSR to bring MR up to, say, .75, SR would have to take on a value of .625. An SR of .625 implies that people are experiencing nearly a 40% cut-back in government output! Looked at in this manner, the absolute level of responsiveness MRSR does not seem so extreme.

The final component of MR is Market Response to Threat to National Security MRTNS. Recall that this effect is additive, while all of the others are multiplicative (see equation 62). MRTNS is designed to capture the relatively carte blanche acquiescence to government debt issues on the part of the market that occurs during periods of national crisis, like war. During crises, government's powers are necessarily expanded and with the expansion goes a willingness to under write government's activities. MRTNS, by coupling additively into MR, is able to capture this effect.

MRTNS is defined in equation 70, as dependent upon Threat to National Security TNS.

MRTNS.K(LG)=TABHL(TMRTNS(*,LG),TNS.K,0,1,.25) /0, A
MRTNS - MARKET RESPONSE TO THREAT TO NATIONAL
SECURITY (DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TMRTNS - TABLE OF MARKET RESPONSE TO THREAT TO
NATIONAL SECURITY
TNS - INDEX OF THREAT TO NATIONAL SECURITY (DIM)

TNS is defined in equation 159 as an index which takes on values between 0 and 1.0

TNS.K=TABHL(TTNS,TIME.K,0,10,1) 159, A
TTNS=0/0/0/0/0/0/0/0/0/0/0 159.1, T
TNS - INDEX OF THREAT TO NATIONAL SECURITY (DIM)
TABHL - TABLE LOOK-UP FUNCTION
TIME - DYNAMO FUNCTION FOR RECORDING ELAPSED
SIMULATION TIME (YEARS)

As equation 159.1 indicates, TNS is set equal to zero in the initial parameterization of the model. TNS may take on any value between 0 and 1.0 for testing purposes. A value of zero indicates no threat to National security. A value of 1.0 indicates a major threat, such as that posed by World War II. Making TNS a continuous function, enables the effect of minor, but nevertheless perceptible, threats to National security to be investigated. President Carter's much-quoted reference to Opec's pricing policies as "the moral equivalent of war" provides an example of such a non-war threat to National security.

As Figure A1-25 indicates, MRTNS rises with rising TNS. Initially, the effect is linear. However, as TNS rises above .25, MRTNS comes quickly to dominate MR (i.e, to neutralize any constraining market reactions to government's desired sale of securities).

TABLE OF MARKET RESPONSE
TO THREAT TO NATIONAL
SECURITY
TMRTNS, 158.6, T

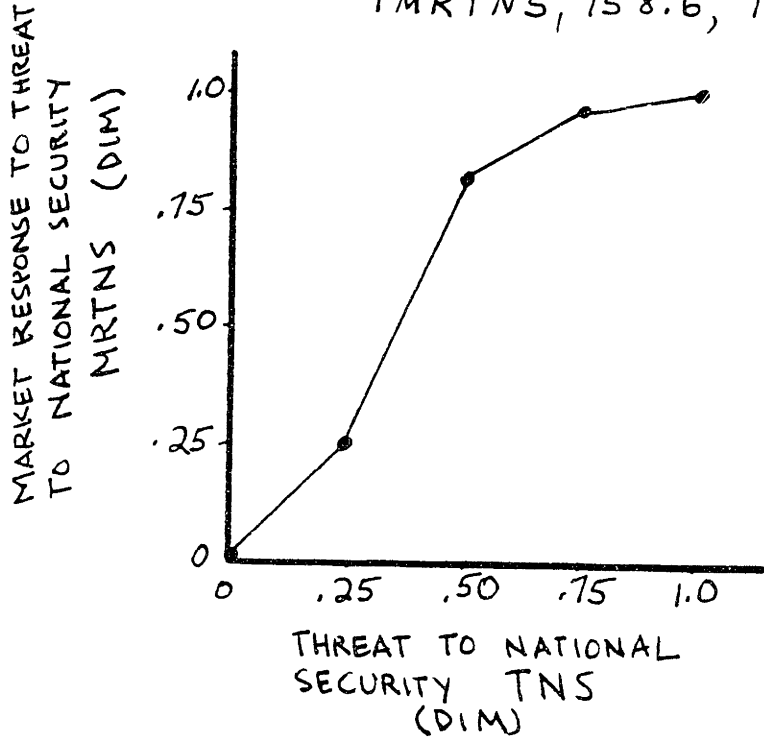


FIGURE A1-25. Market Response to Threat to National Security.

The stock of Outstanding Government Securities OGSY is reduced by Retirement of Government Securities RGS and Default on Government Securities DGS.

RGS, is the dollar volume of government securities that come to maturity and must be retired each year. RGS is defined, in equation 71, as the stock of Outstanding Government Securities OGSY divided by the Average Term of Government Securities ATGS.

$$\text{RGS.KL(LG)} = \text{OGSY.K(LG)} / \text{ATGS} \quad 71, R$$

RGS - RETIREMENT OF GOVT SECURITIES (\$/YEAR)
LG - LEVEL OF GOVT
OGSY - OUTSTANDING GOVT SECURITIES (\$)
ATGS - AVERAGE TERM OF GOVT SECURITIES (YEARS)

For simplicity, ATGS is defined, in equation 159.2, as a constant equal to 2.5 years. A value of 2.5 years was selected to strike a compromise between the government's very short-term 30, 60, 90-day, T-bills and its very long-term bond issues.

Default on Government Securities DGS is formulated as the Stock of Outstanding Government Securities times a Default Fraction DF.

$$\text{DGS.KL(LG)} = \text{OGSY.K(LG)} * \text{DF.K(LG)} \quad 72, R$$

DGS - DEFAULT ON GOVT SECURITIES (\$/YEAR)
LG - LEVEL OF GOVT
OGSY - OUTSTANDING GOVT SECURITIES (\$)
DF - DEFAULT FRACTION (DIM)

Default Fraction, defined in equation 73, is equal to a Reference Default fraction RDF moderated by the Effect of Money Adequacy on Default Fraction EMADF.

$$\text{DF.K(LG)} = \text{RDF(LG)} * \text{EMADF.K(LG)} \quad 73, A$$

DF - DEFAULT FRACTION (DIM)
LG - LEVEL OF GOVT
RDF - REFERENCE DEFAULT FRACTION (DIM)
EMADF - EFFECT OF MONEY ADEQUACY ON DEFAULT FRACTION (DIM)

RDF is defined in equation 159.3 as equal to Interest Rate on Government Securities IRGS divided by the Effect of Money Adequacy on Default Fraction EMADF. As a result, when RDF is multiplied by EMADF, in equation 74, EMADF cancels leaving DF equal to IRGS in the

reference equilibrium. This seemingly curious result comes about as an artifact of the equilibration process as discussed in Appendix 3.

EMADF is defined in equation 74.

EMADF.K(LG)=TABLE(TEMADF,GMA.K(LG),0,2,.25) 74, A
EMADF - EFFECT OF MONEY ADEQUACY ON DEFAULT
FRACTION (DIM)
LG - LEVEL OF GOVT
TABLE - TABLE LOOK-UP FUNCTION
TEMADF - TABLE OF EFFECT OF MONEY ADEQUACY ON
DEFAULT FRACTION
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

As Figure A1-26 indicates, it is assumed that declining GMA causes defaults to increase. The effect is linear down to a GMA of .25, where the effect becomes more pronounced. As GMA rises above 1.0, the depressive effect on defaults is not as pronounced. No matter how far GMA rises above 1.0, the depressive effect on defaults is not as pronounced. No matter how high GMA rises, RDF is never reduced by more than 27%. The asymmetry in the slope of the table function reflects an assumption that even when money adequacy for government, in the aggregate, is high, there will always be some governments (at the state or local level) who will be in default.

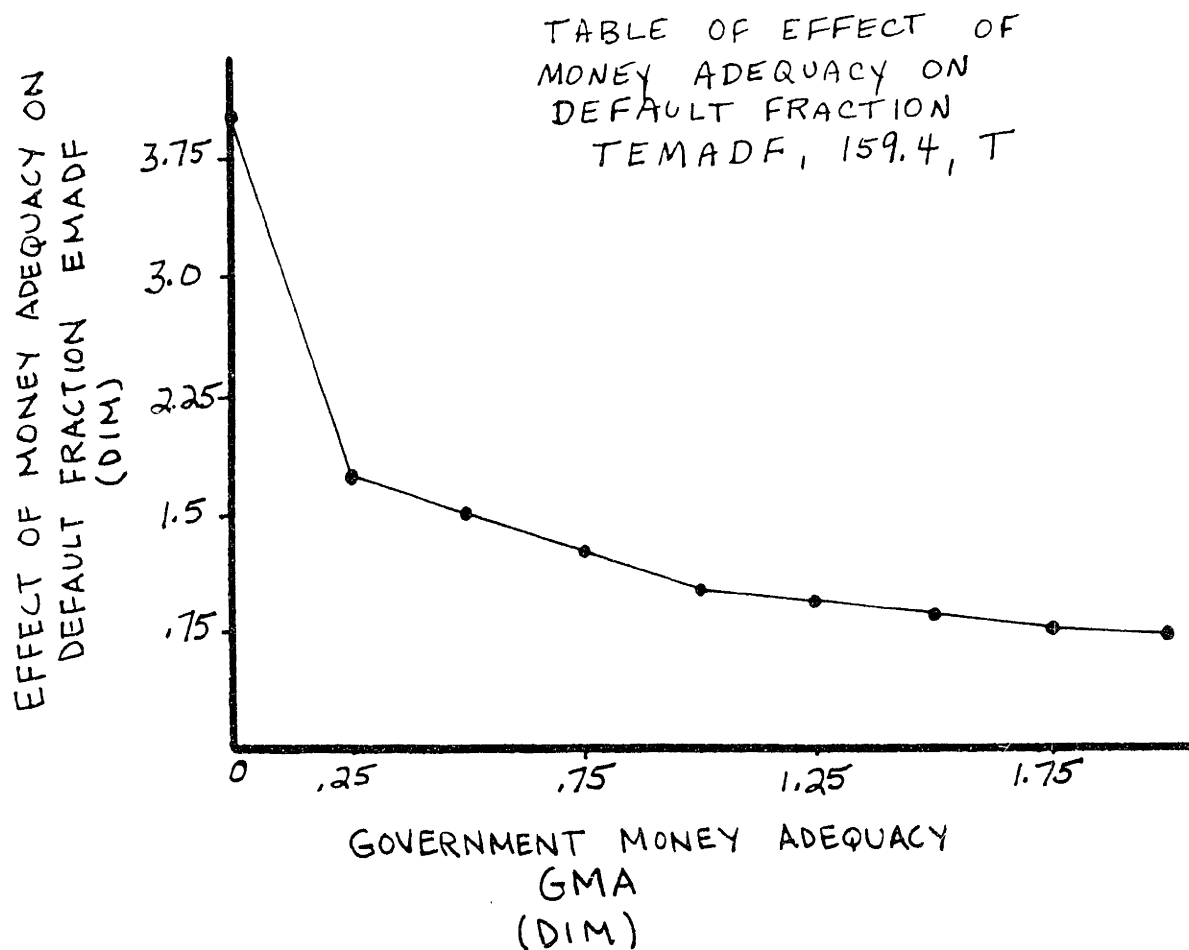


FIGURE A1-26. The Effect of Money Adequacy on Default Fraction.

The final equation in the Government Debt block is Interest on Government Securities Outstanding IGSO. As seen from equation 75, IGSO is modeled as the product of the stock of Outstanding Government Securities OGSY and the Interest Rate on Government Securities IRGS.

$IGSO.K(LG) = OGSY.K(LG) * IRGS$ 75, A
IGSO - INTEREST ON GOVT SECURITIES OUTSTANDING (\$/
YEAR)
LG - LEVEL OF GOVT
OGSY - OUTSTANDING GOVT SECURITIES (\$)
IRGS - INTEREST RATE ON GOVT SECURITIES (1/YEAR)

For simplicity, IRGS is formulated, in equation 159.5 as a constant equal to 5%. Making IRGS a constant renders the model incapable of examining the set of shorter-term issues revolving around interest rate adjustments. Such issues, while important, are secondary to a consideration of the forces that determine the longer-term equilibrium distribution of productive resources between the public and private sector. In any such consideration, interest rates will settle at values that reflect the real preferences of the society. Hence, taking IRGS as constant should not unduly distort the analysis.

A1.4 TAX RATE SETTING

A flow diagram of the tax rate setting equations appears as Figure A1-27. The major level in this block is tax rate. Tax rate is continuously changed in response to pressures from both inside and outside of government.

Tax Rate TR as defined in equation 76, is changed by change in Tax Rate CTR and an Exogenous Change in Tax Rate ECTR; the latter functioning only under test conditions.

$$\text{TR.K(TAX)} = \text{TR.J(TAX)} + (\text{DT}) (\text{CTR.JK(TAX)} - \text{ECTR.J(TAX)}) \quad 76, \text{ L}$$

TR - TAX RATE (DIM)
TAX - TYPES OF TAX
DT - SOLUTION INTERVAL (YEARS)
CTR - CHANGE IN TAX RATE (1/YEAR)

CTR is a net rate which can take on positive, or negative, values. CTR is formulated in equation 77 as the product of TR and a Fractional Change in Tax Rate FCTR.

$$\text{CTR.KL(TAX)} = \text{TR.K(TAX)} * \text{FCTR.K(TAX)} \quad 77, \text{ R}$$

CTR - CHANGE IN TAX RATE (1/YEAR)
TAX - TYPES OF TAX
TR - TAX RATE (DIM)
FCTR - FRACTIONAL CHANGE IN TAX RATE (1/YEAR)

Fractional Change in Tax Rate FCTR, as seen from equation 78, is formulated as the sum of three component fractional changes: Fractional Change in Tax from Money Adequacy FCTMA, Fractional Change in Tax from Public Sentiment FCTPS, and Fractional Change in Tax from Fiscal Action FCTFA.

$$\text{FCTR.K(TAX)} = \text{FCTMA.K(TAX)} + \text{FCTPS.K(TAX)} + \text{FCTFA.K(TAX)} \quad 78, \text{ A}$$

FCTR - FRACTIONAL CHANGE IN TAX RATE (1/YEAR)
TAX - TYPES OF TAX
FCTMA - FRACTIONAL CHANGE IN TAX FROM MONEY ADEQUACY (1/YEAR)
FCTPS - FRACTIONAL CHANGE IN TAX FROM PUBLIC SENTIMENT (1/YEAR)
FCTFA - FRACTIONAL CHANGE IN TAX FROM FISCAL ACTION (1/YEAR)

The first and third components of FCTR--i.e., FCTMA and FCTFA--are generated from pressures within government. The first is

government's response to its own money adequacy position. The third is a governmental policy response to the level of economic activity. The second component of FCTR, FCTPS, is a response generated by the public. The resultant of the pressures emanating from these three channels determines the change in Tax Rate TR over time.

Fractional Change in Tax from Money Adequacy FCTMA is seen, in equation 79, to depend upon Government Money Adequacy Perceived by Government GMAPG.

FCTMA.K(TAX)=TABHL(TFCTMA(*,TAX),GMAPG.K(TAX),0,1, 79, A
.25)

- FCTMA - FRACTIONAL CHANGE IN TAX FROM MONEY ADEQUACY (1/YEAR)
- TAX - TYPES OF TAX
- TABHL - TABLE LOOK-UP FUNCTION
- TFCTMA - TABLE OF FRACTIONAL CHANGE IN TAX FROM MONEY ADEQUACY
- GMAPG - GOVT MONEY ADEQUACY PERCEIVED BY GOVT (DIM)

GMAPG is defined in equation 160 to be equal to GMA. The need for the additional variable arises from the fact that GMA is subscripted by level of government. And, in order to preserve the genericism of equation 79, it is necessary to have a variable subscripted by type of tax. Thus, GMAPG is merely a re-subscripting of GMA.

The responsiveness of FCTMA to GMAPG is depicted in Figure A1-28.

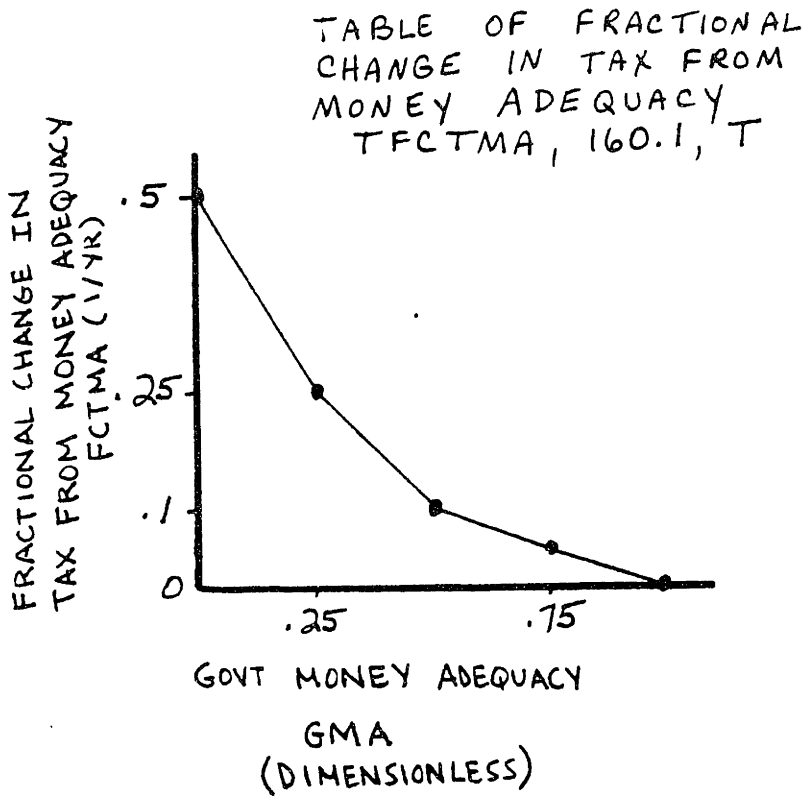


FIGURE A1-28. Fractional Change in Tax From Government Money Adequacy.

Any level of government money adequacy of 1.0 or greater gives rise to no pressure to increase tax rates, from this source. As GMAPG dips below 1.0, increasing pressure--translated into a fractional change in the existing tax rate--to increase tax rate arises. A 25% money shortfall causes government to attempt, other things equal, to increase Tax Rate TR by 5% per year. A 50% shortfall yields a 10% rate of change. If GMAPG declines to .25, it is assumed

that government will seek to push up TR, other things equal, by 25% per year. Finally, at zero money adequacy, Government would be trying to raise TR by half-again each year.

The second component of FCTR, Fractional Change in Tax from Public Sentiment FCTPS, is the most elaborate. FCTPS amalgamates several independent pressures which, as equation 80 indicates, themselves translate into fractional changes.

$$\text{FCTPS.K(TAX)} = (\text{FCLT.K(TAX)} + \text{FCCTR.K(TAX)} + \text{FCPGMA.K(TAX)}) * \text{ETNSPS.K(TAX)} \quad 80, A$$

FCTPS - FRACTIONAL CHANGE IN TAX FROM PUBLIC SENTIMENT (1/YEAR)
TAX - TYPES OF TAX
FCLT - FRACTIONAL CHANGE FROM LEVEL OF TAX (1/YEAR)
FCCTR - FRACTIONAL CHANGE FROM CHANGE IN TAX RATE (1/YEAR)
FCPGMA - FRACTIONAL CHANGE FROM PERCEIVED GOVT MONEY ADEQUACY (1/YEAR)
ETNSPS - EFFECT OF THREAT TO NATIONAL SECURITY ON PUBLIC SENTIMENT (DIM)

FCTPS consists of four components. The first three--Fractional Change from the Level of Tax FCLT, Fractional Change from Change in Tax Rate FCCTR, and Fractional Change from Perceived Government Money Adequacy FCPGMA--combine additively. An additive formulation permits any one of the three fractional change components to equal zero without the necessity of the combined effect equaling zero, as it would in a multiplicative coupling. The fourth

component--Effect of Threat to National Security on Public Sentiment ETNSPS--is coupled multiplicatively to the sum of the first three components. As with Market Response MR (see equation 62) in the Government Debt block of equations, this formulation enables a perceived threat to National security to effectively neutralize public sentiment; in this case it is sentiment against tax rate increases.

The first component of Fractional Change in Tax from Public Sentiment FCTPS is Fractional Change from the Level of Tax FCLT, represented in equation 81.

$$\text{FCLT.K(TAX)} = \frac{\text{TABHL(TFCLT(*, TAX), PTR.K(TAX))}}{\text{ATR.K(TAX), 1, 2, .2}} \quad 81, A$$

FCLT - FRACTIONAL CHANGE FROM LEVEL OF TAX (1/
YEAR)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
TFCLT - TABLE OF FRACTIONAL CHANGE FROM LEVEL OF
TAX
PTR - PERCEIVED TAX RATE (DIM)
ATR - ACCEPTABLE TAX RATE (DIM)

FCLT is an aggregate response of the public--individuals, corporations, institutions, etc.-- to the Perceived Tax Rate PTR relative to what the public considers an Acceptable Tax Rate ATR.

Perceived Tax Rate PTR is modeled, in equation 82, as the actual Tax Rate TR moderated by a Bias in Perceiving Tax Rate BPTR.

$PTR.K(TAX) = TR.K(TAX) * BPTR(TAX)$. 82, A
PTR - PERCEIVED TAX RATE (DIM)
TAX - TYPES OF TAX
TR - TAX RATE (DIM)
BPTR - BIAS IN PERCEIVING TAX RATE (DIM)

BPTR is a constant which can vary by tax. In the initial model configuration, BPTR is set to 1.0 in equation 160.4. BPTR is included in order to capture the public's differential awareness of various types of tax rates. For example, the level of an excise tax, which is buried in the cost of a gallon of gas, is not as accurately perceived as the level of a property tax which is a highly visible burden. Goetz [6], referenced in Chapter 2, cites several empirical studies which indicate that, for example individuals consistently underestimate the tax which they pay on retail purchases. By assigning tax-specific values to BPTR, the model can investigate the impact of differential sensitivities on governmental expansion.

Acceptable Tax Rate ATR, against which the public bench-marks PTR, is defined on equation 83.

$ATR.K(TAX) = ATRURC(TAX) * ELOATR.K(TAX) * ECOATR.K(TAX) * ESRATR.K(TAX)$ 83, A
ATR - ACCEPTABLE TAX RATE (DIM)
TAX - TYPES OF TAX
ATRURC - ACCEPTABLE TAX RATE UNDER REFERENCE
CONDITIONS (DIM)
ELOATR - EFFECT OF LEVEL OF OUTPUT ON ACCEPTABLE TAX
RATE (DIM)
ECOATR - EFFECT OF CHANGE IN LEVEL OF OUTPUT ON
ACCEPTABLE TAX RATE (DIM)
ESRATR - EFFECT OF SERVICE RATIO ON ACCEPTABLE TAX
RATE (DIM)

ATR is formulated as an Acceptable Tax Rate Under Reference Conditions ATRURC moderated by three influences: Effect of Level of Output on Acceptable Tax Rate ELOATR, Effect of Change in Output on Acceptable Tax Rate ECOATR and Effect of Service Ratio on Acceptable Tax Rate ESRATR. The logic behind the formulation is that, given the conditions in the reference equilibrium, there is a level of tax which, from the level alone, will stimulate no pressure to reduce tax rates. This level is ATRURC. However, if conditions change from those prevailing in the reference equilibrium, the level of tax deemed "acceptable" (i.e., that level of tax rate which will stimulate no public pressure for a reduction) will likewise be altered. In particular, if the level of private output (real income) shifts, if the rate at which private output is growing is altered, or if the level of government output is changed, ATR will take on a new value.

The Effect of the Level of Private Output on Acceptable Tax Rate ELOATR is defined, in equaton 84, as dependent upon the level of Private Production of Goods and Services Per capita PPGSP relative to the Reference Level of Private Production Per capita RLPPP.

ELOATR.K(TAX)=TABHL(TELOAT(*,TAX),PPGSP.K/RLPPP,0, 84, A
3,.25)

ELOATR - EFFECT OF LEVEL OF OUTPUT ON ACCEPTABLE TAX
RATE (DIM)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
TELOAT - TABLE OF EFFECT OF LEVEL OF OUTPUT ON
ACCEPTABLE TAX RATE
PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER
CAPITA (\$/PERSON/YEAR)
RLPPP - REFERENCE LEVEL OF PRIVATE PRODUCTION PER
CAPITA (\$/PERSON/YEAR)

As Figure A1-29 indicates, ELOATR is a positive function of PPGSP relative to RLPPP. At a ratio of 1.0, the ratio which exists in the reference equilibrium, ELOATR takes on a neutral value of 1.0. As private output rises relative to the reference level, it is assumed that the tax rate that the public will find acceptable likewise increases, although not proportionally. A 25% increase in private output per capita relative to the reference level causes the acceptable level of tax, other things equal, to rise by only 10%. Similarly, a 50% and 75% increase in per capita production relative to the reference standard causes ATR to rise, all else equal, by 20% and 30%, respectively. As PPGSP continues to rise relative to RLPP, tax rate acceptability begins to saturate. Ratios of per capita private output to reference levels of three or more yield no more than a 60% increase in ATR over ATRURC. Given that ATRURC is set at .4, the table function indicates that under no condition can the level of output alone cause people to deem a tax rate in excess of 64% to be acceptable.

TABLE OF EFFECT OF LEVEL
OF OUTPUT ON ACCEPTABLE
TAX RATE
TELOAT, 160.5, T

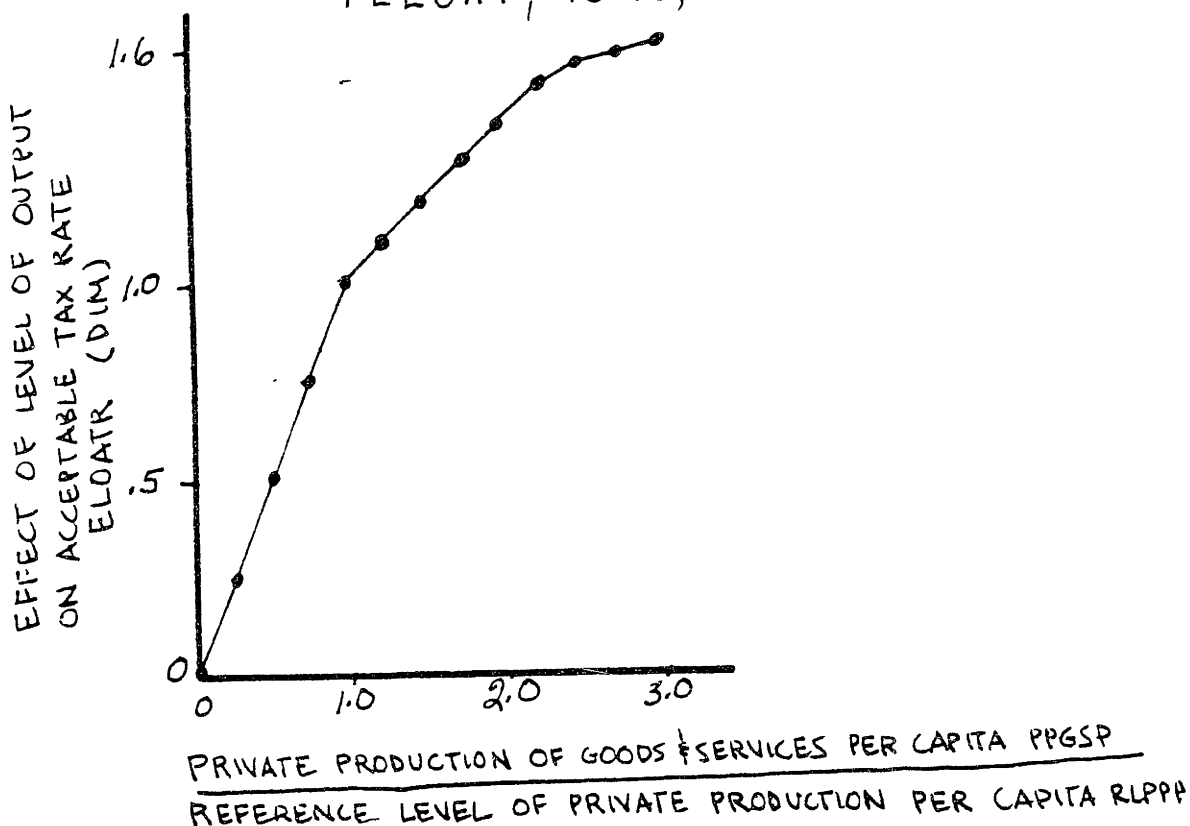


FIGURE A1-29. Effect of Level of Output on Acceptable Tax Rate.

The ultimate saturation of ELOATR on the up-side of 1.0 reflects the assumption that irrespective of how high incomes rise, the public would never acquiesce to paying more than a certain percent of their income (asset values) to the government.

As Figure A1-29 shows, the responsiveness of ELOATR to the ratio of PTR to ATR is much higher below the 1.0 point than above it. A 25% decline in PPGSP relative to RLPPP gives rise to a 25% reduction

in what the public considers an acceptable level of tax. The effect remains exactly proportional over the entire range below the 1.0 point.

The asymmetry embedded in ELOATR reflects the assumption that people will acquiesce to higher tax rates as long as the increase in the burden is not too noticeable. However, any decline in the real standard of living is assumed to make virtually any money "given" to government "too noticeable"! Thus, people are assumed to be very sensitive to the cost of government output when the level of private output is below what is expected or traditional.

The second moderating influence on ATRURC is the Effect of Change in Output on Acceptable Tax Rate ECOATR, defined in equation 85.

$$\text{ECOATR.K(TAX)} = \text{TABHL}(\text{TECOAT}(*, \text{TAX}), \text{PPGSP.K/APPGSP.K}, 85, \text{A}.5, 1.2, .1)$$

- ECOATR - EFFECT OF CHANGE IN LEVEL OF OUTPUT ON ACCEPTABLE TAX RATE (DIM)
- TAX - TYPES OF TAX
- TABHL - TABLE LOOK-UP FUNCTION
- TECOAT - TABLE OF EFFECT OF CHANGE IN LEVEL OF OUTPUT ON ACCEPTABLE TAX RATE
- PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER CAPITA (\$/PERSON/YEAR)
- APPGSP - AVERAGE PRIVATE PRODUCTION OF GOODS AND SERVICES PER CAPITA (\$/PERSON/YEAR)

ECOATR is complimentary to ELOATR. The latter looks at the level of private output and the former considers the rate of change of the level of output. ECOATR embodies the assumption that, other things equal, the public is more willing to tolerate a given level of

tax rate when private output (income) is rising than when it is falling.

As Figure A-30 shows, when PPGSP rises to 10% above Average Private Production of Goods and Services Per capita APPGSP, the acceptable tax rate rises, other things by 10%. If a 20%, or more, disparity between PPGSP and APPGSP arises, what is deemed acceptable as a tax burden rises by only another 5%. The saturation, here, is again due to the assumption that people will never tolerate government taking more than a certain absolute fraction of income.

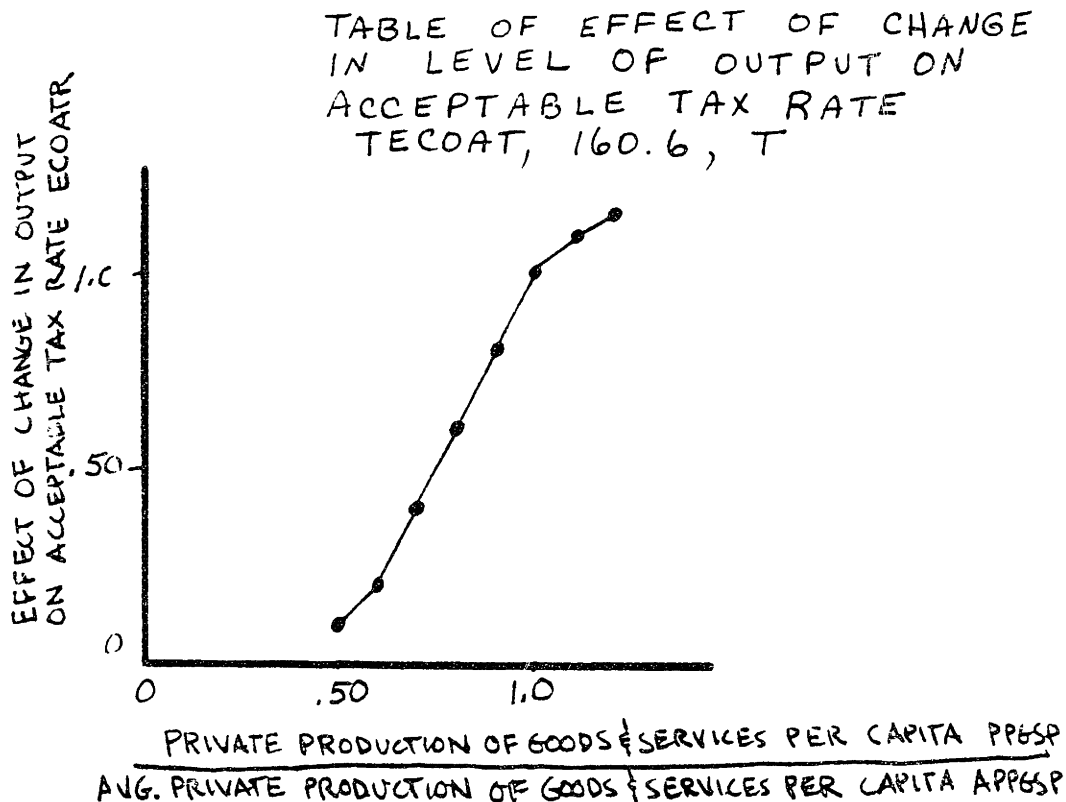


FIGURE A1-30. The Effect of Change in Output on Acceptable Tax Rate.

When PPGSP dips below its average value, ECOATR is highly responsive. A 10% dip causes the acceptable tax rate to decline by 20%. A 20% dip gives rise to a 40% decline in what is considered acceptable. The effect continues to be steeply non-linear over the entire range below the 1.0 point. Here, again, the justification for the non-linearity hinges on the assumption that the public will become very intolerant of bearing costs for relatively intangible services, like those provided by government, under conditions in which material standard of living is declining.

The final moderating influence on ATRURC is Effect of Service Ratio on Acceptable Tax Rate ESRATR. ESRATR is intended to capture the effect on the public's attitude toward an acceptable tax rate that is generated by the experience of cutbacks in government output, or the recognition of government boondoggling. ESRATR is defined in equation 86 as dependent upon Service Ratio by Tax SRT. SRT is simply a re-indexation of Service Ratio SR (see equation 161). SRT is subscripted by tax type, while SR is subscripted by level of government. SR, as discussed previously, is the ratio of the current level output of government services to the level of output to which the public has become accustomed.

ESRATR.K(TAX)=TABHL(TESRAT,SRT.K(TAX),0,1.8,.2) 86, A
ESRATR - EFFECT OF SERVICE RATIO ON ACCEPTABLE TAX
RATE (DIM)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
TESRAT - TABLE OF EFFECT OF SERVICE RATIO ON
ACCEPTABLE TAX RATE
SRT - SERVICE RATIO BY TAX (DIM)

Figure A1-31 depicts ESRATR as it depends upon SRT. When SRT is equal to 1.0, as it is in the reference equilibrium condition, ESRATR exerts a neutral influence on ATRURC. When SRT dips below 1.0, indicating a cut-back in the level of government services and transfers relative to the level to which the public has become accustomed, ESRATR increases. This means that, under such conditions, the public will acquiesce, other things equal, to a higher level of tax in order to pay for a restoration of the cutbacks in public output.

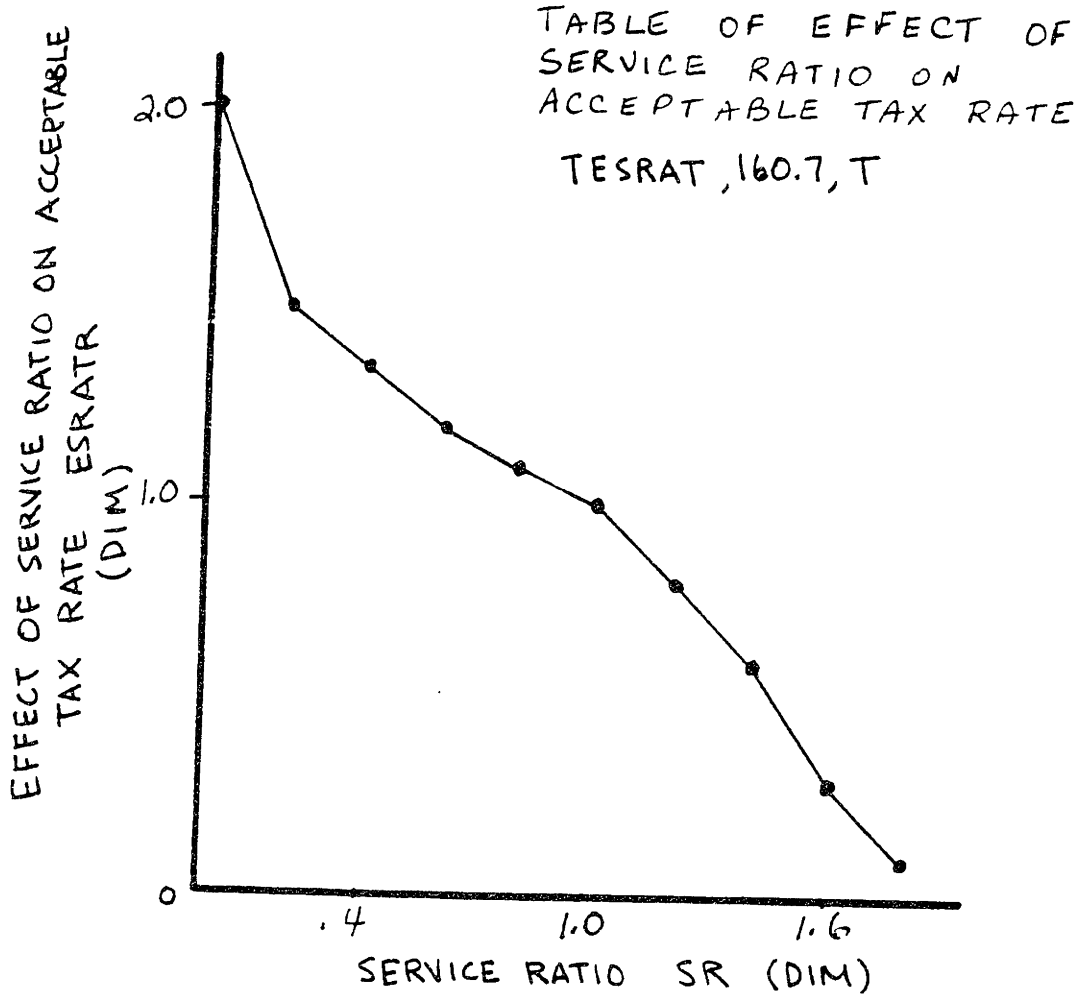


FIGURE A1-31. The Effect of Service Ratio on Acceptable Tax Rate.

On the other hand, if government is oversupplying government output (i.e., there is a perception that boondoggling is occurring), the public is assumed to respond quite sharply via a reduction of what it considers to be an acceptable tax rate. The responsiveness is, here again, asymmetric. The public is assumed to be more responsive in determining tax rate acceptability, to an oversupply of government output than it is to an undersupply.

The net effect of ELOATR, ECOATR and ESRATR, then, determines an Acceptable Tax Rate ATR. The public then compares Perceived Tax Rate PTR to ATR and responds accordingly. The response is defined as the Fractional Change from the Level of Tax FCLT, and constitutes the first component of Fractional Change in Tax from Public Sentiment FCTPS. Figure A1-32 depicts FCLT as it depends upon the ratio of PTR to ATR.

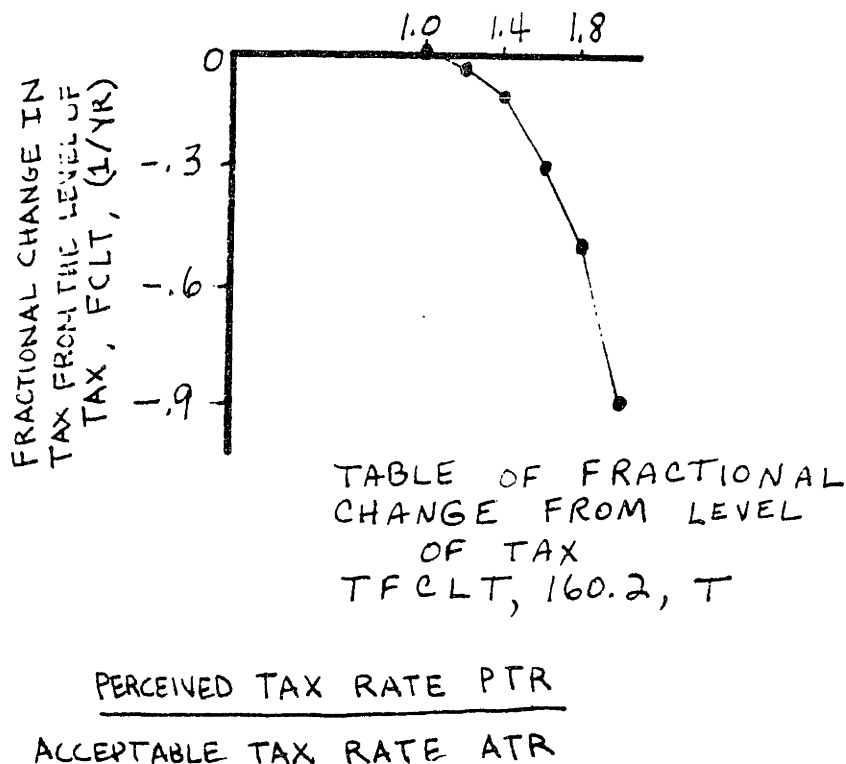


FIGURE A1-31. Fractional Change in Tax from the Level of the Tax Rate.

When PTR is less than or equal to ATR, FCLT adds no pressure to FCTPS. As the ratio climbs above 1.0, increasing pressure to lower the tax rate is generated. When the ratio climbs to 1.2, a pressure to reduce the tax rate by 5% per year is produced. When the ratio rises by another 17% (i.e., to 1.4), the resulting pressure that is generated climbs by 240% (i.e., to -12% per year). An additional 30% increase in the ratio of PTR to ATR (i.e., from 1.4 to 1.8) generates more than a 400% increase in the pressure to cut taxes (i.e, FCLT climbs from -12% to -50% per year). Thus, public reaction to the level of the tax rate is assumed to be highly non-linear. It is assumed that people simply will not tolerate a tax rate above what they consider acceptable. In reality, it is extremely unlikely that a discrepancy between PTR and ATR would be maintained for very long because it would always be in the best interest of some political candidate to promise, and then enact, a tax cut.

The second component of Fractional Change in Tax from Public Sentiment FCTPS is Fractional Change from Change in Tax Rate FCCTR. This influence is designed to capture the public's response to the rate of change of Tax Rate. The assumption here is that, irrespective of the level of the tax rate, a large, positive fractional increase in the tax rate, will draw more public reaction than a small, positive one. FCCTR is intended to capture this effect.

FCCTR is formulated in equation 87 as a function of the Perceived Change in Tax Rate PCTR.

$$FCCTR.K(TAX) = TABHL(TFCCTR, PCTR.K(TAX), 0, .5, .1) \quad 87, A$$

FCCTR - FRACTIONAL CHANGE FROM CHANGE IN TAX RATE
(1/YEAR)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
TFCCTR - TABLE OF FRACTIONAL CHANGE IN TAX RATE
PCTR - PERCEIVED CHANGE IN TAX RATE (1/YEAR)

PCTR is formulated in equation 88 as the difference between Tax Rate TR and Traditional Tax Rate TTR divided by the product of TTR and the averaging time, Time to Establish Traditional Tax Rate TETTR.

$$PCTR.K(TAX) = ((TR.K(TAX) - TTR.K(TAX)) / (TTR.K(TAX) * TETTR)) * BPTR(TAX) \quad 88, A$$

PCTR - PERCEIVED CHANGE IN TAX RATE (1/YEAR)
TAX - TYPES OF TAX
TR - TAX RATE (DIM)
TTR - TRADITIONAL TAX RATE (DIM)
TETTR - TIME TO ESTABLISH TRADITIONAL TAX RATE (YEARS)
BPTR - BIAS IN PERCEIVING TAX RATE (DIM)

The averaging time TETTR appears in the divisor of the expression for PCTR in order to remove time from the calculation of the percentage change. For example, a TETTR of 100 years or 1 year would yield two different values for PCTR for a given change in TR, unless the length of time over which TR is averaged is removed. The entire expression is multiplied by Bias in Perceiving Tax Rate BPTR in order to reflect differences in awareness between various tax burdens.

Traditional Tax Rate TTR is formulated as exponential average of TR, in equation 89.

$$TTR.K(TAX) = TTR.J(TAX) + (DT/TETTR) (TR.J(TAX) - TTR.J(TAX) - ECTR.J(TAX)) \quad 89, L$$

TTR - TRADITIONAL TAX RATE (DIM)
TAX - TYPES OF TAX
DT - SOLUTION INTERVAL (YEARS)
TETTR - TIME TO ESTABLISH TRADITIONAL TAX RATE (YEARS)
TR - TAX RATE (DIM)

TTR differs from TR only in periods when TR is changing. It reflects the fact that it takes the society at large some amount of time, here assumed to be 2 years on average (see equation 162.5) to come to fully recognize a new level of tax rate. The adjustment time reflects delays in communicating the new tax rate, as well as the force of human habit.

Figure A1-33 depicts the assumed relationship between Perceived Change in Tax Rate PCTR and the second component of FCTPS, FCCTR.

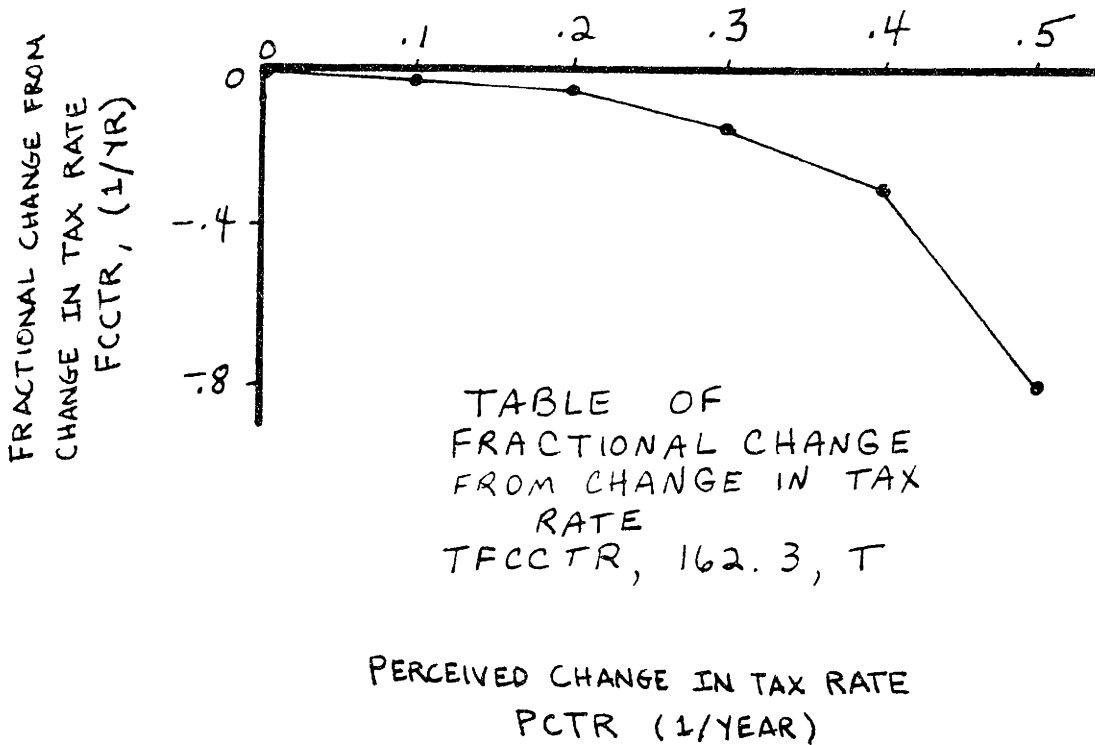


FIGURE A1-33. The Relationship Between Perceived Change in Tax Rate and Fractional Change from Change in Tax Rate.

As the Figure indicates, any value of PCTR less than or equal to zero generates no pressure to reduce tax rate, other things equal. As PCTR rises above zero, increasing pressure to cut tax rate is generated. Here, as in the relationship depicted for FCLT, the effect is assumed to be extremely non-linear. A 10% increase in TR generates a pressure to cut taxes by 2% per year. A 20% increase gives rise to a pressure to cut taxes by 5% per year. A 50% increase gives rise to a pressure to lower TR by 80% per year; a rate which, other things equal, would drive the level of tax to zero in just over one year! Thus, here again, public sentiment against taxes is assumed to rise very sharply as government's taxing behavior is perceived to be "getting out of hand".

The third component of FCTPS is Fractional Change from Perceived Government Money Adequacy FCPGMA. This component is intended to capture the public's reaction to swollen government treasuries. Proposition 13, the reaction of California electorate to the large budget surpluses which had built up at the state and local levels of government, is an example of such a reaction. FCPGMA is needed because government is assumed to make no response to reduce high money adequacy by cutting tax rates (see equation 79). Instead, it is assumed that government will endeavor to absorb money excesses into expanded spending commitments. However, while it is in the process of doing so, it is reasonable to assume that should the public become aware of large government budget surpluses, it would demand rebates in the form of lower tax rates. FCPGMA captures this effect.

FCPGMA is formulated in equation 90 as dependent upon Perceived Government Money Adequacy PGMA.

FCPGMA.K(TAX)=TABHL(TFCPGM(*,TAX),PGMA.K(TAX),1,3, 90, A .25)

- FCPGMA - FRACTIONAL CHANGE FROM PERCEIVED GOVT MONEY ADEQUACY (1/YEAR)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
TFCPGM - TABLE OF FRACTIONAL CHANGE FROM PERCEIVED GOVT MONEY ADEQUACY
PGMA - PERCEIVED GOVT MONEY ADEQUACY (DIM)

Perceived Government Money Adequacy PGMA is an exponential average of Government Money Adequacy by Tax GMAT (which, it will be recalled, is merely a re-indexing of GMA from level of government to tax type). The averaging of GMAT to yield PGMA reflects the fact that it takes time for the public to perceive the true state of government's money adequacy, and for the perception to coalesce into a pressure to cut tax rates. Here, the averaging time, Time to Perceive Government Money Adequacy TPGMA, is set (in equation 162.7) equal to 2 years.

PGMA.K(TAX)=PGMA.J(TAX)+(DT/TPGMA)(GMAT.J(TAX)- PGMA.J(TAX)) 91, L

- PGMA - PERCEIVED GOVT MONEY ADEQUACY (DIM)
TAX - TYPES OF TAX
DT - SOLUTION INTERVAL (YEARS)
TPGMA - TIME TO PERCEIVE GOVT MONEY ADEQUACY (YEARS)
GMAT - GOVT MONEY ADEQUACY BY TAX (DIM)

GMAT.K(1)=GMA.K(1) 92, A
GMAT - GOVT MONEY ADEQUACY BY TAX (DIM)
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

Figure A1-34 depicts the relationship between FCPGMA and PGMA.

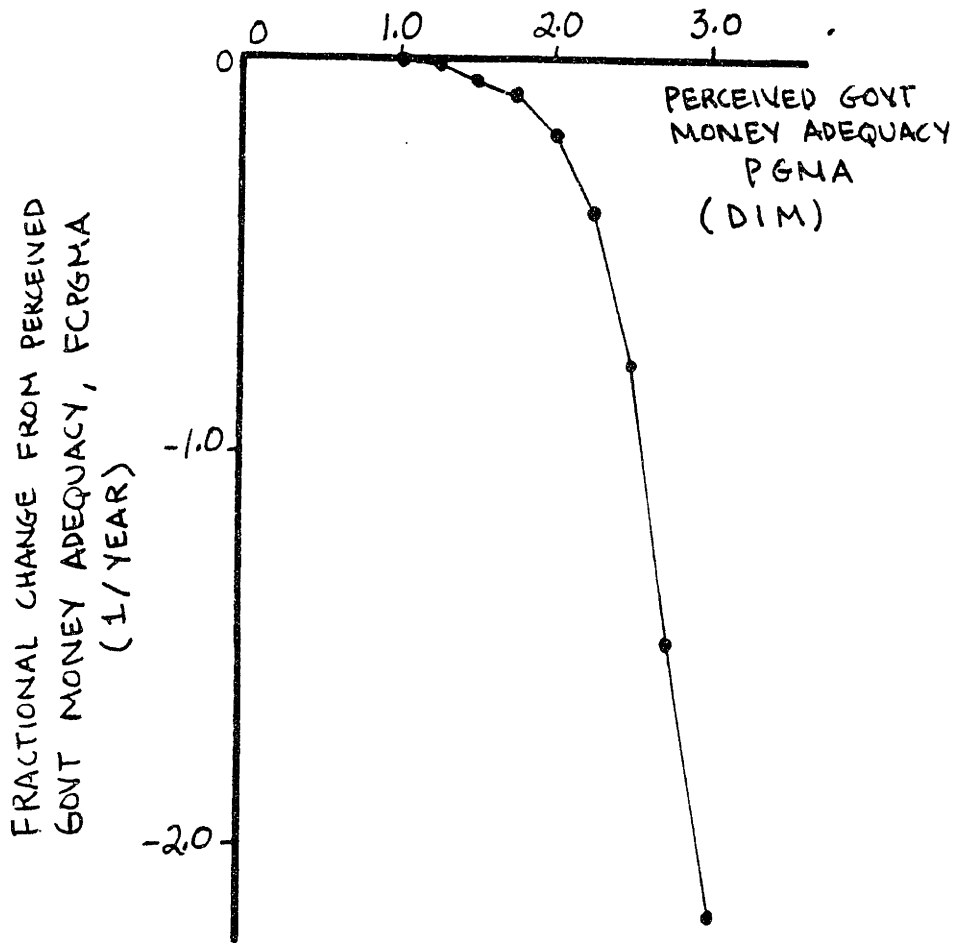


TABLE OF FRACTIONAL CHANGE FROM PERCEIVED GOVT MONEY ADEQUACY
TFC PGM, 162.8, T

FIGURE A1-34. Fractional Change in Tax from Perceived Government Money Adequacy.

As the Figure indicates, no public sentiment to cut taxes is assumed to be generated by a perception that government's money adequacy is at, or below, 1.0. When PGMA rises above 1.0, however, increasing pressure to cut tax rates is assumed to arise. Here, again the extreme non-linearity evident in the other two components of FCTPS, is present. A doubling of PGMA, from 1.25 to 2.5, causes

FPCGMA to increase forty-fold, from -.02 to -.8. A doubling, from 1.5 to 3.0 in PGMA generates a forty-five-fold rise in FPCGMA, from -.05 to -2.2. Once again, then, the public is assumed to tolerate minor excesses in government operations, but to react increasingly strongly to progressively larger deviations from normal operating conditions.

The final component of Fractional Change in Tax from Public Sentiment FCTPS is the Effect of Threat to National Security on Public Sentiment ETNSPS. ETNSPS functions in an exactly analogous manner to MRTNS (equation 70) in the Debt equations. Both variables serve to neutralize public reaction to government's fund-raising activities during times of National crisis (especially war). In reality, government at the Federal level is the primary beneficiary of this effect. Therefore, in parameterizing a multi-level government sector, ETNSPS could be calibrated so as to neutralize public sentiment to a degree that varied by level of government.

ETNSPS is defined in equation 93 as dependent upon the exogenous time series Threat to National Security TNS (defined in equation 159),

ETNSPS.K(TAX)=TABHL(TETNSS(*,TAX),TNS.K,0,1,.25) 93, A
ETNSPS - EFFECT OF THREAT TO NATIONAL SECURITY ON
PUBLIC SENTIMENT (DIM)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
TETNSS - TABLE OF EFFECT OF THREAT TO NATIONAL
SECURITY ON PUBLIC SENTIMENT
TNS - INDEX OF THREAT TO NATIONAL SECURITY (DIM)

As Figure A1-35 indicates, ETNSPS decreases non-linearly with rising TNS. The effect decreases because ETNSPS couples multiplicatively to FCTPS. Thus, smaller values of ETNSPS mean a greater neutralization of public sentiment. The effect is non-linear because it is assumed that the public is initially cautious in taking a threat to National security seriously. However, once such a threat

is taken seriously, the public is assumed to be willing to make the sacrifices necessary to ensure that a maximum crisis-reduction effort is achieved.

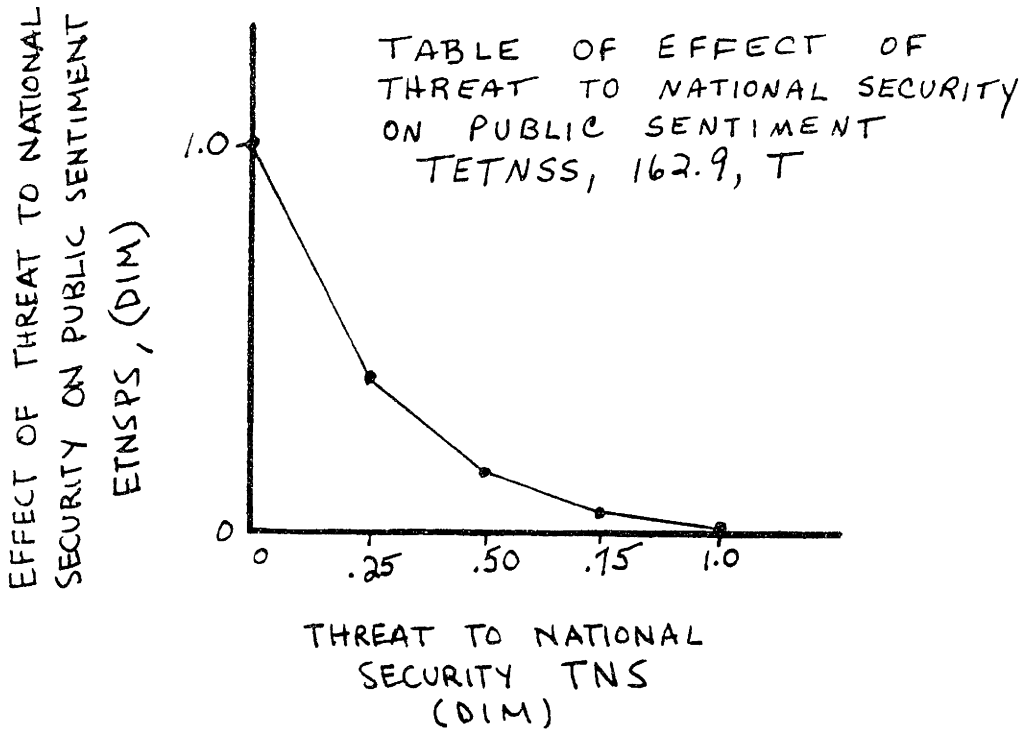


FIGURE A1-35. The Effect of Threat to National Security on Public Sentiment.

The third, and final, component of Fractional Change in Tax Rate FCTR is Fractional Change in Tax From Fiscal Action FCTFA. FCTFA is designed to capture government's fiscal response to the level of economic activity. Again, such a response is primarily a Federal

perogative. Thus, in a multi-level government sector the effect could be zeroed-out at the State and Local levels of government.

FCTFA is defined in equation 94. It depends upon the ratio of Private Production of Goods and Services Per capita PPGSP to the Reference Level of Private Production Per capita RLPPP,

$$FCTFA.K(TAX) = TABHL(TFCTFA(*, TAX), PPGSP.K/RLPPP, .6, 94, A1, .05)$$

- FCTFA - FRACTIONAL CHANGE IN TAX FROM FISCAL ACTION (1/YEAR)
- TAX - TYPES OF TAX
- TABHL - TABLE LOOK-UP FUNCTION
- TFCTFA - TABLE OF FRACTIONAL CHANGE IN TAX FROM FISCAL ACTION
- PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER CAPITA (\$/PERSON/YEAR)
- RLPPP - REFERENCE LEVEL OF PRIVATE PRODUCTION PER CAPITA (\$/PERSON/YEAR)

When private output dips below the reference standard, government is assumed to attempt to stimulate aggregate demand by cutting tax rate, and thereby putting more money into the hands of consumers (assuming that government does not reduce its spending by an amount commensurate with the reduction in tax inflows). Figure A1-36 portrays the assumed effect graphically.

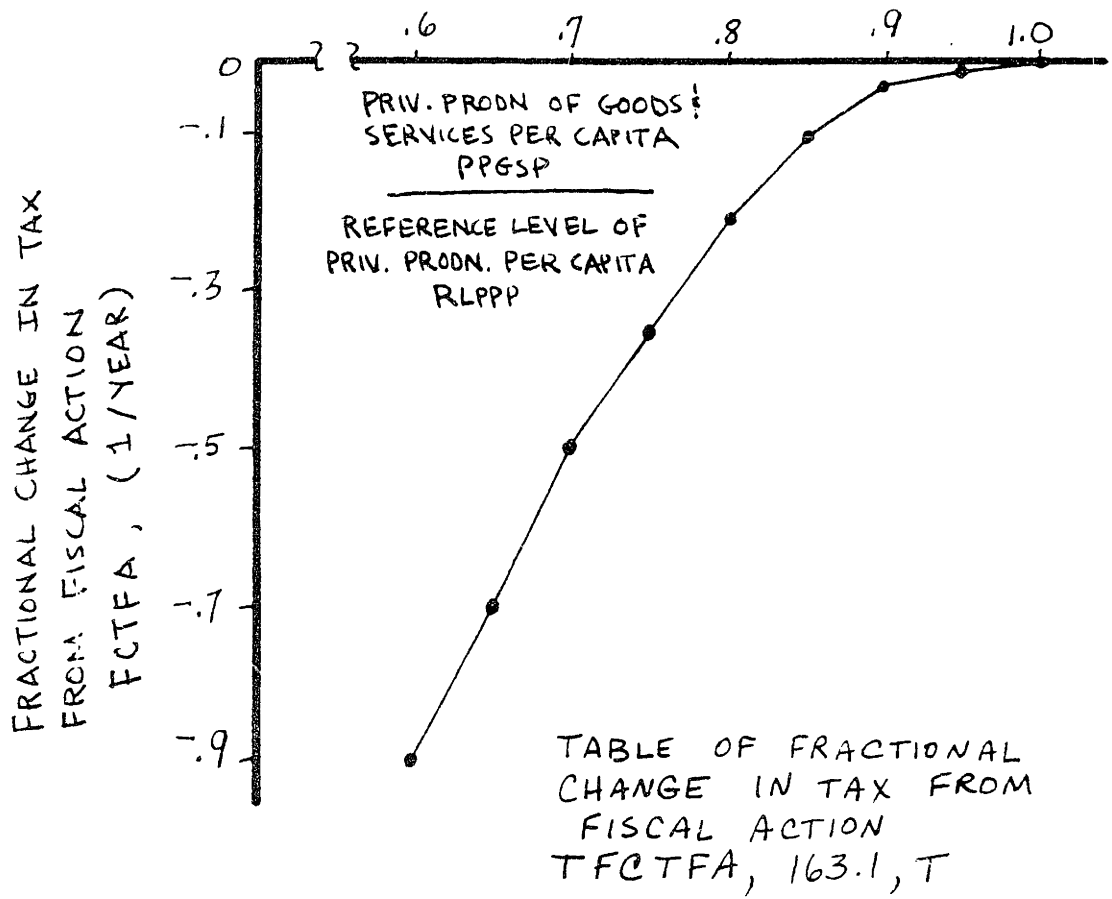


FIGURE A1-36. Fractional Change in Tax From Fiscal Action.

As the Figure indicates, no pressure to increase tax rates is generated when PPGSP is greater than, or equal to, RLPPP. When PPGSP declines below RLPPP, however, increasing pressure to cut taxes is generated. Notice that small downward excursions of PPGSP relative to RLPPP call for only a very small tax-cutting response from government. Only when PPGSP dips 15% or more below the reference level is there

any very substantial effort on the part of government to cut tax rate. The "slow start" in cutting tax rate evidenced in Figure A1-36 reflects an assumption that, in addition to a natural predilection against reducing revenues, government is somewhat reluctant to cut taxes for fear of not being able to reinstitute them again when economic conditions improve.

The final three variables in the tax rate setting block are not directly involved in determining the tax rate. However, they are related to tax rate and are therefore included here,

Tax Revenues TAXREV are defined in equation 95 as the sum of Tax Revenue by Tax TRBT. TAXREV is really only a re-indexing of TRBT, TAXREV must be subscripted by level of government, while TRBT must be subscripted by tax type.

$$\begin{aligned} \text{TAXREV.K(1)} &= \text{TRBT.K(1)} && 95, A \\ \text{TAXREV} &- \text{TAX REVENUES (\$/YEAR)} \\ \text{TRBT} &- \text{TAX REVENUE BY TAX (\$/YEAR)} \end{aligned}$$

TRBT is formulated in equation 96 as the product of Tax Rate TR and Tax Base TB,

$$\begin{aligned} \text{TRBT.K(TAX)} &= \text{TR.K(TAX)} * \text{TB.K(TAX)} && 96, A \\ \text{TRBT} &- \text{TAX REVENUE BY TAX (\$/YEAR)} \\ \text{TAX} &- \text{TYPES OF TAX} \\ \text{TR} &- \text{TAX RATE (DIM)} \\ \text{TB} &- \text{TAX BASE (\$/YEAR)} \end{aligned}$$

Tax Base TB is an aggregate model representation of all of the things upon which taxes are, in reality, levied. In a more sophisticated representation, each tax would have a uniquely-defined tax base. Here as equation 97 indicates, TB is taken as a fixed fraction of Gross National Product GNP.

TB.K(TAX)=GNP.K*TBF(TAX) 97, A
TB - TAX BASE (\$/YEAR)
TAX - TYPES OF TAX
GNP - GROSS NATIONAL PRODUCT (\$/YEAR)
TBF - TAX BASE FRACTION (DIM)

In this configuration of the model, Tax Base Fraction TBF is defined, in equation 163,2, so that tax revenues will exactly offset the sum of Payments to Factors of Government Production (which, when summed over all levels of government, is equal to GPG), and Transfer Payments TP.

$$TBF(1) = (GPGS + TP(1)) / (GNP * TR(1))$$

TBF - TAX BASE FRACTION (DIM)
GPGS - GOVT PRODUCTION OF GOODS & SERVICES (\$/
YEAR)
TP - TRANSFER PAYMENTS (\$/YEAR)
GNP - GROSS NATIONAL PRODUCT (\$/YEAR)

Defining TBF in this manner allows for flexibility in the selection of other parameters, while ensuring that Per Capita Disposable Income PCDI will always equal Private Production of Goods and Services Per Capita PPGSP; the latter being a requirement for equilibrium (i.e., when PCDI equals PPGSP, there is exactly enough income to buy all of the privately-produced output, and government is spending, for salaries and transfers, exactly what it is taking in tax revenues.

This concludes the description of the equation blocks within the government sector of the model. What follows is a description of the equation blocks within the rest-of-the socioeconomy sector,

A1.6 POPULATION

A flow diagram of the population block of equations appears in Figure A1-37.

Population POP is held constant in all runs of the model and is therefore defined in equation 99 as equal to a constant Reference Population RPOP. RPOP is set equal to two-hundred million, which approximates the current population of the United States.

```
POP.K=RPOP
RPOP=200E6
POP      - POPULATION (PEOPLE)
RPOP     - REFERENCE POPULATION (PEOPLE)
```

99, A
99.1, C

Fraction of Elderly FE, defined in equation 100, is the fraction of the population aged 65 or older.

```
FE.K=CLIP(AFE,RFE,TIME.K,TIE4)
AFE=.4
RFE=.2
FE      - FRACTION OF ELDERLY (DIM)
CLIP    - DYNAMO FUNCTION USED FOR ALTERING
          PARAMETERS FOR TESTING PURPOSES
AFE     - ALTERED FRACTION OF ELDERLY (DIM)
RFE     - REFERENCE FRACTION OF ELDERLY (DIM)
TIME    - DYNAMO FUNCTION FOR RECORDING ELAPSED
          SIMULATION TIME (YEARS)
TIE4    - TIME TO IMPLEMENT EXPERIMENT 4 (YEAR)
```

100, A
100.1, C
100.2, C

FE is a constant in the model set equal to a Reference Fraction of Elderly RFE, itself set equal to .2. A Clip function is used in defining FE so that the fraction of elderly may be changed to equal a user-specified Altered Fraction of Elderly AFE at any time during the simulation. Alteration of the fraction of elderly constitutes the fourth experiment conducted with the model and is implemented by setting Time to Implement Experiment 4 TIE4 to some value within the time horizon of the simulation.

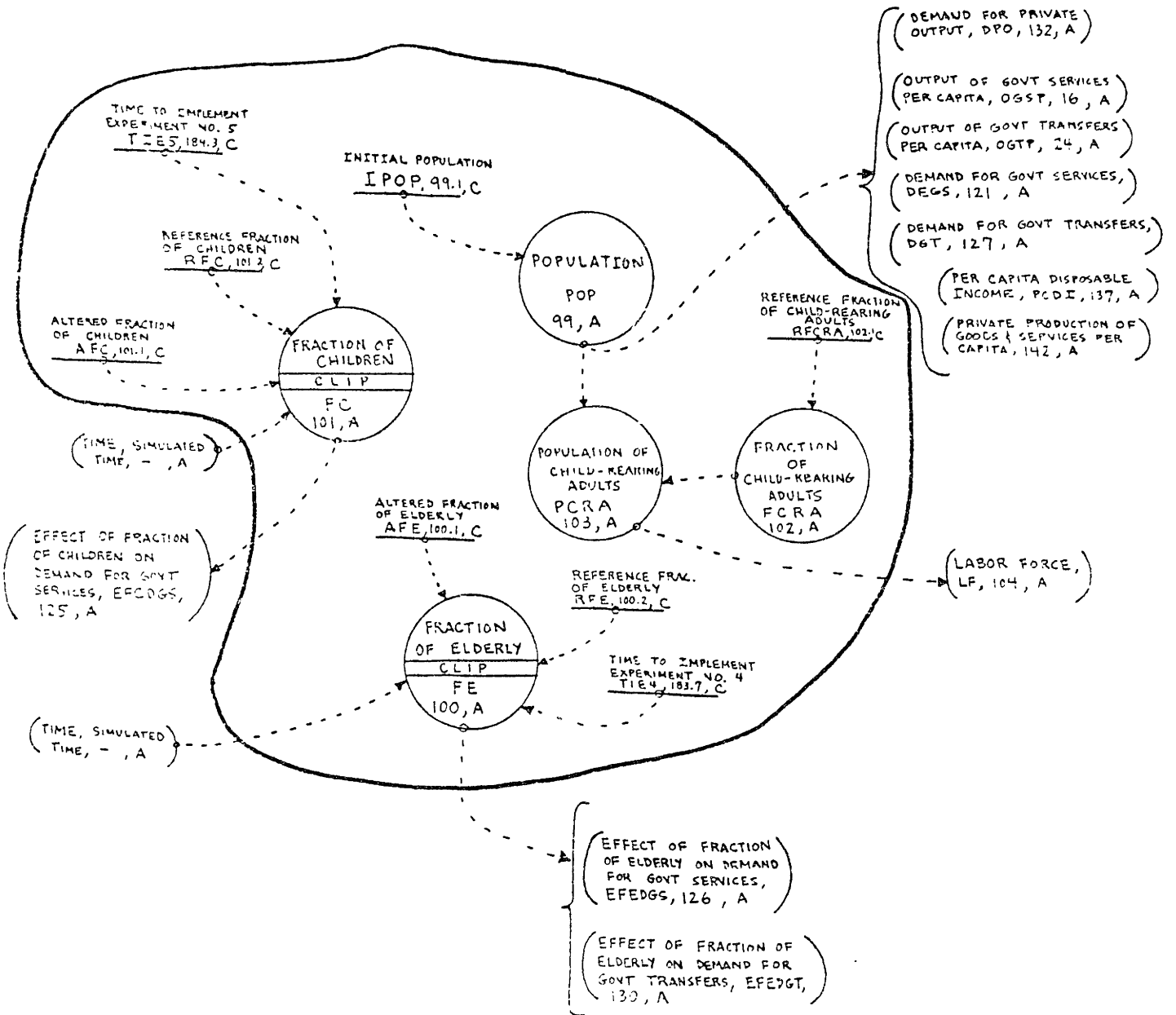


FIGURE A1-37. A Flow Diagram of The Population Block of Equations.

Fraction of Children FC is defined in an exactly analogous manner to FE in Equation 101. FC is the fraction of the population below working age.

```
FC.K=CLIP(AFC,RFC,TIME,K,TIES)          101, A
AFC=.4                                  101.1, C
RFC=.3                                  101.2, C
FC - FRACTION OF CHILDREN (DIM)
CLIP - DYNAMO FUNCTION USED FOR ALTERING
      PARAMETERS FOR TESTING PURPOSES
AFC - ALTERED FRACTION OF CHILDREN (DIM)
RFC - REFERENCE FRACTION OF CHILDREN (DIM)
TIME - DYNAMO FUNCTION FOR RECORDING ELAPSED
      SIMULATION TIME (YEARS)
TIES - TIME TO IMPLEMENT EXPERIMENT 5 (YEAR)
```

Both FC and FE are assumed to play a role in determining the demand for government output, as subsequent discussion will indicate.

The third component of the population is the Fraction of Child-Rearing Adults FCRA. Included in this category are people who are child-rearing aged, and therefore eligible for participation in the labor force. FCRA is a constant in this configuration of the model. It is defined as equal to the Reference Fraction of Child-Rearing Adults RFCRA in equation 102.

```
FCRA.K=RFCRA                            102, A
RFCRA=.5                                 102.1, C
FCRA - FRACTION OF CHILD-REARING ADULTS (DIM)
RFCRA - REFERENCE FRACTION OF CHILD-REARING ADULTS
      (DIM)
```

FCRA is used to calculate a Population of Child-Rearing Adults PCRA in equation 103.

```
PCRA.K=POP.K*FCRA.K                     103, A
PCRA - POPULATION OF CHILD-REARING ADULTS (PEOPLE)
POP - POPULATION (PEOPLE)
FCRA - FRACTION OF CHILD-REARING ADULTS (DIM)
```

PCRA is determined as the product of Population POP and FCRA. It then serves as the base from which the labor force is drawn.

A1.7 LABOR MARKET

A flow diagram of the Labor Market equations appears as Figure A1-37.

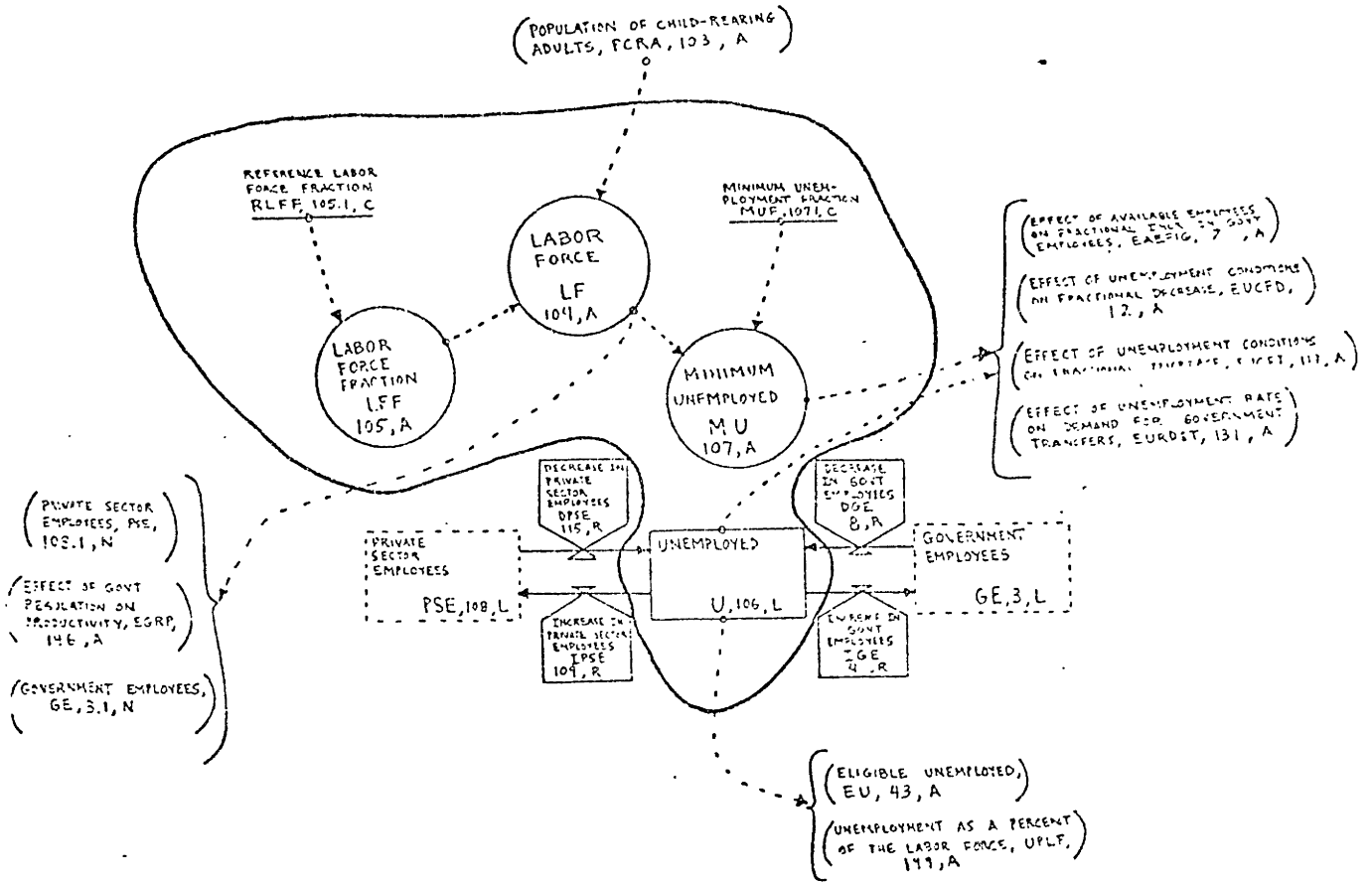


FIGURE A1-38. A Flow Diagram of the Labor Market Block of Equations.

Labor Force LF provides labor for the production of private and government output. As previously discussed, LF is fully allocated to either government or private sector employment or to the unemployed pool.

LF is defined, in equation 104, as the Population of Child-Rearing Adults PCRA times a Labor Force Fraction LFF.

LABOR MARKET

LF.K=PCRA.K*LFF.K 104, A
LF - LABOR FORCE (PEOPLE)
PCRA - POPULATION OF CHILD-REARING ADULTS (PEOPLE)
LFF - LABOR FORCE FRACTION (DIM)

LFF is a constant in this configuration of the model and set equal to a Reference Labor Force Fraction in equation 105.

LFF.K=RLFF 105, A
RLFF=.4 105.1, C
LFF - LABOR FORCE FRACTION (DIM)
RLFF - REFERENCE LABOR FORCE FRACTION (DIM)

The level of Unemployed U includes all those in the labor force but not employed by either government or the private sector. U, as defined in equation 106, is increased by Decrease in Private Sector Employees DPSE and Decrease in Government Employees DGE and depleted by Increase in Private Sector Employees IPSE and Increase in Government Employees IGE.

U.K=U.J+(DT) (DPSE.JK+DGE.JK(1)-IPSE.JK-IGE.JK(1)) 106, L
U=LF-(PSE+SUM(GE)) 106.1, N
U - UNEMPLOYED (PEOPLE)
DT - SOLUTION INTERVAL (YEARS)
DPSE - DECREASE IN PRIVATE SECTOR EMPLOYEES
(PEOPLE/YEAR)
DGE - DECREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)
IPSE - INCREASE IN PRIVATE SECTOR EMPLOYEES
(PEOPLE/YEAR)
IGE - INCREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)
LF - LABOR FORCE (PEOPLE)
PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
GE - GOVERNMENT EMPLOYEES (PEOPLE)

U is initialized, in equation 106.1, by subtracting the sum of Private Sector Employees PSE and Government Employees GE from the total number of people in the Labor Force LF.

Minimum Unemployed MU is the number of people who are in the labor force but who would be unemployed even under extremely good economic conditions. MU represents a level of so-called frictional unemployment. It includes primarily those who are between jobs but out of a job for long enough to be counted among the unemployed. MU is defined, in equation 107, as the product of Labor Force LF and Minimum Unemployment Fraction MUF. MUF is set equal to 2% in equation 107.1.

MU.K=LF.K*MUF 107, A
MUF=.02 107.1, C
MU - MINIMUM UNEMPLOYED (PEOPLE)
LF - LABOR FORCE (PEOPLE)
MUF - MINIMUM UNEMPLOYMENT FRACTION (DIM)

A1-8. PRIVATE SECTOR EMPLOYMENT

A flow diagram of the Private Sector Employment block of equations is presented in Figure A1-39.

As the Figure indicates Private Sector Employees PSE, like Government Employees GE, are drawn directly from and discharged directly into, the pool of Unemployed U. As Equation 108 shows, PSE is increased by Increase in Private Sector Employees IPSE and decreased by Decrease in Private Sector Employees DPSE.

PSE.K=PSE.J+(DT)(IPSE.JK-DPSE.JK)	108, L
PSE=LF*PSEF	108.1, N
PSEF=.8	108.2, C
PSE	- PRIVATE SECTOR EMPLOYEES (PEOPLE)
DT	- SOLUTION INTERVAL (YEARS)
IPSE	- INCREASE IN PRIVATE SECTOR EMPLOYEES (PEOPLE/YEAR)
DPSE	- DECREASE IN PRIVATE SECTOR EMPLOYEES (PEOPLE/YEAR)
LF	- LABOR FORCE (PEOPLE)
PSEF	- PRIVATE SECTOR EMPLOYMENT FRACTION (DIM)

PSE is initialized by multiplying Labor force by Private Sector Employment Fraction PSEF in equation 108.1. PSEF is, in equation 108.2, set equal to .8 to reflect the approximate percentage of total labor force currently employed in the private sector of the U.S. economy.

Increase in Private Sector Employees IPSE is formulated in equation 109 as the product of PSE and a Fractional Increase in Private Sector Employees FIPSE. In addition, for testing purposes, an Exogenous Transfer of Employees from Government to the Private Sector ETEGP is included.

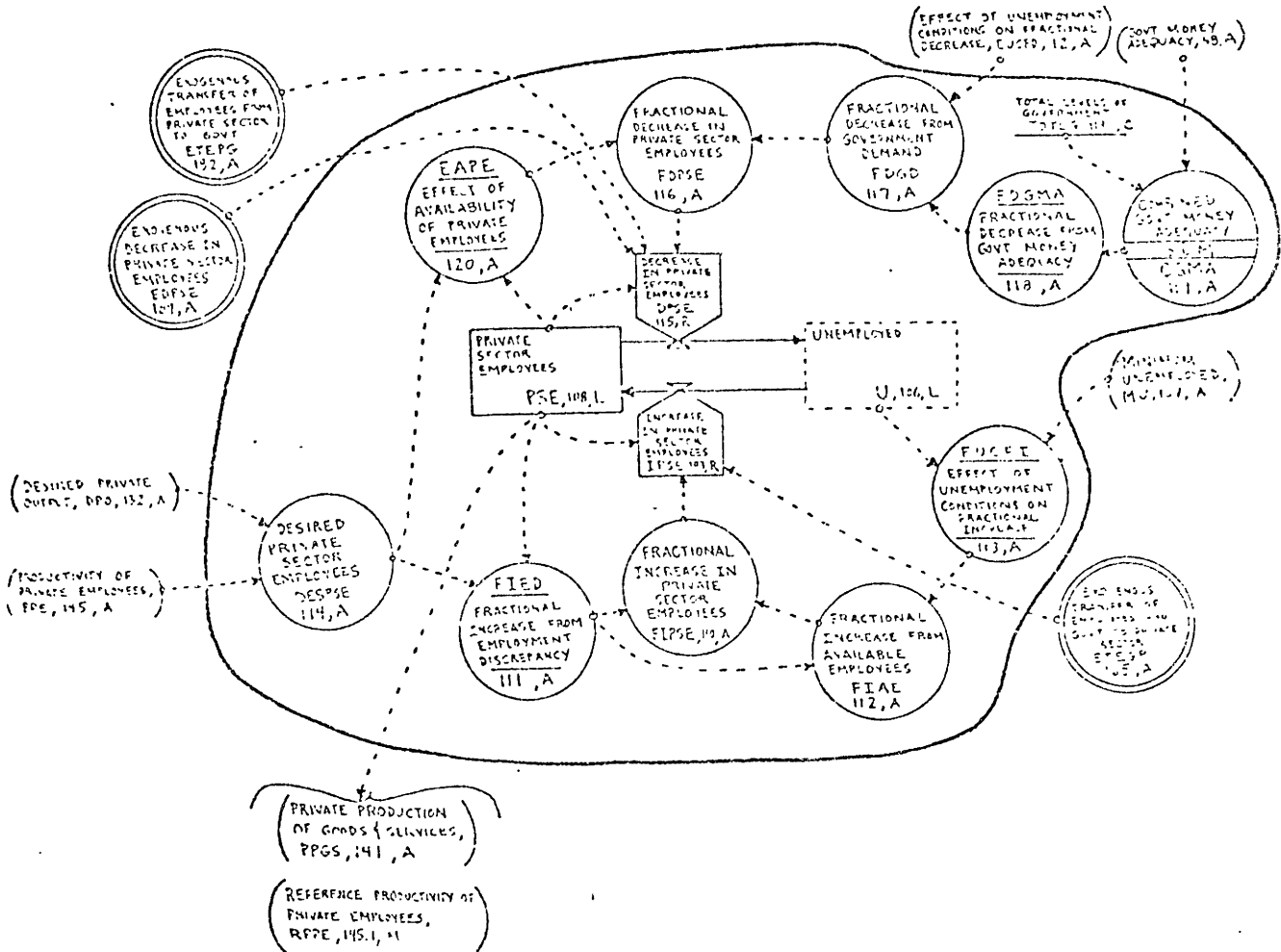


FIGURE A1-39. Flow Diagram of the Private Sector Employment Block of Equations.

IPSE.KL=(PSE.K*FIPSE.K)+SUM(ETEGP.K) 109, R
IPSE - INCREASE IN PRIVATE SECTOR EMPLOYEES
(PEOPLE/YEAR)
PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)
FIPSE - FRACTIONAL INCREASE IN PRIVATE SECTOR
EMPLOYEES (1/YEAR)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
ETEGP - EXOGENOUS TRANSFER OF EMPLOYEES FROM GOVT
TO PRIVATE SECTOR (PEOPLE/YEAR)

Fractional Increase in Private Sector Employees FIPSE is modeled, in equation 110, as the sum of Fractional Increase from Employment Discrepancy FIED and Fractional Increase from Availability of Employees FIAE.

FIPSE.K=FIED.K+FIAE.K 110, A
FIPSE - FRACTIONAL INCREASE IN PRIVATE SECTOR
EMPLOYEES (1/YEAR)
FIED - FRACTIONAL INCREASE FROM EMPLOYMENT
DISCREPANCY (1/YEAR)
FIAE - FRACTIONAL INCREASE FROM AVAILABLE
EMPLOYEES (1/YEAR)

Fractional Increase from Employment Discrepancy FIED represents the "pull" on members of the labor force who are not currently employed in the private sector, generated by the demand for increased private output. Fractional Increase from Available Employees FIAE represents the "push" from high levels of unemployed workers seeking employment in the private sector.

FIED is seen, in equation 111, to depend upon the ratio of Desired Private Sector Employees DESPSE to the current level of Private Sector Employees PSE.

FIED.K=TABHL(TFIED,DESPSE.K/PSE.K,1,5,1) 111, A
TFIED=0/.25/.5/.75/1 111.1, T
FIED - FRACTIONAL INCREASE FROM EMPLOYMENT
DISCREPANCY (1/YEAR)
TABHL - TABLE LOOK-UP FUNCTION
TFIED - TABLE OF FRACTIONAL INCREASE FROM
EMPLOYMENT DISCREPANCY
DESPSE - DESIRED PRIVATE SECTOR EMPLOYEES (PEOPLE)
PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)

DESPSE represents the number of workers that the private sector requires, at current productivity levels, to generate a level of output that meets current demand.

As Figure A1-40 indicates, when DESPSE is less than or equal to PSE, no pressure to bring additional employees into the sector is generated from this source. As the ratio climbs above 1.0, FIED increases linearly. When the ratio of DESPSE to PSE equals 2.0, FIED takes on a value of .25. At this rate of acquisition, roughly two-thirds of the employee shortfall would be eliminated in four years! The rate at which the discrepancy between DESPSE and PSE is closed is assumed to be even more rapid as the discrepancy becomes larger. For example, were the ratio of DESPSE to PSE to climb to 3.0, FIED would take on a value of .5. At this fractional rate of assimilation, two-thirds of the disparity would be eliminated in only two years! The extreme quickness of the response to private sector employment discrepancies reflects, again, the assumption of a societal hierarchy of need. When PSE falls relative to DESPSE, it indicates that society can not produce material essentials at a level that it is demanding. Because government, by assumption, can not produce these essentials, employees must flow back other things equal, into the private sector in order to get the job done. FIED indicates that the flow proceeds quite rapidly.

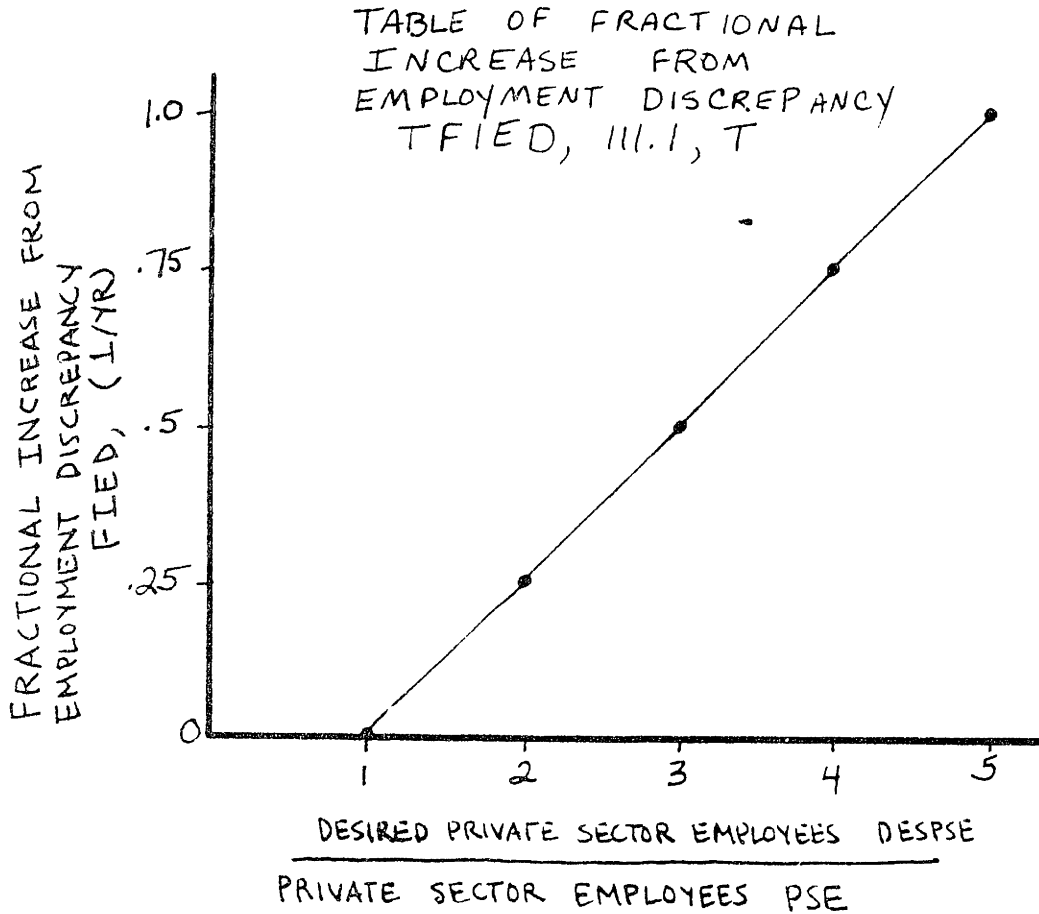


FIGURE A1-40. Fractional Increase in Private Employees from Employment Discrepancy.

The second term in the expression for Fractional Increase in Private Sector Employees FIPSE is Fractional Increase from Available Employees FIAE. As equation 112 indicates, FIAE is itself a function of Fractional Increase from Employment Discrepancy FIED, the first term in FIPSE. In fact, FIAE actually moderates FIED, with the degree of moderation depending upon unemployment conditions.

FIAE.K=FIED.K*EUCFI.K 112, A
FIAE - FRACTIONAL INCREASE FROM AVAILABLE
EMPLOYEES (1/YEAR)
FIED - FRACTIONAL INCREASE FROM EMPLOYMENT
DISCREPANCY (1/YEAR)
EUCFI - EFFECT OF UNEMPLOYMENT CONDITIONS ON
FRACTIONAL INCREASE (DIM)

FIAE is defined as the product of FIED and the Effect of Unemployment Conditions on Fractional Increase EUCFI. EUCFI depends, as seen in equation 113, upon the ratio of Unemployed U to Minimum Unemployed MU.

EUCFI.K=TABHL(TEUCFI,U.K/MU.K,0,7,.5) 113, A
TEUCFI=-1/-1/-.9/-.5/-.2/0/.1/.2/.3/.4/.5/.55/.58/
.59/.6 113.1, T
EUCFI - EFFECT OF UNEMPLOYMENT CONDITIONS ON
FRACTIONAL INCREASE (DIM)
TABHL - TABLE LOOK-UP FUNCTION
TEUCFI - TABLE OF EFFECT OF UNEMPLOYMENT CONDITIONS
ON FRACTIONAL INCREASE
U - UNEMPLOYED (PEOPLE)
MU - MINIMUM UNEMPLOYED (PEOPLE)

As Figure A1-41 indicates, when U is equal to 2.5 times MU, as it is in the reference equilibrium, EUCFI takes on a value of zero. Therefore, as seen from an examination of equation 112, FIAE assumes a value of zero, and hence FIPSE depends only upon whatever discrepancy might exist between DESPSE and PSE. When the ratio of U to MU exceeds 2.5, EUCFI takes on positive values. This means that, from equation 113, FIAE becomes equal to some fraction of FIED. Thus, FIPSE is augmented by a "push" from relatively high levels of unemployed. On the other side of the coin, when the ratio of U to MU dips below 2.5,

EUCFI assumes negative values. This means that some fraction of FIED is subtracted from FIED, thereby reducing FIPSE when unemployment pools are relatively low.

TABLE OF EFFECT OF
UNEMPLOYMENT CONDITIONS
ON FRACTIONAL INCREASE
TEUCFI, 113.1, T

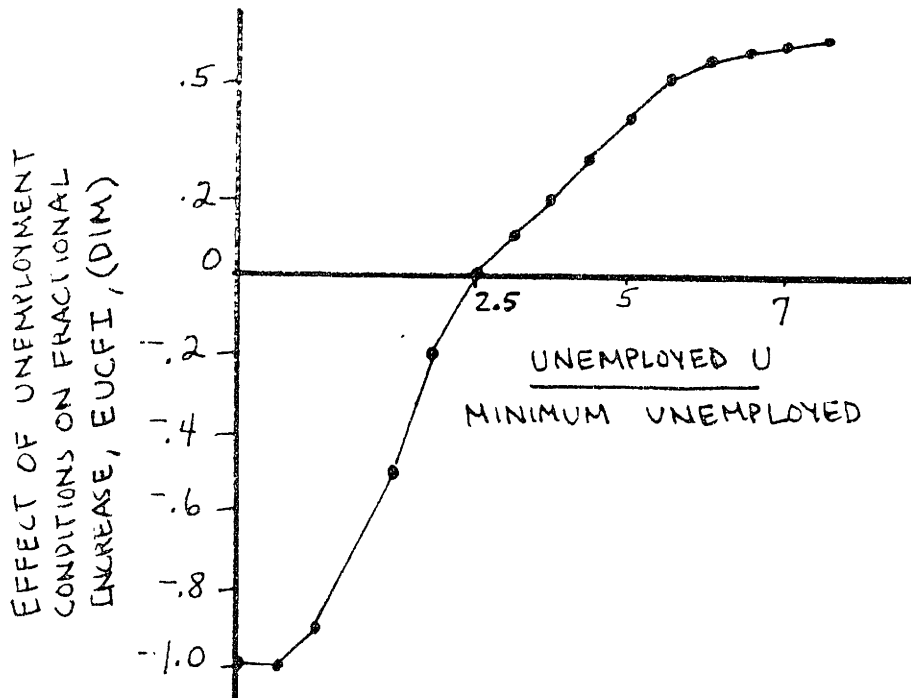


FIGURE A1-41 The Effect of Unemployment Conditions on Fractional Increase in Private Sector Employees.

The selection of an unemployment level of 2.5 times the frictional level as the "zero point" for EUCFI is somewhat arbitrary. However, in principle, such a point exists. At this level of unemployment, people are not bad off enough to begin "pushing" for jobs (i.e., accepting lower wages, offering to work non-union, etc.) in the private sector. At the same time, the unemployment pool is far enough above the frictional level not to constrain whatever pull the private sector might be exerting on the unemployed pool.

As the ratio of U to MU rises above the 2.5 point, the stimulative effect on private sector hiring is linear at first. At very high levels of unemployment, however, the effect begins to saturate. The saturation of the effect reflects the assumption that as unemployment reaches double digit figures, the private economy is in deep trouble and is not able, by itself, to hire on additional workers even at reduced wages. Below the zero point, EUCFI really acts as a strict availability constraint. When U is just equal to MU, any non-zero value of FIED is cut by 90%; reflecting the assumed difficulty of hiring workers; no matter how strong the demand, when unemployment is at frictional levels. By the time U has fallen to one-half MU, FIPSE is driven to zero, reflecting the physical impossibility of a completely empty unemployment pool.

Desired Private Sector Employees DESPSE is defined in equation 114 as Desired Private Output DPO divided by Productivity of Private Employees PPE. DESPSE thus represents the number of employees, at prevailing productivity levels, needed to produce the private output that is currently being demanded by the society.

DESPSE.K=DPO.K/PPE.K 114, A
DESPSE - DESIRED PRIVATE SECTOR EMPLOYEES (PEOPLE)
DPO - DEMAND FOR PRIVATE OUTPUT (\$/YEAR)
PPE - PRODUCTIVITY OF PRIVATE EMPLOYEES (\$/
PERSON/YEAR)

Decrease in Private Sector employees DPSE is formulated in equation 115 in a manner exactly analogous to Increase in Private Sector Employees IPSE.

DPSE.KL=(PSE.K*FDPSE.K)+SUM(ETEPG.K)+EDPSE.K 115, R
DPSE - DECREASE IN PRIVATE SECTOR EMPLOYEES
(PEOPLE/YEAR)
PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)
FDPSE - FRACTIONAL DECREASE IN PRIVATE SECTOR
EMPLOYEES (1/YEAR)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
ETEPG - EXOGENOUS TRANSFER OF EMPLOYEES FROM
PRIVATE TO GOVT SECTOR (PEOPLE/YEAR)
EDPSE - EXOGENOUS DECREASE IN PRIVATE SECTOR
EMPLOYEES (PEOPLE/YR)

DPSE is generated as the product of Private Sector Employees PSE and Fractional Decrease in Private Sector Employees FDPSE. Two additional exogenous rates--Exogenous Transfer of Employees from Private Sector to Government ETEPG and Exogenous Decrease in Private Sector Employees EDPSE--are included for use in testing the model.

Fractional Decrease in Private Sector Employees FDPSE is modeled, in equation 116, as Fractional Decrease from Government Demand FDGD moderated by the Effect of Availability of Private Employees EAPE.

FDPSE.K=(FDGD.K*EAPE.K) 116, A
FDPSE - FRACTIONAL DECREASE IN PRIVATE SECTOR
EMPLOYEES (1/YEAR)
FDGD - FRACTIONAL DECREASE FROM GOVT DEMAND (1/
YEAR)
EAPE - EFFECT OF AVAILABILITY OF PRIVATE EMPLOYEES
(DIM)

Fractional Decrease from Government Demand FDGD is the analogue of Fractional Decrease from Private Sector Demand FDPSE (equation 10) which appeared in the Government Employment equations. FDPSE represents the pull of the private sector on government

employees and FDGD represents the pull of government on private sector employees. FDGD, is defined in equation 117 as Fractional Decrease from Government Money Adequacy FDGMA moderated, as is its analogue FDPD, by the Effect of Unemployment conditions on Fractional Decrease EUCFD.

$$\text{FDGD.K} = \text{FDGMA.K} * \text{EUCFD.K} \quad 117, A$$

FDGD - FRACTIONAL DECREASE FROM GOVT DEMAND (1/YEAR)

FDGMA - FRACTIONAL DECREASE FROM GOVT MONEY ADEQUACY (1/YEAR)

EUCFD - EFFECT OF UNEMPLOYMENT CONDITIONS ON FRACTIONAL DECREASE (DIM)

It is instructive to compare the source of the respective "pulls" represented by FDPD and FDGD. The pull coming from FDPD (equation 10) is generated by the discrepancy between DESPSE and PSE. Because DESPSE depends upon the level of private output that is being demanded by society, FDPD is a direct reflection of the state of satisfaction of society's preference for private output. The "pull" generated by FDGD, however, only indirectly reflects the satisfaction of societal preferences. FDGD depends upon government's money adequacy position through FDGMA. With high money adequacy, it is assumed that government can attract employees away from the private sector (other things equal). With low money adequacy, government's drawing power is assumed to be relatively weak. However, the only way that government can maintain a healthy money adequacy position, and therefore generate a strong "pull" on private sector employees, is if societal preferences are such that government can continue to full its coffers via taxation and sale of securities. Therefore, the "pulls"

generated by FDGD and FDPD are closely analogous in that both reflect societal preferences. But, in the case of the former, the reflection is indirect.

Fractional Decrease from Government Money Adequacy FDGMA is formulated in equation 118 as dependent upon Combined Government Money Adequacy CGMA.

FDGMA.K=TABHL(TFDGMA,CGMA.K,.75,2.5,.25) 118, A
TFDGMA=0/.015/.02/.025/.03/.035/.038/.04 118.1, T
FDGMA - FRACTIONAL DECREASE FROM GOVT MONEY
ADEQUACY (1/YEAR)
TABHL - TABLE LOOK-UP FUNCTION
TFDGMA - TABLE OF FRACTIONAL DECREASE FROM GOVT
MONEY ADEQUACY
CGMA - COMBINED GOVT MONEY ADEQUACY (DIM)

CGMA is a simple arithmetic average of the Government Money Adequacy that prevails at each level of government. Because there is only one level of government in this configuration of the model, CGMA is just equal to GMA.

CGMA.K=SUM(GMA.K)/TOTLG 119, A
TOTLG=1 119.1, C
CGMA - COMBINED GOVT MONEY ADEQUACY (DIM)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)
TOTLG - TOTAL LEVELS OF GOVT (DIM)

Figure A1-42 depicts the relationship between FDGMA as it depends upon CGMA. As indicated in the Figure, at a money adequacy of .75 or less, it is assumed that government exert no draw upon private employees. As CGMA climbs above .75, government's draw upon private sector employees strengthens. At CGMA equal to 1.0, government is assumed to be able to attract employees away from the private sector,

other things equal, at the rate of 1.5% per year. When CGMA doubles to 2.0, the assumed "pull" of government on private employees more than doubles, reaching a value of 3.5% per year. As CGMA rises above 2.0, however the "draw" increases more slowly and ultimately saturates at 4%. The saturation reflects the assumption that some private employees simply would not, as a matter of principle, work for government. Some self-employed entrepreneurs, farmers, ranchers and other groups of private sector employees, value self-employment too highly to be drawn into government, irrespective of the possible financial incentives for doing so.

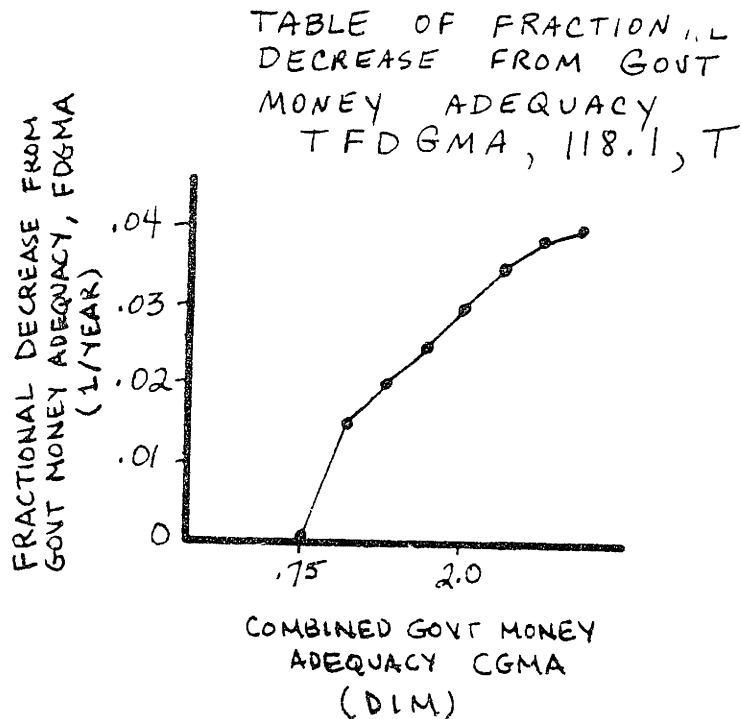


FIGURE A1-42. Fractional Decrease in Private Sector Employees from Government Money Adequacy.

As equation 117 indicates, FDGMA is moderated by the Effect of Unemployment Conditions on Fractional Decrease EUCFD. EUCFD was defined and discussed previously (see equation 12). To summarize its effect, EUCFD moderates FDGMA as a function of unemployment conditions. As the unemployed pool becomes increasingly swollen, EUCFD takes on values approaching zero. This, in turn, progressively shuts down the draw by government on Private employees (or vice versa) in reflection of the ample availability of unemployed.

The final equation in the Private Sector Employment block is the Effect of Availability of Private Employees EAPE. EAPE constitutes the moderating influence of availability of private employees on the "pull" being exerted by government (see equation 116). EAPE is defined, in equation 120, as dependent upon the ratio of Private Sector Employees PSE to Desired Private Sector Employees DESPSE.

EAPE.K=TABHL(TEAPE,PSE.K/DESPSE.K,0,3,.25) 120, A
TEAPE=0/.1/.4/.75/1/1.25/1.5/2/2.5/3/3.5/4/4.5 120.1, T
EAPE - EFFECT OF AVAILABILITY OF PRIVATE EMPLOYEES
(DIM)
TABHL - TABLE LOOK-UP FUNCTION
TEAPE - TABLE OF EFFECT OF AVAILABILITY OF PRIVATE
SECTOR EMPLOYEES
PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)
DESPSE - DESIRED PRIVATE SECTOR EMPLOYEES (PEOPLE)

As Figure A1-43 indicates, when PSE is equal to DESPSE, EAPE exerts a neutral influence on Fractional Decrease from Government Demand FDGD. As PSE grows to exceed DESPSE, EAPE exerts an increasingly stimulative influence on FDGD. The excess supply of private employees, with consequent layoffs and firings, is thus

assumed to add to any "pull" being exerted by government. As the ratio of PSE to DESPSE declines below 1.0, EAPE responds quite vigorously, thereby shutting down any "pull" that government might be seeking to exert.

TABLE OF EFFECT OF AVAILABILITY OF PRIVATE SECTOR EMPLOYEES
TEAPE, 120.1, T

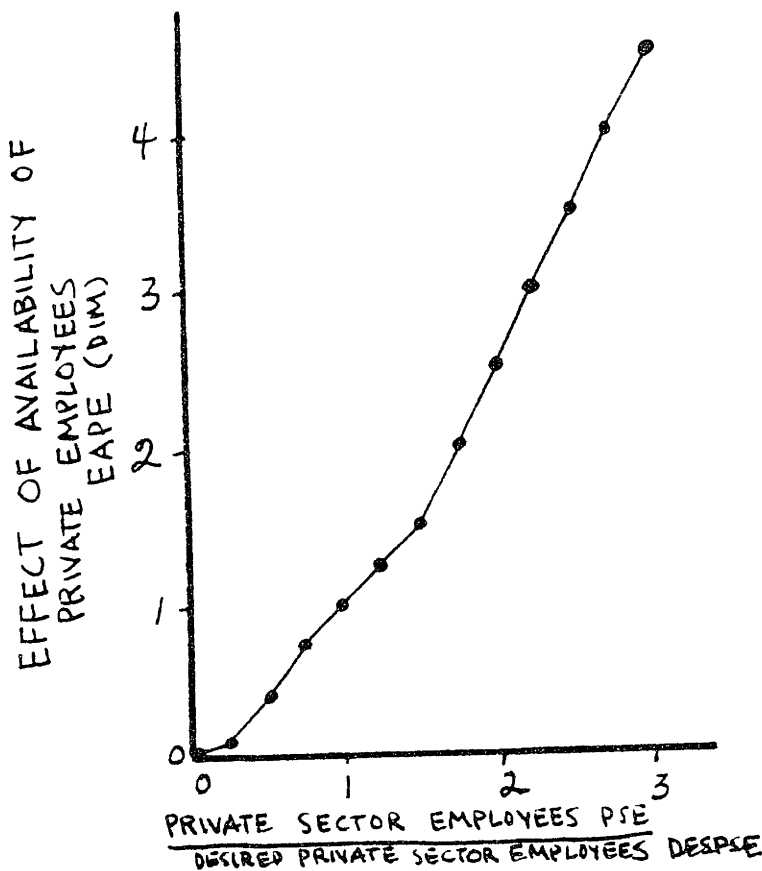


FIGURE A1-43. The Effect of Availability of Private Sector Employees on Decrease in Private Sector Employees.

A1.9 DEMAND FOR GOVERNMENT SERVICES

A flow diagram of the equations that generate demand for government services appears in Figure A1-44.

People do not demand government output in exactly the same sense that they demand private output. In the latter case, the private sector generates an output of products, each with a price. The public then expresses its demand by purchasing a certain volume of these products at the specified prices. The resulting expenditure, registered as revenue from sale of product, is an index of demand for private output. In the case of government, there is not such a clear-cut measure of demand. Government generates as much output as it can. In most instances, there is not a price tag directly affixed to the product being provided by government. The price is communicated indirectly, and usually after the fact, by the tax burden and/or debt burden that the public is asked to bear. The public lets government know, with some delay, whether it is under or over-supplying output by responding either favorably or unfavorably to tax rates and debt issues.

In this model, it is assumed that the public will accommodate to as much government output as it can get, as long as the price is not too noticeable. Thus, the Demand for Government Services DEGS and the Demand for Government Transfers DGT (discussed subsequently), should really be thought of as a level of government output to which the public has accommodated, rather than a strictly measurable dollar amount of purchases as in the case of demand for private output. In fact, there is no way to gauge a demand for government output in terms of dollar purchases.

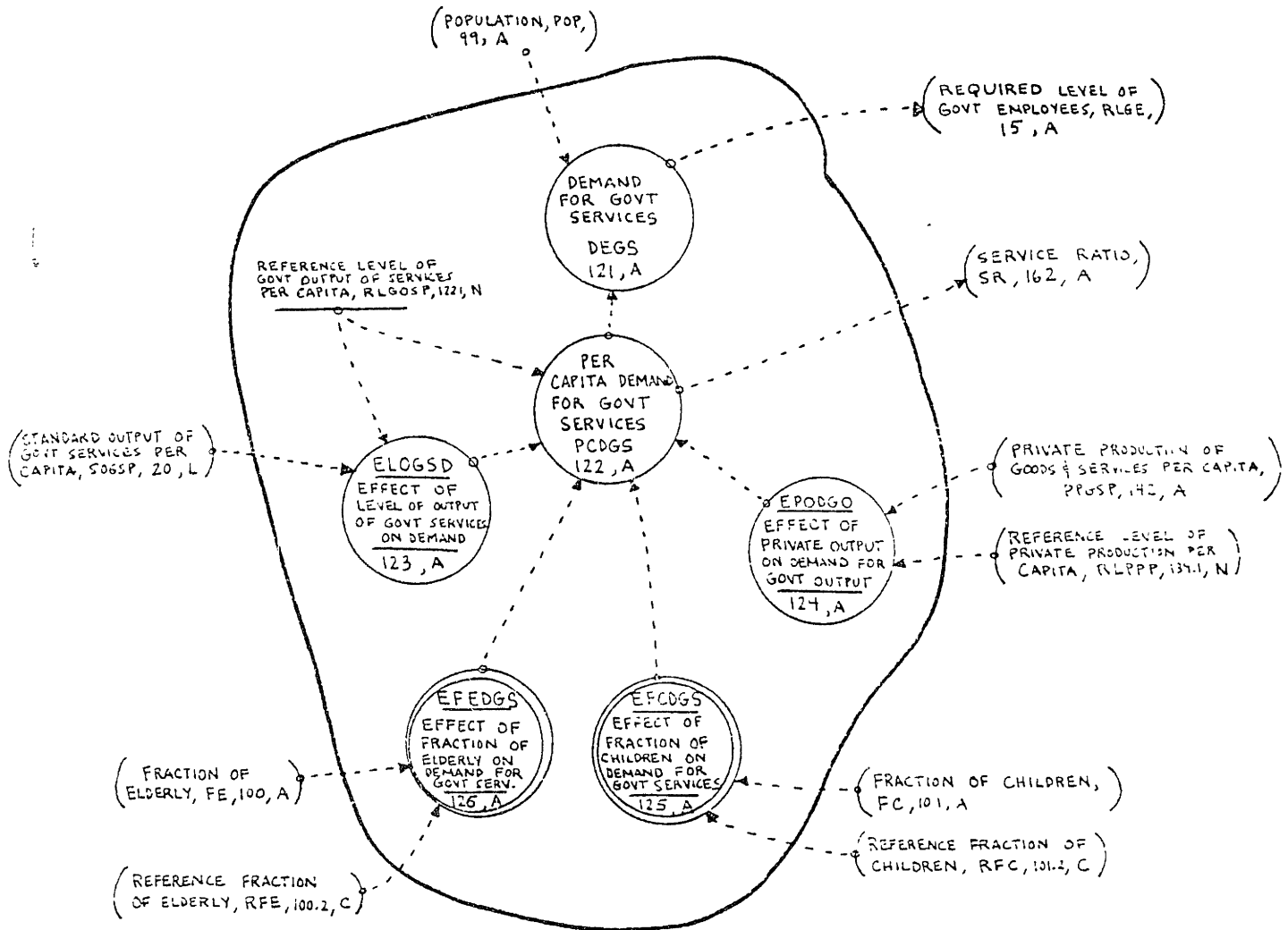


FIGURE A1-44. A Flow Diagram of the Demand for Government Services Block of Equations.

Demand for Government services DEGS is defined in equation 121 as the product of Population POP and Per Capita Demand for Government Services PCDGS.

$$\text{DEGS.K(LG)} = \text{POP.K} * \text{PCDGS.K(LG)} \quad 121, \text{ A}$$

DEGS - DEMAND FOR GOVT SERVICES (OUTPUT UNITS/
YEAR)
LG - LEVEL OF GOVT
POP - POPULATION (PEOPLE)
PCDGS - PER CAPITA DEMAND FOR GOVT SERVICES (OUTPUT
UNITS/PERSON/YEAR)

PCDGS is formulated in equation 122 as a Reference Level of Government Output of Services Per capita RLGOSP moderated by four influences: Effect of the level of Output of Government Services on Demand ELOGDS, Effect of Private Output on Demand for Government Output EPODGO, Effect of Fraction of Children on Demand for Government Services EFCDGS, and the Effect of Fraction of Elderly on Demand for Government Services EFEDGS. The latter two influences are constant except during testing when they are switched in one at a time.

$$\text{PCDGS.K(LG)} = \text{RLGOSP(LG)} * \text{ELOGSD.K(LG)} * \text{EPODGO.K} * \text{EFCDGS.K} * \text{EFEDGS.K} \quad 122, \text{ A}$$
$$\text{RLGOSP(1)} = \text{OGS(1)} / \text{RPOP} \quad 122.1, \text{ N}$$

PCDGS - PER CAPITA DEMAND FOR GOVT SERVICES (OUTPUT
UNITS/PERSON/YEAR)
LG - LEVEL OF GOVT
RLGOSP - REFERENCE LEVEL OF GOVT OUTPUT OF SERVICES
PER CAPITA (OUTPUT UNITS/PERSON/YEAR)
ELOGSD - EFFECT OF LEVEL OF OUTPUT OF GOVT SERVICES
ON DEMAND (DIM)
EPODGO - EFFECT OF PRIVATE OUTPUT ON DEMAND FOR GOVT
OUTPUT (DIM)
EFCDGS - EFFECT OF FRACTION OF CHILDREN ON DEMAND
FOR GOVT SERVICES (DIM)
EFEDGS - EFFECT OF FRACTION OF ELDERLY ON DEMAND FOR
GOVT SERVICES (DIM)
OGS - OUTPUT OF GOVT SERVICES (OUTPUT UNITS/YEAR)
RPOP - REFERENCE POPULATION (PEOPLE)

Reference Level of Government Output of Services Per capita
RLGOSP is the level of output of government services per person, measured in output units /per person/ per year, to which the society has accommodated; i.e., the level it is willing to tolerate given all of the other conditions that prevail in the reference equilibrium. RLGOSP is set equal, equation 122.1, to the reference level of Output of Government Services OGS divided by the Reference Population RPOP. As a result, because the four moderating influences bearing on RLGOSP are neutral in the reference equilibrium, when PCDGD is multiplied by POP in equation 121, DEGS becomes exactly equal to OGS; the condition for equilibrium.

The first of the four moderating influences that bear on determination of PCDGS is the Effect of Level of Output of Government Services on Demand ELOGSD. This influence reflects the previously described assumption that people will accommodate, i.e., come to "demand" whatever level of government service that government is capable of providing. Remember, however, that government's ability to provide a given level of service depends upon the public's willingness to tolerate the costs of these services (costs which it perceives only indirectly, and with some delay).

ELOGSD is formulated in equation 123 as dependent upon a Standard Output of Government Services Per capita SOGSP relative to a Reference Level of Government Output of Government Services Per capita RLGOSP.

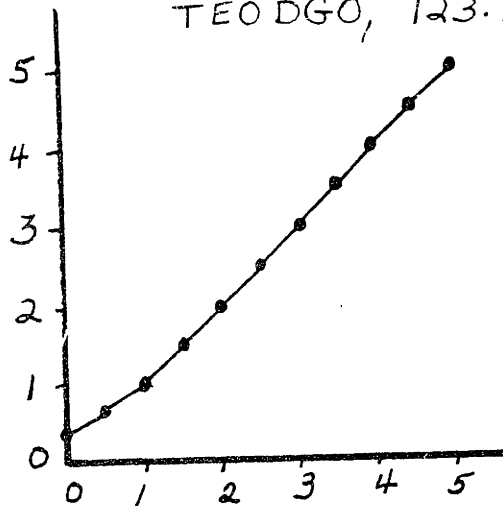
ELOGSD.K(LG)=TABHL(TEODGO,SOGSP.K(LG)/RLGOSP(LG),0,123,A
5,.5)
TEODGO=.4/.6/1/1.5/2/2.5/3/3.5/4/4.5/5 123.1, T
ELOGSD - EFFECT OF LEVEL OF OUTPUT OF GOVT SERVICES
ON DEMAND (DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TEODGO - TABLE OF EFFECT OF OUTPUT ON DEMAND FOR
GOVT OUTPUT
SOGSP - STANDARD OUTPUT OF GOVT SERVICES PER PERSON
(OUTPUT UNITS/PERSON/YEAR)
RLGOSP - REFERENCE LEVEL OF GOVT OUTPUT OF SERVICES
PER CAPITA (OUTPUT UNITS/PERSON/YEAR)

Standard Output of Government Services Per capita SOGSP was defined and discussed previously (see equation 20). Briefly, SOGSP is an exponential average of OGSP. In order to reflect the assumption of a quick accommodation to any increases in the level of government services, yet a reluctance to accept service cutbacks, the averaging time associated with the generation of SOGSP from OGSP is a variable. When OGSP is increasing relative to SOGSP the averaging time becomes very short allowing for quick accommodation. When OGSP is declining relative to SOGSP, the averaging time becomes quite long, thereby slowing the downward adjustment of SOGSP to OGSP.

As Figure A1-45 indicates, when SOGSP is equal to RLGOSP, as it is in the reference equilibrium, ELOGSD exerts a neutral influence on RLGOSP. As the ratio of SOGSP to RLGOSP rises above 1.0, ELOGSD increases in exact proportion. That is, a ratio of 1.5 yields a value for ELOGSD of 1.5, and so on. Again, the idea here is that people will, other things equal, take whatever they can get--over and above what they are already getting--from government.

EFFECT OF LEVEL OF OUTPUT OF
GOVT SERVICES ON DEMAND
ELOGSD, (DIM)

TABLE OF EFFECT OF
OUTPUT ON DEMAND FOR
GOVT OUTPUT
TEODGO, 123.1, T



STANDARD OUTPUT OF GOVT SERVICES PER CAPITA SOGSP
REFERENCE LEVEL OF GOVT OUTPUT OF SERVICES PER CAPITA RLGOSP

FIGURE A1-45. The Effect of the Level of Output of Government Services on the Demand for Government Services.

As the Figure shows, however, below the 1.0 point, ELOGSD responds non-linearly. That is, other things equal, the public is assumed not to be willing to relinquish all of the services that government is providing simply because government output of services declines. When SOGSP dips 50% below RLGOSP, people are assumed to be willing to accommodate to, other things equal, a 40% reduction in the output of government services. Another 50% dip, however, causes only an additional 20% reduction in the level of societal demand for government services. The non-linear relationship reflects the assumption that, other conditions remaining constant, people will be unwilling to do without a certain base level of government services. In other words, for a given set of conditions in the rest of the socioeconomy, it is assumed that there is some minimum acceptable level of government output that society will deem essential.

An example might help to illustrate the assumed relationship. For a given standard of living, age distribution, level of technology and population, a society would be willing to substitute, say, private for public, education, private trash collection for public, and private fire protection for public. However, the society would be unwilling to substitute (or do without) a private for a public armed forces, a private for a public judiciary, or a private for a public police force.

When the second influence on Per Capita Demand for Government Service PCDGS, Effect of the Level of Private Output on Demand for Government Output EPODGO, is operative, the public may raise or lower the aforescribed minimum acceptable level of government output of

services. EPODGO is defined in equation 124 as dependent upon the ratio of Private Production of Goods and Services Per capita PPGSP to the Reference level of Private Production Per Capita RLPPP.

EPODGO.K=TABHL(TEPODG,PPGSP.K/RLPPP,0,2,.25) 124, A
TEPODG=0/0/.25/.6/1/1.05/1.1/1.15/1.2 124.1, T
EPODGO - EFFECT OF PRIVATE OUTPUT ON DEMAND FOR GOVT
OUTPUT (DIM)
TABHL - TABLE LOOK-UP FUNCTION
TEPODG - TABLE OF EFFECT OF PRIVATE OUTPUT ON DEMAND
FOR GOVT OUTPUT
PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER
CAPITA (\$/PERSON/YEAR)
RLPPP - REFERENCE LEVEL OF PRIVATE PRODUCTION PER
CAPITA (\$/PERSON/YEAR)

Effect of Private Output on Demand for Government Output
EOPDGO is designed to capture the assumption that a society's opinion of what is an acceptable level of government output will change with per capita income. Other things equal, the richer a society, the more it is assumed to expect its government to provide in the way of services. And, again ceteris paribus, the less well-off a society is materially, the less, in the way of government services, it will tolerate.

Figure A1-46 depicts the precise assumption that is embodied in the model. As the Figure indicates, when private output is equal to the reference standard, EOPDGO is assumed to exert a neutral influence on Per Capita Demand for Government Services PCDGS. As PPGSP rises above RLPPP, people expect more government services. However, expectations are assumed to rise much less than in proportion to the rise in income. For example, a 50% increase in PPGSP above RLPPP causes EPODGO to rise by only 10%. And, a doubling of PPGSP above RLPPP, causes EPODGO to increase by only 20%. The shallowness

of the response reflects, again, the assumption that government services are not really "demanded"; they are, rather supplied and then accommodated to. Therefore, rising incomes are not assumed to have a very substantial impact on demand for government services directly. Instead, rising incomes impact indirectly by expanding the tax base, making more funds available for government to borrow, and raising the standard of what society deems an acceptable tax rate. All of these, in turn, enable government to raise more money so that it can hire additional factors of production and expand its output of services.

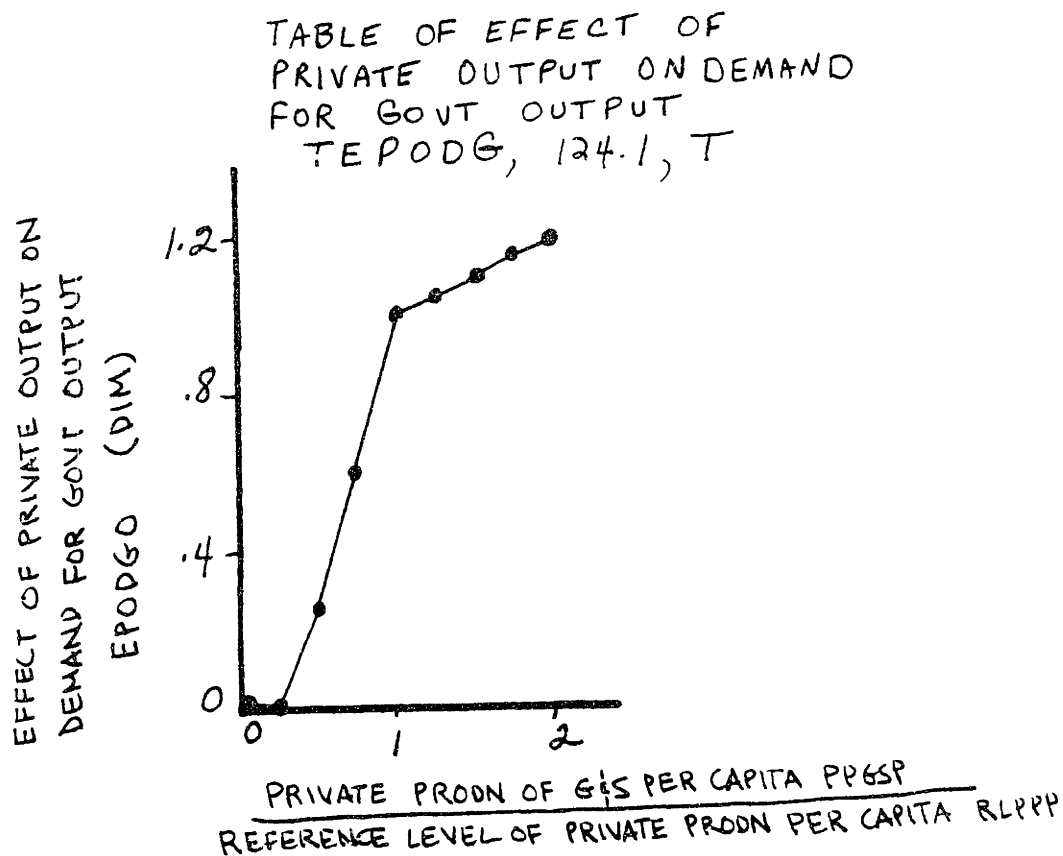


FIGURE A1-46. The Effect of the Level of Private Output on the Demand for Government Output.

Below the 1.0 point, the responsiveness of EPODGO is considerably sharper. A 25% reduction in PPGSP relative to RLPPP generates a 40% cutback in the demand for government output. One can visualize such a cutback by mentally revising all of the values in Figure A1-45 downward by 40%. In other words, for example, a society that has experienced a 25% reduction in the production of private goods and services, relative to a reference level, is assumed to reduce, by 40%, what it deems to be the minimum acceptable level of government output of services. As PPGSP declines further with respect to RLPPP, the effect is assumed to become even more pronounced! A 50% decline, for example, causes a 75% cutback in the demand for government services. And finally, when PPGSP has declined to 25% of its reference level, it is assumed that people are willing to do without government services completely!

The extreme responsiveness of EPODGO on the down-side of the 1.0 point reflects the aforescribed assumption of a societal hierarchy of need. It is only when the bare material essentials of survival are provided for, that a society can agree to perform certain functions collectively. If a society were indeed plummeting back downward toward this level, it is assumed that people would be willing to do without progressively more of collectively-provided services in favor of obtaining more of the basic material essentials of survival. The steepness of the slope of the function relating EPODGO to PPGSP relative to RLPPP, below the 1.0 point, reflects this assumption.

The final two influences on Per Capita Demand for Government Services PCDGS (see equation 122) are both related to the age

distribution of the population. Each is activated only for testing purposes. The first of these influences, Effect of Fraction of Children on Demand for Government Services EFCDGS, is formulated in equation 125.

```
EFCDGS.K=TABLE(TEFCD,FC.K/RFC,0,2,.25)           125, A
TEFCD=0/.25/.5/.75/1/1.25/1.5/1.75/2           125.1, T
EFCDGS - EFFECT OF FRACTION OF CHILDREN ON DEMAND
          FOR GOVT SERVICES (DIM)
TABLE - TABLE LOOK-UP FUNCTION
TEFCD - TABLE OF EFFECT OF FRACTION OF CHILDREN ON
        DEMAND FOR GOVT SERVICES
FC - FRACTION OF CHILDREN (DIM)
RFC - REFERENCE FRACTION OF CHILDREN (DIM)
```

EFCDGS is designed to represent the assumption that the relative size of the population of children in a given society will affect that society's preference for government output of services. In particular, because primary and secondary education has traditionally been (at least in the U.S. socioeconomy) one of government's principal services, an alternation in the fraction of children in the society will affect the demand for educational output. As Figure A1-47 shows, perturbations in the fraction of children FC relative to the Reference Fraction of Children RFC are assumed to cause an exactly proportional response in EFCDGS. The actual elasticities of such a relationship would be hard to estimate very precisely. However, the direction of the relationship appears reasonable. And, because the relationship is only used in a comparative statics sense to determine whether there is an effect on the equilibrium distribution, a precise specification of the numerical values in the relationship is not essential.

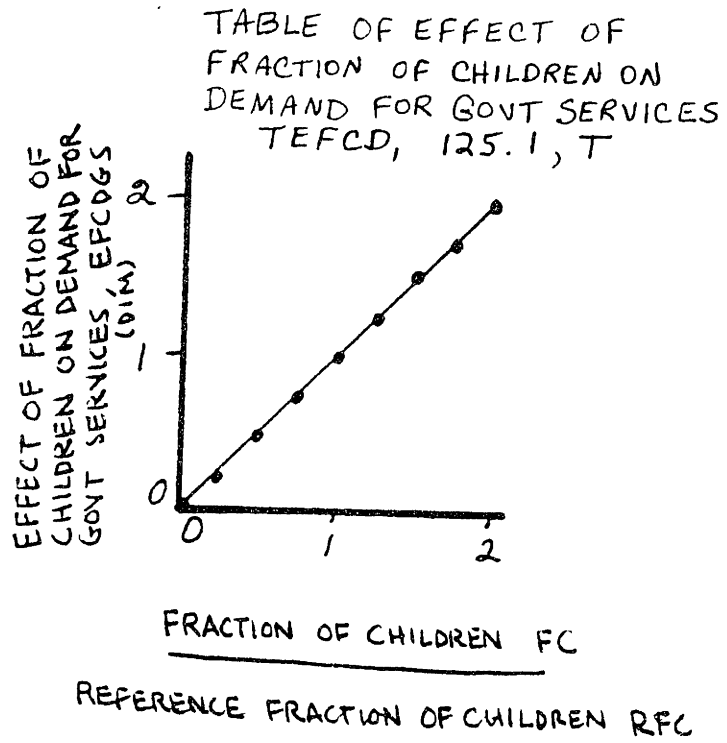


FIGURE A1-47. The Effect of the Fraction of Children on the Demand for Government Services.

The final influence operating to determine Per Capita Demand for Government Services PCDGS, the Effect of Fraction of Elderly on Demand for Government Services EFEDGS, functions in an exactly analogous manner to EFCDGS. The effect is included in order to reflect the assumption that a population with a relatively large proportion of elderly people, other things equal, will desire a higher level of output of government services than one with a relatively small fraction of elderly. Elderly are likely to need relatively more in the way of public transportation, public health care and public safety and police protection, for example, than younger people. EFEDGS reflects this assumption.

Equation 126 indicates that EFEDGS depends upon the ratio of Fraction of Elderly FE to Reference Fraction of Elderly RFE.

```
EFEDGS.K=TABLE(TEFED,FE.K/RFE,0,2,.25)          126, A
TEFED=0/.25/.5/.75/1/1.25/1.5/1.75/2          126.1, T
  EFEDGS - EFFECT OF FRACTION OF ELDERLY ON DEMAND FOR
            GOVT SERVICES (DIM)
  TABLE - TABLE LOOK-UP FUNCTION
  TEFED - TABLE OF FRACTION OF ELDERLY ON DEMAND FOR
            GOVT SERVICES
  FE - FRACTION OF ELDERLY (DIM)
  RFE - REFERENCE FRACTION OF ELDERLY (DIM)
```

As FE varies with respect to RFE, EFEDGS, like EFCDGS, varies in exact proportion, as indicated in Figure A1-48. Here, again, there is great uncertainty about the precise numerical magnitudes that define the relationship. But, again, the effect only operates in a testing mode in which the impact of step-changes in FE on the resulting equilibrium set point are examined. Little importance is attached to the exact magnitude of the impact. The question is only

whether there is, in fact, a change in the equilibrium. For these purposes, the precise numerical specification of the relationship is not critical.

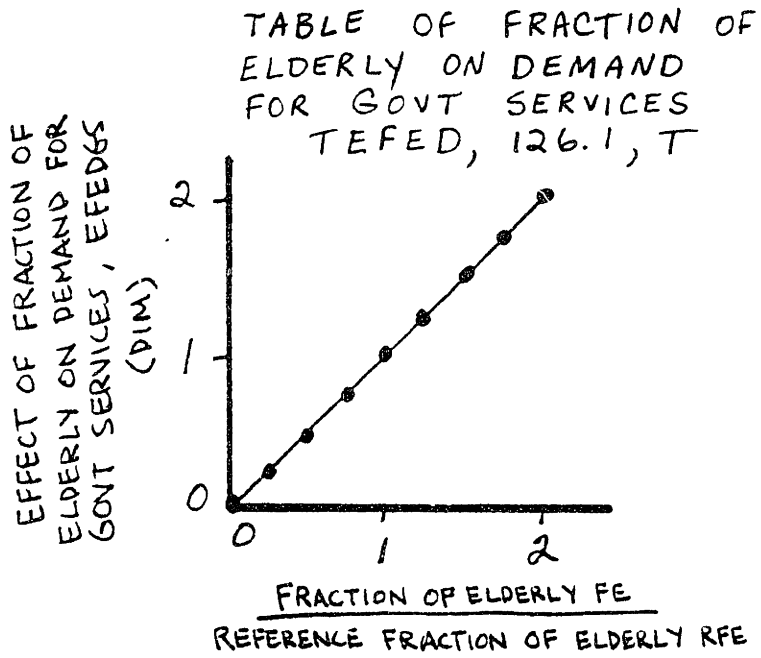


FIGURE A1-48. The Effect of Fraction of Elderly on the Demand for Government Services.

A1.10 DEMAND FOR GOVERNMENT TRANSFERS.

A flow diagram of the equations used to generate demand for government transfers appears as Figure A1-49.

The equations for generating demand for transfers are formulated in an exactly analogous manner to those for generating demand for government services.

Demand for Government Transfers DGT is defined, in equation 127, as the product of Population POP and Per Capita Demand for Government Transfers PCDGT.

$$DGT.K(LG) = POP.K * PCDGT.K(LG) \quad 127, A$$

DGT - DEMAND FOR GOVT TRANSFERS (OUTPUT UNITS/
YEAR)

LG - LEVEL OF GOVT

POP - POPULATION (PEOPLE)

PCDGT - PER CAPITA DEMAND FOR GOVT TRANSFERS
(OUTPUT UNITS/PERSON/YEAR)

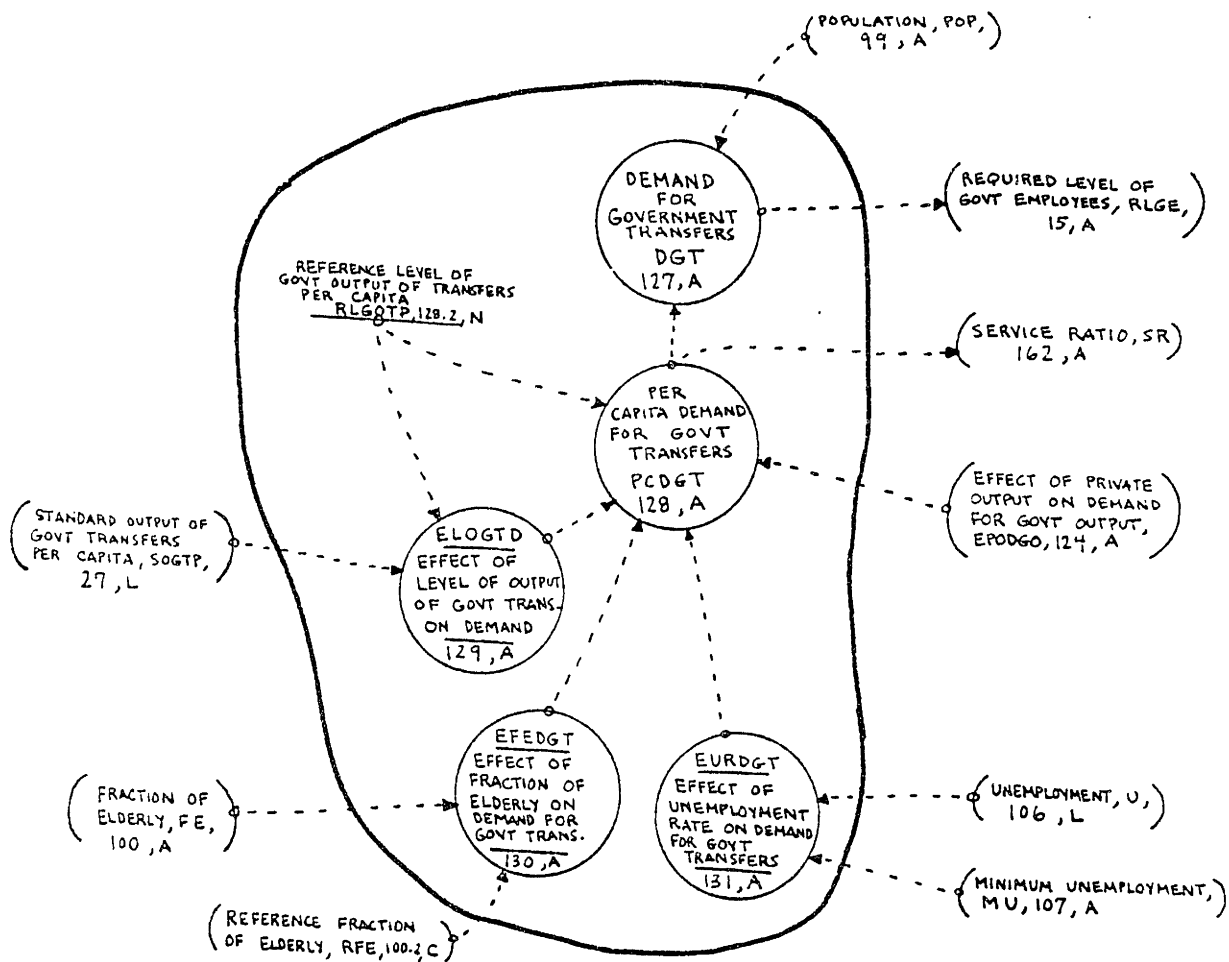


FIGURE A1-49. A Flow Diagram of the Demand for Government Transfers Equations.

Per Capita Demand for Government Transfers PCDGT is formulated as a Reference Level of Government Output of Transfers Per capita RLGOTP moderated by four influences: Effect of Level of Output of Government Transfers on Demand ELOGTD, Effect of Private Output on Demand for Government Output EPODGO, Effect of Fraction of Elderly on Demand for Government Transfers EFEDGT, and the Effect of Unemployment Rate on the Demand for Government Transfers EURDGT.

$$PCDGT.K(LG) = RLGOTP(LG) * ELOGTD.K(LG) * EPODGO.K * EFEDGT.K * EURDGT.K(LG)$$

128, A

$$RLGOTP(1) = OGT(1) / RPOP$$

128.2, N

PCDGT - PER CAPITA DEMAND FOR GOVT TRANSFERS
(OUTPUT UNITS/PERSON/YEAR)

LG - LEVEL OF GOVT

ELOGTD - EFFECT OF LEVEL OF OUTPUT OF GOVT TRANSFERS
ON DEMAND (DIM)

EPODGO - EFFECT OF PRIVATE OUTPUT ON DEMAND FOR GOVT
OUTPUT (DIM)

EFEDGT - EFFECT OF FRACTION OF ELDERLY ON DEMAND FOR
GOVT TRANSFERS (DIM)

EURDGT - EFFECT OF UNEMPLOYMENT RATE ON DEMAND FOR
GOVT TRANSFERS (DIM)

OGT - OUTPUT OF GOVT TRANSFERS (OUTPUT UNITS/
YEAR)

RPOP - REFERENCE POPULATION (PEOPLE)

A comparison of equation 128 with its analogue, equation 122, in the Demand for Government Services block of equations, reveals that: (1) the first and second terms in each expression are exactly analogous, (2) the third terms are identical (3) the fourth term in equation 128 is exactly analogous to the fifth term in equation 122, and (4) the fifth term in equation 128 replaces the fourth term in equation 122. Except in the testing mode, then, the two equations differ only by the scaling of RLGOTP versus RLGOSP and by EURDGT.

As equation 129 indicates, ELOGTD uses the same table TEODGO as ELOGSD. The arguments to the two functions are analogous, but one reflects the level of transfer payment activity and the other the level of government service activity.

$$\text{ELOGTD.K(LG)} = \text{TABHL}(\text{TEODGO}, \text{SOGTP.K(LG)}/\text{RLGOTP(LG)}, 0, 129, \text{A}, 5, .5)$$

- ELOGTD - EFFECT OF LEVEL OF OUTPUT OF GOVT TRANSFERS ON DEMAND (DIM)
- LG - LEVEL OF GOVT
- TABHL - TABLE LOOK-UP FUNCTION
- TEODGO - TABLE OF EFFECT OF OUTPUT ON DEMAND FOR GOVT OUTPUT
- SOGTP - STANDARD OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT UNITS/PERSON/YEAR)

As will be recalled from the discussion of ELOGSD (equation 123), the table function is formulated so as to permit any increases in the level of government output (in this case, transfer payments) relative to the reference standard level of output, to be almost immediately accommodated into what people deem an acceptable level of government output. Small cutbacks in the level of output relative to the reference level, are accepted readily. However, the table function incorporates the assumption of some minimum acceptable level of government output, for a given fixed set of conditions in the rest of the socioeconomy.

The Effect of Private Output on Demand for Government Output EPODGO was defined (see equation 124), discussed and illustrated in the previous equation block. Its primary function, it will be recalled, is to make certain that in a collapse mode, people cut back their demands for government output more rapidly than their need for the privately produced material essentials of survival.

Effect of Fraction of Elderly on Demand for Government Transfers EFEDGT, the third influence on PCDGT, is defined in equation 130.

EFEDGT.K=TABLE(TEFEDT,FE.K/RFE,0,2,.25) 130, A
TEFEDT=0/.25/.5/.75/1/1.25/1.5/1.75/2 130.1, T
EFEDGT - EFFECT OF FRACTION OF ELDERLY ON DEMAND FOR
GOVT TRANSFERS (DIM)
TABLE - TABLE LOOK-UP FUNCTION
TEFEDT - TABLE OF EFFECT OF FRACTION OF ELDERLY ON
DEMAND FOR TRANSFERS
FE - FRACTION OF ELDERLY (DIM)
RFE - REFERENCE FRACTION OF ELDERLY (DIM)

EFEDGT is included in order to reflect the assumption that, other things equal, an older population makes more demands for government transfers than a younger one. With the steady aging of the American population, for example, has come the expansion of the social security system into a program which includes disability and a wide range of medical benefits, as well as the retirement benefits which the program was originally intended to provide.

Figure A1-50 portrays the assumed relationship between FE relative to RFE and EFEDGT. Just as in the other two age-distribution relationships, associated with the demand for government services, the effect here is assumed to be strictly proportional. Again, while the assumed numerical elasticities are difficult to justify, the direction of the assumed relationship appears reasonable. And, because the relationship will only be used to determine whether an altered fraction of elderly has an impact on the resulting equilibrium position (and not to measure the magnitude of this impact), precise numerical specification is not essential.

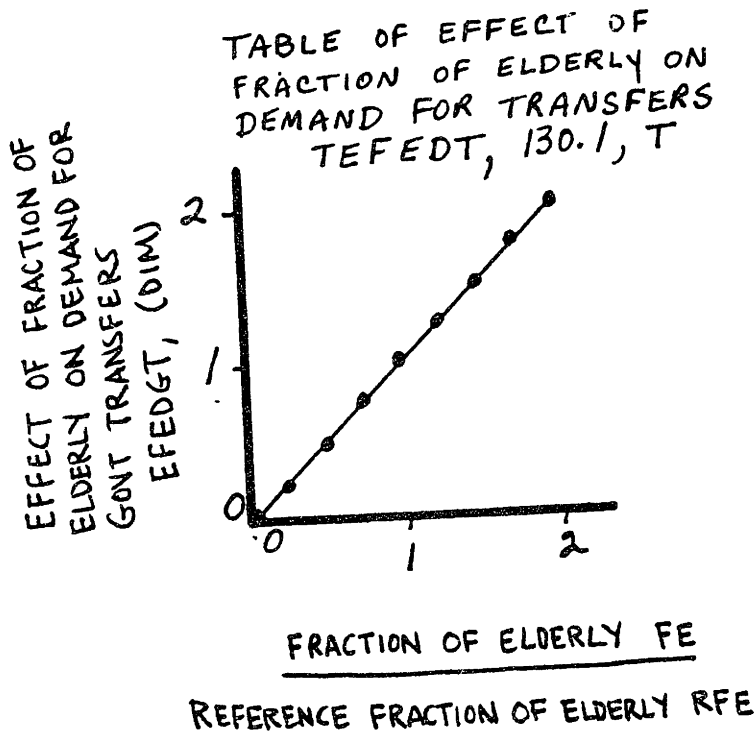


FIGURE A1-50. The Effect of Fraction of Elderly on the Demand for Government Transfers.

The final influence bearing upon the determination PCDGT is the Effect of Unemployment Rate on the Demand for Government Transfers EURDGT. This effect is included to reflect the assumption that, other things equal, a society with high unemployment will make greater demands for government transfers than one with low unemployment. The principal government transfer payment involved here is unemployment compensation. However, during times of high unemployment, it is likely that demands for income transfers for such programs as Aid for Dependent Children and Food Stamps will likewise increase.

EURDGT is defined, in equation 131, as dependent upon Unemployment U relative to Minimum Unemployment MU.

EURDGT.K(LG)=TABHL(TEURDT(*,LG),U.K/MU.K,1,6,.5) 131, A
TEURDT(*,1)=.4/.6/.8/1/1.2/1.4/1.6/1.8/2/2.2/2.4 131.1, T
EURDGT - EFFECT OF UNEMPLOYMENT RATE ON DEMAND FOR
GOVT TRANSFERS (DIM)
LG - LEVEL OF GOVT -
TABHL - TABLE LOOK-UP FUNCTION
TEURDT - TABLE OF EFFECT OF UNEMPLOYMENT ON DEMAND
FOR GOVT TRANSFERS
U - UNEMPLOYED (PEOPLE)
MU - MINIMUM UNEMPLOYED (PEOPLE)

As Figure A1-51 indicates, when U is equal to 2.5 times MU--as it is in the reference equilibrium--EURDGT is assumed to exert a neutral influence on PCDGT. This does not mean that at a level of unemployment equal to 2.5 times the minimum level there is no demand for government transfers. It means, rather, that at this level of unemployment, the resulting demand for government transfers from this source is lumped into RLGOTP, so that there is no added increment of demand from this source.

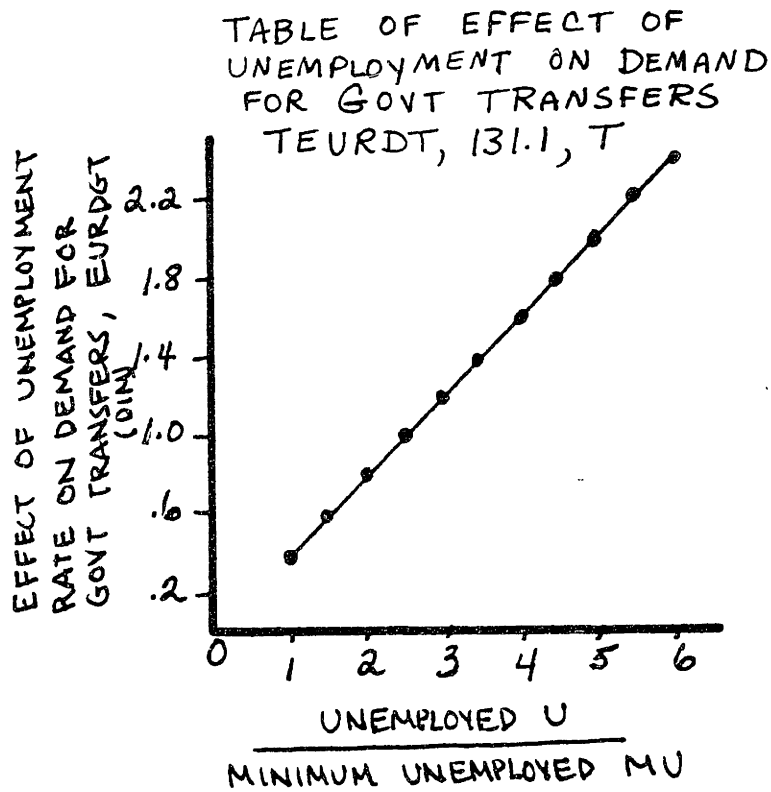


FIGURE A1-51. The Effect of Unemployment Rate on the Demand or Government Transfers.

When U rises above MU, EURDGT is assumed to increase proportionally. That is, a 20% increase in the ratio of U to MU (e.g. from 2.5 to 3.0) generates a 20% increase in EURDGT (e.g. from 1.0 to 1.2). Making the effect proportional, reflects the assumption that as people become unemployed they will demand unemployment compensation. The effect is also assumed to be proportional below the 1.0 point. A 20% decline in the ratio (e.g., from 2.5 to 2.0) gives rise to a 20% decline in EURDGT (e.g., from 1.0 to .8). Again, proportionality

reflects the assumption that the demand for transfers, from this source, is directly tied to the size of the unemployment pool.

A1.11 DEMAND FOR PRIVATE OUTPUT

The flow diagram depicting the Demand for Private Output equations appears in Figure A1-51.

Demand for Private Output DPO is formulated in equation 132 as the product of Population POP and Per Capita Demand for Private Output PCDPO.

2. PRIVATE OUTPUT

$$DPO.K = POP.K * PCDPO.K \quad 132, A$$

DPO - DEMAND FOR PRIVATE OUTPUT (\$/YEAR)
POP - POPULATION (PEOPLE)
PCDPO - PER CAPITA DEMAND FOR PRIVATE OUTPUT (\$/
PERSON/YEAR)

As discussed in the context of demand for government output, Demand for Private Output DPO is, unlike the former, expressed in dollars per year. DPO is the amount of private output, expressed in dollars, that people are demanding in a given year.

Per Capita Demand for Private Output PCDPO is generated, in equation 133, by multiplying Desired Per Capita Demand for Private Output DPCDPO by the Effect of Per Capita Income on Demand EPCID.

$$PCDPO.K = DPCDPO.K * EPCID.K \quad 133, A$$

PCDPO - PER CAPITA DEMAND FOR PRIVATE OUTPUT (\$/
PERSON/YEAR)
DPCDPO - DESIRED PER CAPITA DEMAND FOR PRIVATE
OUTPUT (\$/PERSON/YEAR)
EPCID - EFFECT OF PER CAPITA INCOME ON DEMAND (DIM)

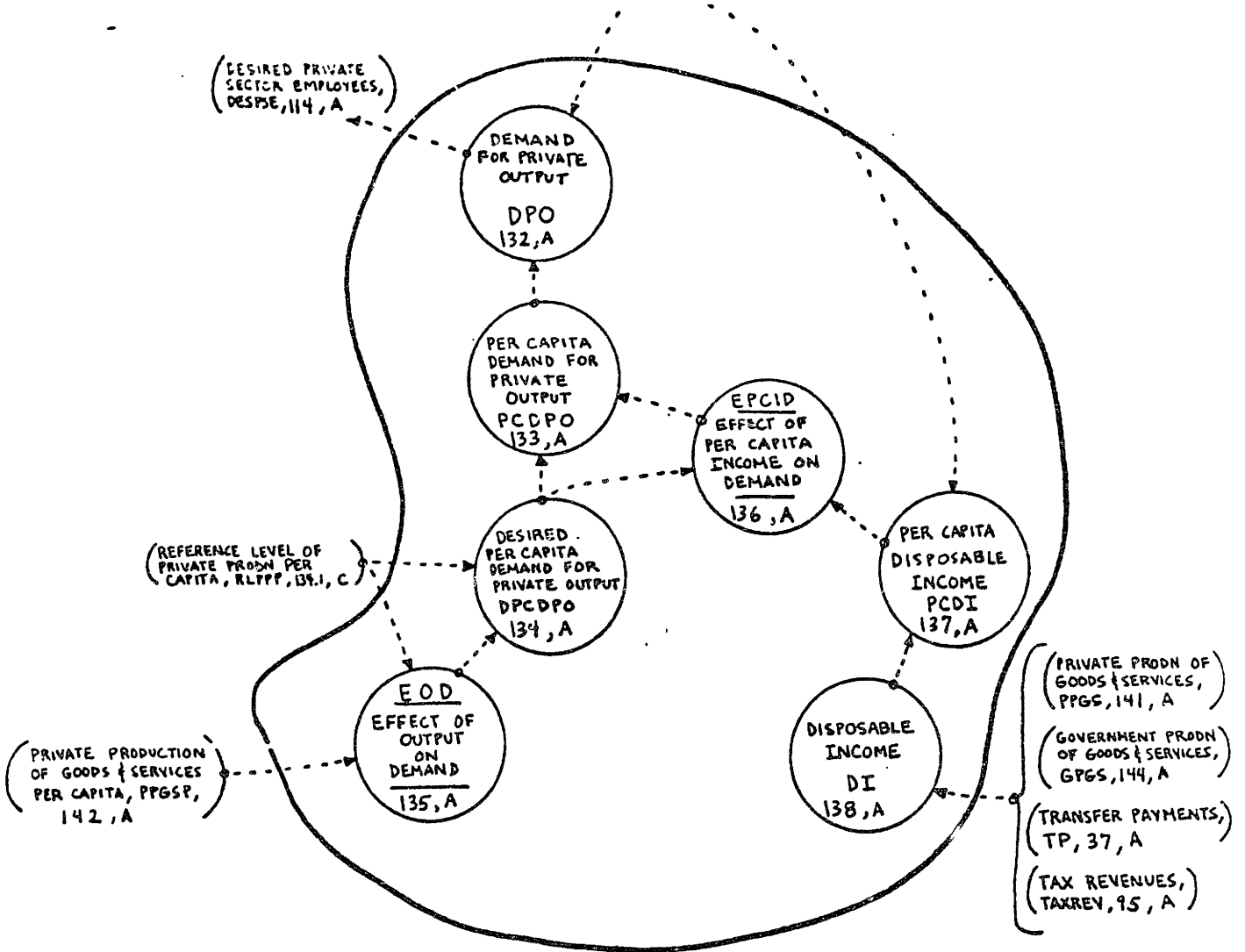


FIGURE A1-51. A Flow Diagram of the Demand for Private Output Equations.

Equation 133, in effect, says that people will demand whatever they desire, subject to income constraints.

Desired Per Capita Demand for Private Output DPCDPO is defined, in equation 134, as a Reference Level of Private Production Per capita RLPPP moderated by the Effect of Output on Demand EOD.

DPCDPO.K=RLPPP*EOD.K 134, A
RLPPP=RPPGS/RPOP 134.1, N
DPCDPO - DESIRED PER CAPITA DEMAND FOR PRIVATE
OUTPUT (\$/PERSON/YEAR)
RLPPP - REFERENCE LEVEL OF PRIVATE PRODUCTION PER
CAPITA (\$/PERSON/YEAR)
EOD - EFFECT OF OUTPUT ON DEMAND (DIM)
RPPGS - REFERENCE PRIVATE PRODUCTION OF GOODS &
SERVICES (\$/YEAR)
RPOP - REFERENCE POPULATION (PEOPLE)

The level of private output that people desire is, then assumed to depend upon the level of private output that is currently being produced. Another way of expressing the assumption represented in equation 134 is that people will desire whatever they can get. If output is produced, people, in the aggregate, will want it.

Reference Level of Private Production Per capita RLPPP is defined, in equation 134.1, as Reference Private Production of Goods and Services RPPGS divided by the Reference Population RPOP.

Effect of Output on Demand EOD is formulated in equation 135 as dependent upon Private Production of Goods and Services Per capita PPGSP relative to the Reference Level of Private Production Per capita RLPPP.

EOD.K=TABHL (TEOD, PPGSP.K/RLPPP, 1, 5, 1) 135, A
TEOD=1/2/3/4/5 135.1, T
EOD - EFFECT OF OUTPUT ON DEMAND (DIM)
TABHL - TABLE LOOK-UP FUNCTION
TEOD - TABLE OF EFFECT OF OUTPUT ON DEMAND
PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER
CAPITA (\$/PERSON/YEAR)
RLPPP - REFERENCE LEVEL OF PRIVATE PRODUCTION PER
CAPITA (\$/PERSON/YEAR)

EOD is such that Desired Per Capita demand for Private Output DPCDPO is simply equal to Private Production of Goods and Services Per capita PPGSP, unless PPGSP dips below RLPPP, in which case DPCDPO becomes equal to RLPPP. In other words, as Figure A1-52 indicates, it is assumed that people will not adjust their desires for private output downward to a level below the level of per capita private output being generated in the reference equilibrium (i.e., EOD remains equal to 1.0 for all values of PPGSP less than RLPPP). This is not to say that people will always be able to realize their desires. If, for example, incomes are depressed so that the society, in the aggregate, can not afford to purchase the reference level of output, people will be unable to realize their desires for private output. Nevertheless, it is assumed that people will continue to desire at least the reference level of output. The assumption of a fixed floor on desires for private output, reflected in Figure A1-52, is reasonable in view of the time frames which the current model is intended to examine. If, for example, the current level of private output of goods and services were in reality to permanently decline to a lower level, it would likely be twenty-five to fifty years before the public fully adjusted their desires for private output to this lower level. Thus, there is, in reality, a kind of "floor" on the public's desire for private output.

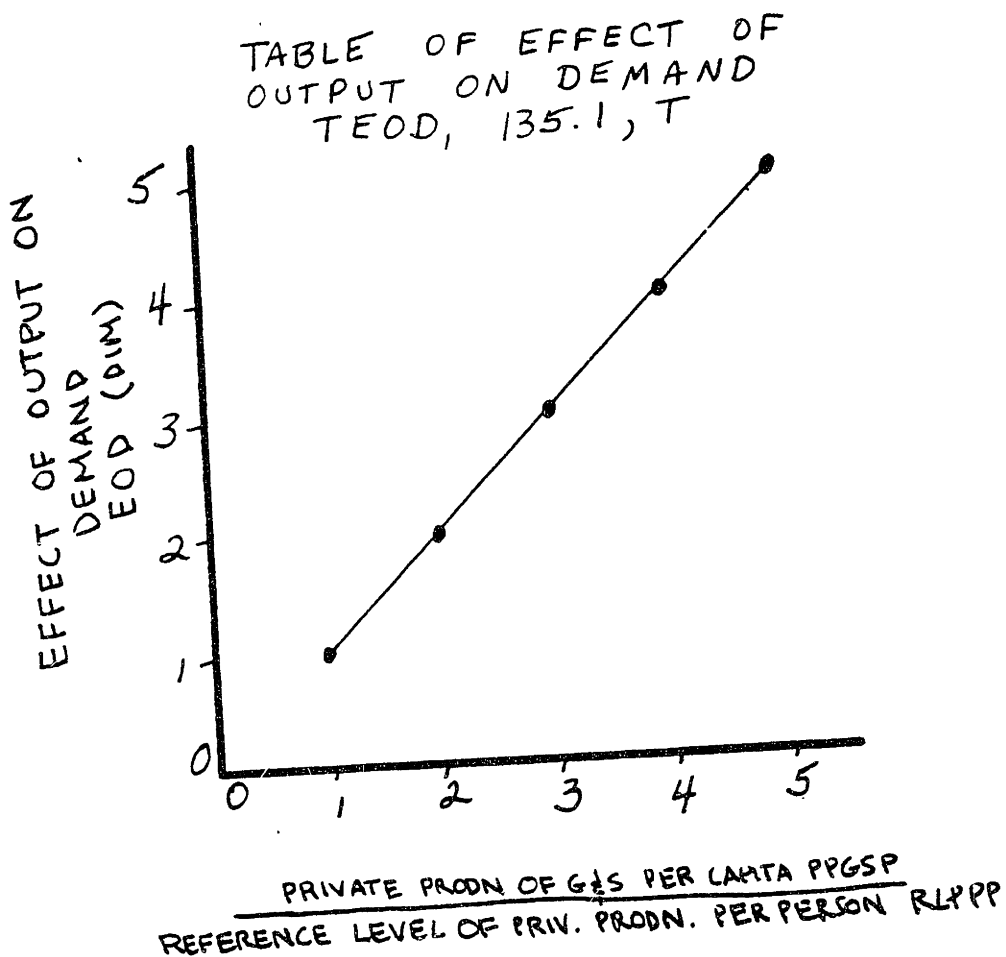


FIGURE A1-52. The Effect of Private Output on the Demand for Private Output.

As the Figure indicates, when PPGSP rises relative RLPPP, EOD responds in exact proportion, reflecting, again, the assumption that people will want whatever they can get.

The Effect of Per Capita Income on Demand EPCID, the moderating influence which translates Desired Per Capita Demand for Private Output DPCDPO into Per Capita Demand for Private Output PCDPO, is defined in equation 136.

Equation 136

EPCID.K=TABHL(TEPCID,PCDI.K/DPCDPO.K,0,1.5,.1) 136, A
TEPCID=.5/.52/.54/.56/.6/.65/.7/.75/.85/.95/1/1.1/
1.2/1.3/1.4/1.5 136.1, T
EPCID - EFFECT OF PER CAPITA INCOME ON DEMAND (DIM)
TABHL - TABLE LOOK-UP FUNCTION
TEPCID - TABLE OF EFFECT OF PER CAPITA INCOME ON
DEMAND
PCDI - PER CAPITA DISPOSABLE INCOME (\$/PERSON/
YEAR)
DPCDPO - DESIRED PER CAPITA DEMAND FOR PRIVATE
OUTPUT (\$/PERSON/YEAR)

EPCID acts to constrain desires when income is less than what is necessary to purchase the desired amount of output. Conversely, EPCID can stimulate desires when income exceeds the level of private output that the society has come to desire. It is in the latter model that government's aggregate demand management policies (e.g., tax cuts, heightened government spending) function.

EPCID is assumed to depend upon the ratio of Per Capita Disposable Income PCDI relative to Desired Per Capita Demand for Private Output DPCDPO. Figure A1-53 portrays the relationship.

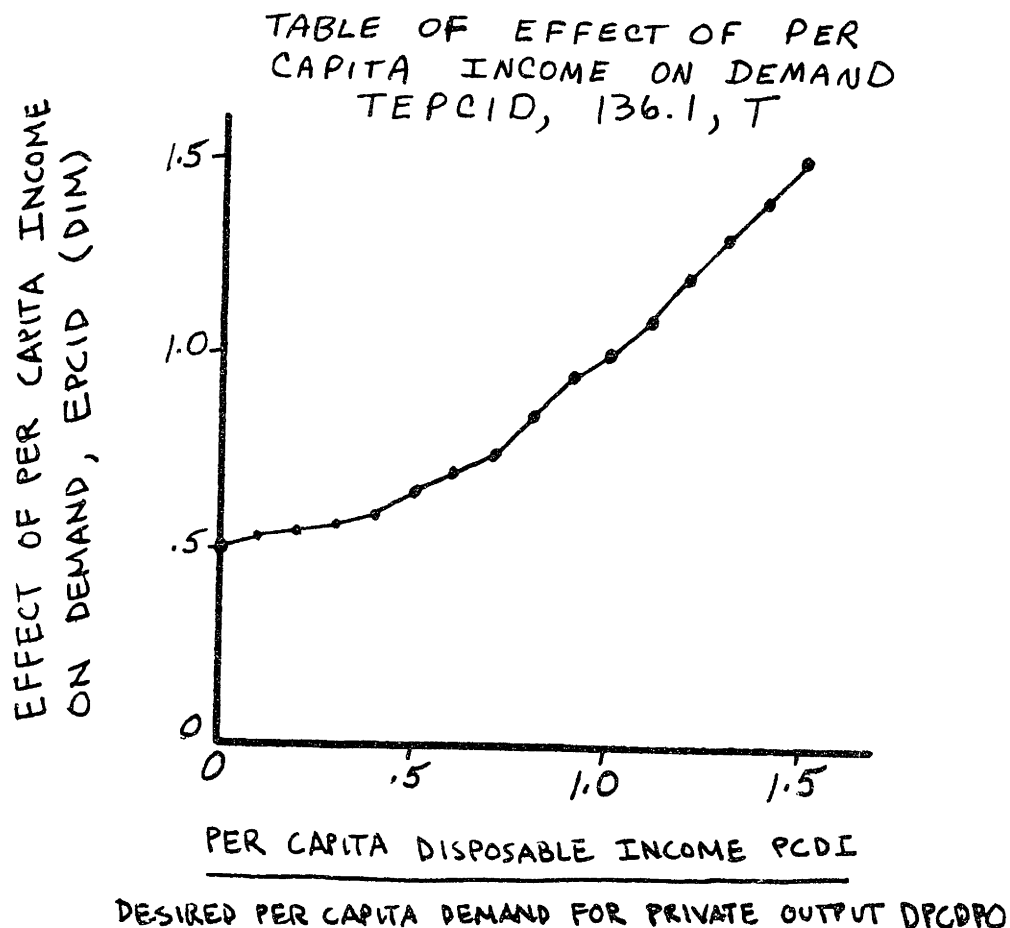


FIGURE A1-53. The Effect of Per Capita Income on the Demand for Private Output.

As Figure A1-53 indicates, when PCDI is equal to DPCDPO, EPCID exerts a neutral effect in determining Per Capita Demand for Private Output PCDPO. As PCDI rises above DPCDPO, EPICD increases proportionally. Thus, the slope of the table function above the 1.0 point reflects the assumption that income will ultimately call forth the level of private output that it implies. And, that "ultimately" is a short enough time to be considered negligible.

As Figure A1-53 indicates, below the 1.0 point, EPCID is assumed to saturate. At first, EPCID responds less than proportionately to declines in PCDI below DPCDPO. A 10% decline in PCDI relative to DPCDPO generates only a 5% reduction in EPCID. A 20% decline produces a 15% reduction. And, a 30% decline yields a 25% reduction. The initial less-than-proportional effect reflects the assumption that, in the face of declining incomes, people will draw down their financial reserves (e.g. savings, stocks, etc.) in an attempt to maintain their previous standard of consumption. As PCDI continues to decline to well below DPCDPO, the response of EPCID begins to saturate. The saturation at the extreme low end of the table function reflects the assumption that at very low levels of per capita income, the direct tie between income and demand that prevails at higher levels of income, begins to evaporate. Under such extreme conditions, the society would be likely to be increasingly functioning as a decentralized barter-type economy rather than a centralized production economy in which income was exchanged for labor. In other words, there is some level of demand for material goods and services that must persist irrespective of the level of income.

Per Capita Disposable Income PCDI is defined in equaton 137 as Disposable Income DI divided by Population POP.

PCDI.K=DI.K/POP.K 137, A
PCDI - PER CAPITA DISPOSABLE INCOME (\$/PERSON/
YEAR)
DI - DISPOSABLE INCOME (\$/YEAR)
POP - POPULATION (PEOPLE)

Disposable Income DI is, in turn, defined as the sum of Private Production of Goods and Services PPGS, Government Production of Goods and Services GPGS and Transfer Payments TP minus Tax Revenues TAXREV. The first two terms in the expression for DI (see equation 138) constitute Gross National Product GNP. The last two terms represent governmental prerogatives for managing aggregate demand. For example, to stimulate aggregate demand government could increase Transfer Payments TP while simultaneously reducing Tax Revenues TAXREV.

$$\text{DI.K} = (\text{PPGS.K} + \text{GPGS.K} + \text{SUM}(\text{TP.K}) - \text{SUM}(\text{TAXREV.K})) \quad 138, \text{ A}$$

DI - DISPOSABLE INCOME (\$/YEAR)
PPGS - PRIVATE PRODUCTION OF GOODS & SERVICES (\$/YEAR)
GPGS - GOVT PRODUCTION OF GOODS & SERVICES (\$/YEAR)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF AN ARRAY
TP - TRANSFER PAYMENTS (\$/YEAR)
TAXREV - TAX REVENUES (\$/YEAR)

A1.12 PRIVATE PRODUCTION AND GNP

A flow diagram of the Private Production and GNP equation block is presented in equation A1-53.

Gross National Product GNP is formulated in equation 139 as the sum of Private Production of Goods and Services PPGS and Government Production of Goods and Services GPGS.

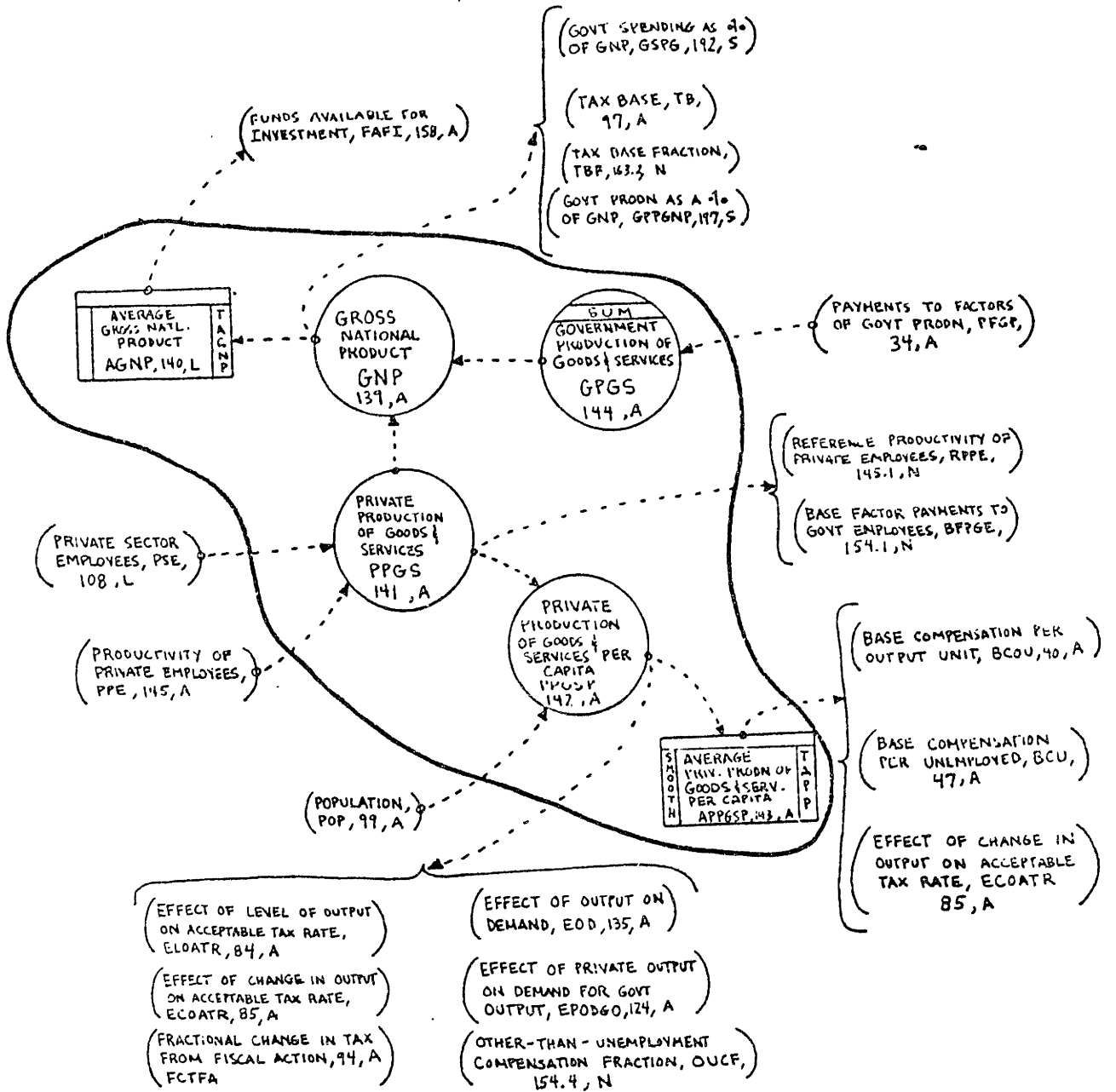


FIGURE A1-54. A Flow Diagram of the Private Production and GNP Equations.

PRIVATE PRODUCTION AND GNP

GNP.K=PPGS.K+GPGS.K	139, A
GNP=RTO	139.1, N
RTO=1E12	139.2, C
GNP - GROSS NATIONAL PRODUCT (\$/YEAR)	
PPGS - PRIVATE PRODUCTION OF GOODS & SERVICES (\$/	
YEAR)	
GPGS - GOVT PRODUCTION OF GOODS & SERVICES (\$/	
YEAR)	
RTO - REFERENCE TOTAL OUTPUT (\$/YEAR)	

GNP is set equal to Reference Total Output RTO in equation 139.1. Reference Total Output RTO is then initialized at \$1 billion, to approximate the current magnitude of output (denominated in real dollars) of the U.S. economy, in equation 139.2.

Average Gross National Product AGNP is a short-term exponential average of GNP as shown in equation 140.

AGNP.K=AGNP.J+(DT/TAGNP)(GNP.J-AGNP.J)	140, L
AGNP=GNP	140.1, N
TAGNP=1	140.2, C
AGNP - AVERAGE GROSS NATIONAL PRODUCT (\$/YEAR)	
DT - SOLUTION INTERVAL (YEARS)	
TAGNP - TIME TO AVERAGE GNP (YEARS)	
GNP - GROSS NATIONAL PRODUCT (\$/YEAR)	

Private Production of Goods and Services PPGS is formulated in equation 141 as the product of Private Sector Employees PSE and Productivity of Private Employees PPE.

PPGS.K=PSE.K*PPE.K	141, A
PPGS=RTO*POFRTO	141.1, N
RPPGS=PPGS	141.2, N
POFRTO=.7	141.3, C

PPGS - PRIVATE PRODUCTION OF GOODS & SERVICES (\$/YEAR)

PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)

PPE - PRODUCTIVITY OF PRIVATE EMPLOYEES (\$/PERSON/YEAR)

RTO - REFERENCE TOTAL OUTPUT (\$/YEAR)

POFRTO - PRIVATE OUTPUT AS A FRACTION OF REFERENCE TOTAL OUTPUT (DIM)

RPPGS - REFERENCE PRIVATE PRODUCTION OF GOODS & SERVICES (\$/YEAR)

PPE is the average amount of output that each private employee can generate in a year. PPE is defined and discussed in the final equation block.

PPGS is initialized by multiplying Reference Total Output RTO by Private Output as a Fraction of Reference Total Output POFRTO in equation 141.1. POFRTO is set equal to .7 in equation 141.3 to approximate the fraction of total output generated by the private sector in the U.S. economy.

Private Production of Goods and Services Per capita PPGSP is formulated, in equation 142, by dividing PPGS by POP.

PPGSP.K=PPGS.K/POP.K	142, A
PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER CAPITA (\$/PERSON/YEAR)	
PPGS - PRIVATE PRODUCTION OF GOODS & SERVICES (\$/YEAR)	
POP - POPULATION (PEOPLE)	

Average Private Production of Goods and Services Per capita
APPGSP is defined as a short-term exponential average of PPGSP in
equation 143.

APPGSP.K=SMOOTH(PPGSP.K,TAPP)	143, A
APPGSP=PPGS/RPOP	143.1, N
TAPP=1	143.2, C

APPGSP - AVERAGE PRIVATE PRODUCTION OF GOODS AND
SERVICES PER CAPITA (\$/PERSON/YEAR)
SMOOTH - DYNAMO FUNCTION FOR CALCULATING FIRST-ORDER
EXPONENTIAL AVERAGE
PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER
CAPITA (\$/PERSON/YEAR)
TAPP - TIME TO AVERAGE PRIVATE PRODUCTION (YEARS)
PPGS - PRIVATE PRODUCTION OF GOODS & SERVICES (\$/
YEAR)
RPOP - REFERENCE POPULATION (PEOPLE)

The final equation in the block is Government Production of
Goods and Services GPGS. GPGS is defined in equation 144, following
National Income Accounting procedures, as the sum of Payments to
Factors of Government Production PFGP by all levels of government.

GPGS.K=SUM(PFGP.K)	144, A
--------------------	--------

GPGS - GOVT PRODUCTION OF GOODS & SERVICES (\$/
YEAR)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
PFGP - PAYMENTS TO FACTORS OF GOVT PRODUCTION (\$/
YEAR)

A1.13 PRODUCTIVITY OF PRIVATE EMPLOYEES

A flow diagram of the Productivity of Private Employees equations appears as Figure A1-55.

Productivity of Private Employees PPE is defined as the amount of private output produced by each private employee on average, in a year. PPE is formulated in equation 145 as a Reference Productivity of Private Employees RPPE moderated by three influences: Effect of Government Regulation on Productivity EGRP, Effect of Technology on Productivity ETP and the Effect of War on Productivity EWP. Only the first influence, EGRP, functions in the normal course of executing the model. The latter two effects play a role only under certain test conditions.

PPE.K=RPPE*EGRP.K*ETP.K*EWP.K	145, A
RPPE=(PPGS/PSE)*(1/EGRP)	145.1, N
PPE	- PRODUCTIVITY OF PRIVATE EMPLOYEES (\$/ PERSON/YEAR)
RPPE	- REFERENCE PRODUCTIVITY OF PRIVATE EMPLOYEES (\$/PERSON/YEAR)
EGRP	- EFFECT OF GOVT REGULATION ON PRODUCTIVITY (DIM)
ETP	- EFFECT OF TECHNOLOGY ON PRODUCTIVITY (DIM)
EWP	- EFFECT OF WAR ON PRODUCTIVITY (DIM)
PPGS	- PRIVATE PRODUCTION OF GOODS & SERVICES (\$/ YEAR)
PSE	- PRIVATE SECTOR EMPLOYEES (PEOPLE)

Reference Productivity of Private Employees RPPE is initialized in equation 145, so that when PPE--which is equal to RPPE in the reference condition--is multiplied by PSE, the product will

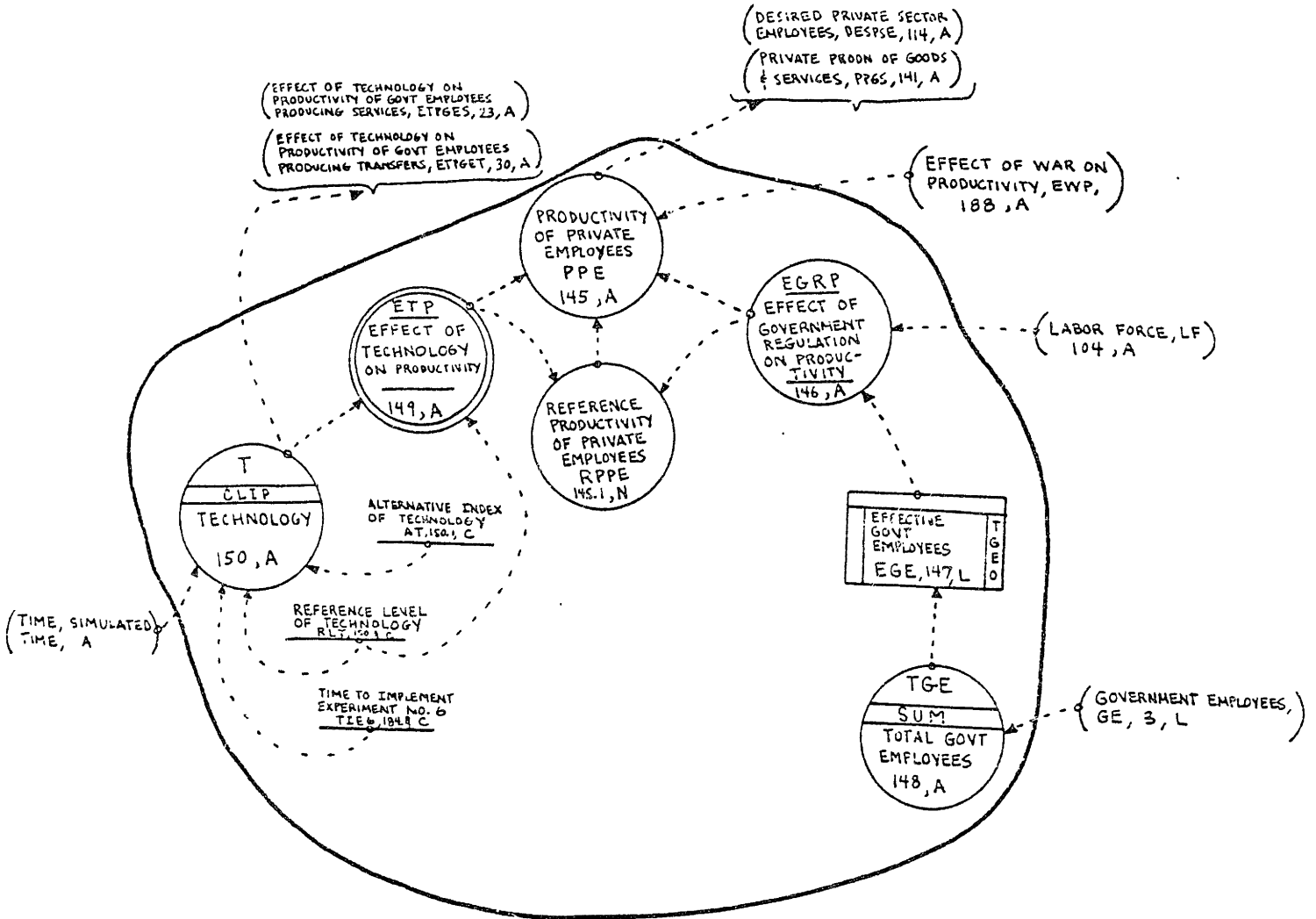


FIGURE A1-55. Flow Diagram of the Productivity of Private Employees Equations.

equal to the reference level of Private Production of Goods and Services PPGS. In order to accomplish this, RPPE is defined as equal to PPGS divided by the product of PSE and whatever influence Effect of Government Regulation on Productivity EGRP might be exerting in the reference condition.

Effect of Government Regulation on Productivity EGRP is included in the model in order to reflect the assumption that government regulation can exert a depressive effect on private productivity. Government regulations dictating that private capital be allocated to pollution abatement and control, for example, mean that this capital is not available for the generation of private output. In addition, the need to comply with government regulations of various sorts (e.g., EOE, OSHA standards, etc.), forces private producers to allocate some of their labor resources to the task of ensuring compliance with government's regulations, rather than to the direct production of private output. According to at least one author [7], government regulation may also contribute to stifling creativity and individual initiative, and thereby retard productivity advance. Several estimates place the impact of government regulation on productivity advance at near $-.5\%$ per year in recent years [8] [9].

EGRP, as equation 146 indicates, depends upon the ratio of Effective Government employees EGE to the number of employees in the Labor Force LF.

EGRP.K=TABLE (TEGRP, (EGE.K/LF.K), 0, 1, .1) 146, A
TEGRP=1/.98/.95/.92/.85/.75/.6/.45/.2/.05/0 146.1, T
EGRP - EFFECT OF GOVT REGULATION ON PRODUCTIVITY
(DIM)
TABLE - TABLE LOOK-UP FUNCTION
TEGRP - TABLE OF EFFECT OF GOVT REGULATION ON
PRODUCTIVITY
EGE - EFFECTIVE GOVT EMPLOYEES (PEOPLE)
LF - LABOR FORCE (PEOPLE)

The assumption here is that as government employees increase as a fraction of the labor force, they will come to play an increasingly large role in regulating the activities of the private labor force. One way of justifying one's existence as a government employee is to create regulations which must then be administered by government employees.

Effective Government Employees EGE is defined, in equation 147, as an exponential average of Total Government Employees TGE.

EGE.K=EGE.J+(DT/TGEO) (TGE.J-EGE.J) 147, L
EGE=SUM(GE) 147.1, N
TGEO=5 147.2, C
EGE - EFFECTIVE GOVT EMPLOYEES (PEOPLE)
DT - SOLUTION INTERVAL (YEARS)
TGEO - TIME FOR GOVT EMPLOYEES TO ORGANIZE
(YEARS)
TGE - TOTAL GOVT EMPLOYEES (PEOPLE)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
GE - GOVERNMENT EMPLOYEES (PEOPLE)

Total Government Employees TGE is, in turn, defined in equation 148 as the sum of Government Employees GE across all levels of government.

TGE.K=SUM(GE.K) 148, A
TGE - TOTAL GOVT EMPLOYEES (PEOPLE)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
GE - GOVERNMENT EMPLOYEES (PEOPLE)

TGE is averaged in EGE before entering into the argument of the table function for EGRP because it is assumed that it will take some time (here assumed to be, on average, five years) for a given increment of government employees to make themselves felt in terms of regulatory statutes and activities. The time delay reflects both planning and drafting of regulatory legislation, as well as the delays associated with getting such legislation on the books.

As Figure A1-56 indicates, EGRP is assumed to be a non-linear function of EGE relative to LF.

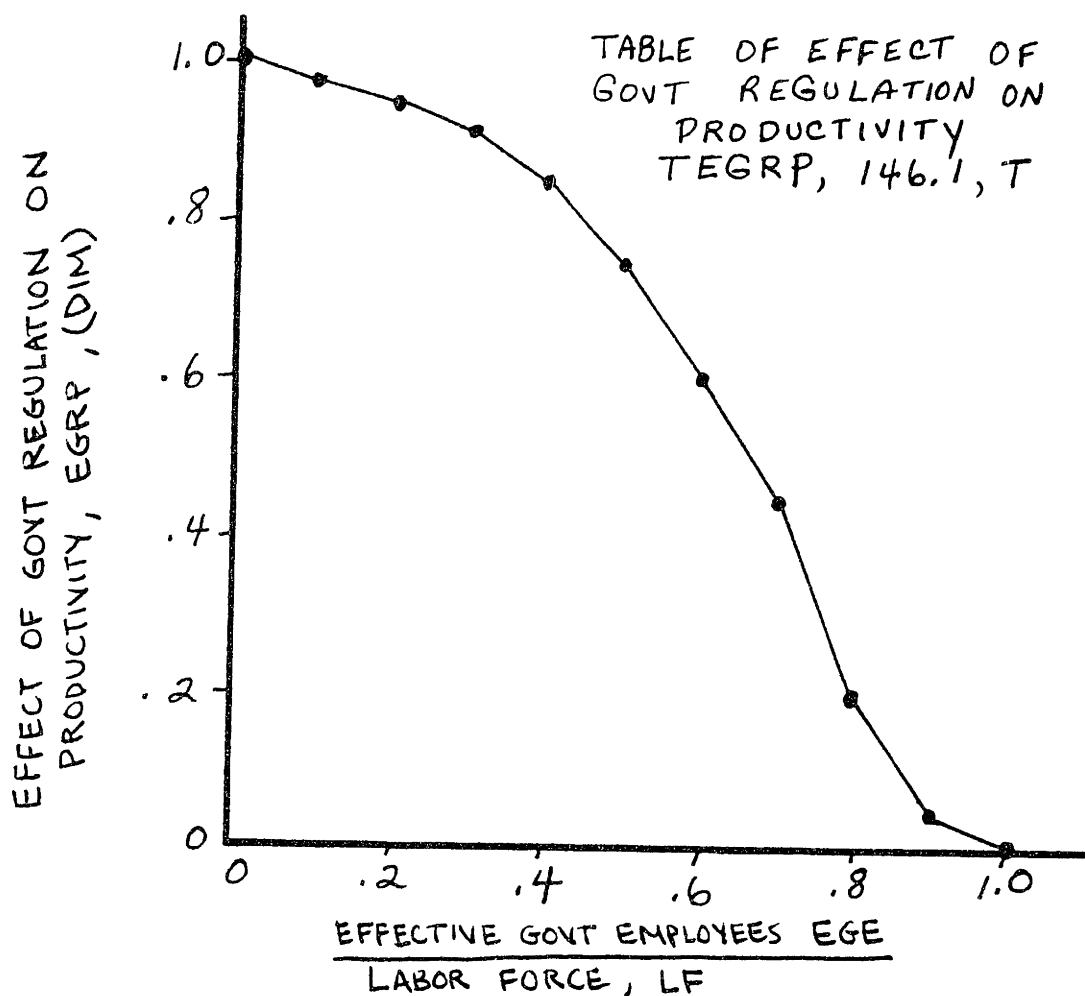


FIGURE A1-56. The Effect of Government Regulation on Productivity of Private Employees.

As long as EGE remains a small fraction of the total Labor Force LF, government regulation is assumed to have very little influence on productivity. As government absorbs more and more of the employees in the labor force, however, the effect on private productivity is assumed to become increasingly pronounced. When government has absorbed all of the available labor in the economy, productivity in the private sector is, by definition, zero (because there is no private output being produced at that point).

The second influence assumed to moderate private

productivity is the Effect of Technology on Productivity ETP. Technology, in the form of higher education and sophisticated capital equipment; clearly boosts output per employee in the private sector. ETP is intended to capture this effect.

ETP is defined, in equation 149 as dependent upon the level of Technology T relative to the Reference Level of Technology RLT.

ETP.K=TABLE(TETP,T.K/RLT,0,1.5,.25)	149, A
TETP=.1/.25/.5/.75/1/1.25/1.5	149.1, T
ETP	- EFFECT OF TECHNOLOGY ON PRODUCTIVITY (DIM)
TABLE	- TABLE LOOK-UP FUNCTION
TETP	- TABLE OF EFFECT OF TECHNOLOGY ON PRODUCTIVITY
T	- INDEX OF TECHNOLOGY (DIMENSIONLESS)
RLT	- REFERENCE LEVEL OF TECHNOLOGY (DIM)

Technology, as previously discussed, is an amalgamation of knowledge and technical sophistication in capital that enables more products to be generated per unit of labor added to the production process. As Figure A1-57 shows, as T increases relative to the Reference Level of Technology RLT, ETP is assumed to rise in proportion. And, as T declines relative to RLT, ETP is likewise assumed to respond in proportion, except as T approaches the theoretically attainable, but practically highly-unlikely, state of zero. At a value of T equal to zero, it is assumed that productivity still takes on some non-zero value.

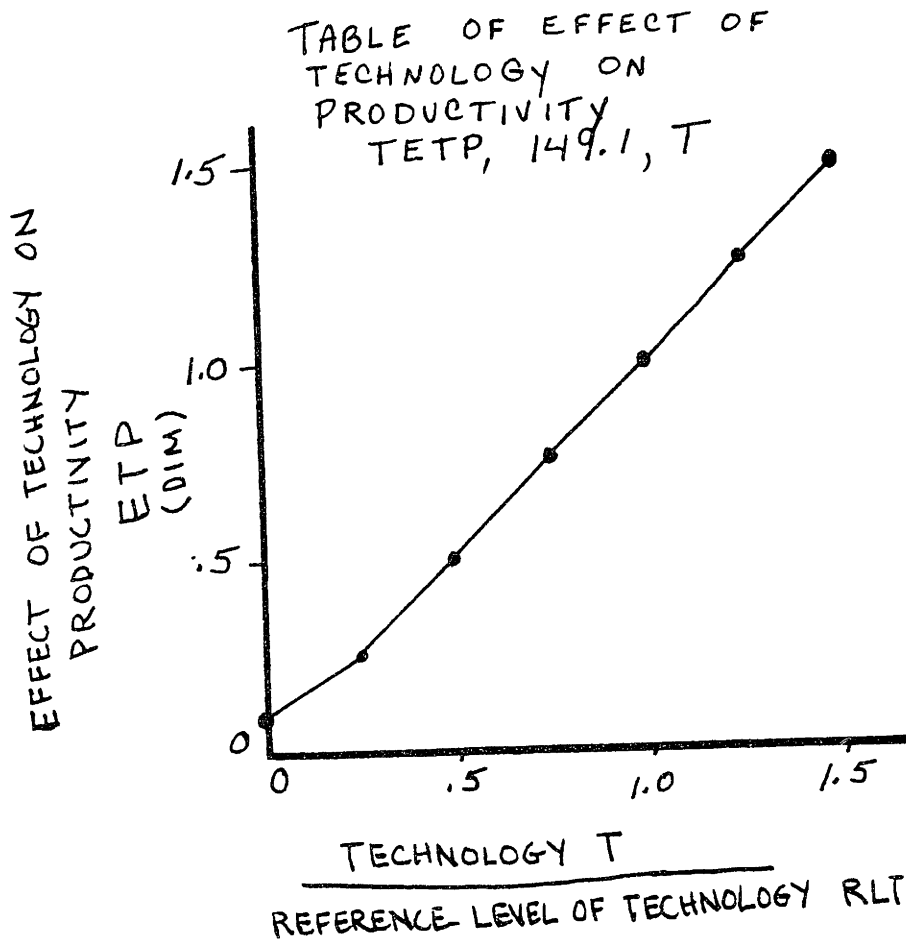


FIGURE A1-57. The Effect of Technology on the Productivity of Private Employees.

The final equation in the rest-of-the socioeconomy sector of the model is Technology T. Technology is defined in equation 150 as a constant equal to the Reference Level of Technology. RLT, which is itself set equal to 1.0. The equation form allows for step-alteraton of the level of Technology to equal a Alternative Level of Technology ALT at any time during the simulation.

T.K=CLIP(ALT,RLT,TIME.K,TIE6)
ALT=RLT*TAF
TAF=1.1
RLT=1

150, A
150.1, N
150.2, C
150.3, C

T - INDEX OF TECHNOLOGY (DIMENSIONLESS)
CLIP - DYNAMO FUNCTION USED FOR ALTERING
PARAMETERS FOR TESTING PURPOSES
ALT - ALTERED LEVEL OF TECHNOLOGY (FIM)
RLT - REFERENCE LEVEL OF TECHNOLOGY (DIM)
TIME - DYNAMO FUNCTION FOR RECORDING ELAPSED
SIMULATION TIME (YEARS)
TIE6 - TIME TO IMPLEMENT EXPERIMENT 6 (YEAR)
TAF - TECHNOLOGY ALTERATION FRACTION (DIM)

A1.14 TESTING EQUATIONS

For the most part, the testing equations perform pulse-increases and pulse-decreases in various system levels, or rates, or step-changes in various components of the exogenous state sector which defines the "fixed economy". All tests, except the war test, are activated by setting a time switch (Time to Implement Experiment i , TIE_i , where $i = 1, 2, \dots, 9$) equal to the time that the test is to be implemented.

The first test is a pulse-transfer of employees from government to the private sector. Exogenous Transfer of Employees from Government to the Private Sector ETEGP is defined as equal to a PULSE function in equation 165.

ETEGP.K(LG)=PULSE(PTEGP.K(LG),TIE1,EI) 165, A
ETEGP - EXOGENOUS TRANSFER OF EMPLOYEES FROM GOVT
TO PRIVATE SECTOR (PEOPLE/YEAR)
LG - LEVEL OF GOVT
PULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
TIE1 - TIME TO IMPLEMENT EXPERIMENT 1 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

The PULSE function has three arguments. The first gives the height of the pulse. The second tells the time of the pulse. The third gives the interval between pulses.

For the first test, the pulse height coincides with the number of employees that are to be instantaneously transferred from government to the private sector. The pulse height is called Pulse Transfer of Employees from Government to the Private Sector PTEGP, and is defined in equation 166.

$PTEGP.K(LG) = (GE.K(LG) * FET) / DT$	166, A
FET=.5	166.1, C
TIE1=1000	166.2, C
EI=1000	166.3, C

LG	- LEVEL OF GOVT
GE	- GOVERNMENT EMPLOYEES (PEOPLE)
FET	- FRACTION OF EMPLOYEES TRANSFERRED (DIM)
DT	- SOLUTION INTERVAL (YEARS)
TIE1	- TIME TO IMPLEMENT EXPERIMENT 1 (YEAR)
EI	- EXPERIMENTAL INTERVAL (YEARS)

PTEGP is defined as the product of Government Employees GE and the Fraction of Employees Transferred FET, divided by DT (the solution interval). FET is set (in equation 166.1) equal to .5, meaning that 50% of the existing stock of Government Employees GE is transferred in the test. The expression is divided by DT so that when the rate into which ETEGP is added, is multiplied by DT, the DT's will cancel. This means that the entire quantity of government employees will be transferred in "one shot".

Time to Implement Experiment 1 TIE1 is set equal to 1000 (in equation 166.2). This means that the pulse-transfer will occur in year 1000 of the simulation. Because no simulation runs are allowed to exceed 100 years in length, setting TIE1=1000 means that the test

will not be implemented. Setting TIE1 equal to some number less than 100 in the RERUN mode will activate the test.

Experimental Interval EI is also set equal to 1000 (in equation 166.3). EI is the time between pulses. Because each test of the model involves a one-time disturbance, EI is set to 1000 in order to prevent the recurrence of a disequilibrating stimuli.

Tests 2 and 3 are identical in form to Test 1. Only the variable names of the exogenous transfers and variables impacted by these transfers differ. As such, each equation is not described in detail. Instead, the entire group of equations comprising Tests 2 and 3 are presented as a block.

- TEST 2: REDUCTION IN SIZE OF GOVT
1. INCLUDE TRANSFER OF EMPLOYEES (I.E., TEST 1)
2. REDUCTION IN MONEY BALANCE

ERGMB.K(LG)=PULSE(EDGMB.K(LG),TIE2,EI) 168, A
ERGMB - EXOGENOUS REDUCTION IN GOVT MONEY BALANCE
(\$/YEAR)
LG - LEVEL OF GOVT
PULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
EDGMB - EXOGENOUS DECREASE IN GOVT MONEY BALANCE
(\$/YEAR)
TIE2 - TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

EDGMB.K(LG)=(GMB.K(LG)*EFDMB)/DT 169, A
EFDMB=.35 169.1, C
TIE2=1000 169.2, C
EDGMB - EXOGENOUS DECREASE IN GOVT MONEY BALANCE
(\$/YEAR)
LG - LEVEL OF GOVT
GMB - GOVT MONEY BALANCE (DOLLARS)
EFDMB - EXOGENOUS FRACTIONAL DECREASE IN GOVT MONEY
BALANCE (DIM)
DT - SOLUTION INTERVAL (YEARS)
TIE2 - TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)

ERDMB.K(LG)=PULSE(EDDMB.K(LG),TIE2,EI) 170, A
ERDMB - EXOGENOUS REDUCTION IN DECREASE IN MONEY
BALANCE (\$/YEAR)
LG - LEVEL OF GOVT
PULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
EDDMB - EXOGENOUS DECREASE IN DECREASE IN MONEY
BALANCE (\$/YEAR)
TIE2 - TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

EDDMB.K(LG)=(ADMB.K(LG)*EFD)/DT 171, A
EFD=.5 171.1, C
EDDMB - EXOGENOUS DECREASE IN DECREASE IN MONEY
BALANCE (\$/YEAR)
LG - LEVEL OF GOVT
ADMB - AVERAGE DECREASE IN MONEY BALANCE (\$/YEAR)
EFD - EXOGENOUS FRACTIONAL DECREASE (DIM)
DT - SOLUTION INTERVAL (YEARS)

ERADPY.K(LG)=PULSE(EDADPY.K(LG),TIE2,EI) 172, A
ERADPY - EXOGENOUS REDUCTION IN AVERAGE DESIRED
PAYMENTS (\$/YEAR)
LG - LEVEL OF GOVT
PULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
EDADPY - EXOGENOUS DECREASE IN AVERAGE DESIRED
PAYMENTS (\$/YEAR)
TIE2 - TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

EDADPY.K(LG)=(ADPAY.K(LG)*EFD)/DT 173, A
EDADPY - EXOGENOUS DECREASE IN AVERAGE DESIRED
PAYMENTS (\$/YEAR)
LG - LEVEL OF GOVT
ADPAY - AVERAGE DESIRED PAYMENTS (\$/YEAR)
EFD - EXOGENOUS FRACTIONAL DECREASE (DIM)
DT - SOLUTION INTERVAL (YEARS)

3. REDUCTION IN TAX RATES

ECTR.K(TAX)=PULSE(EMTR.K(TAX),TIE2,EI) 174, A
TAX - TYPES OF TAX
PULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
EMTR - EXOGENOUS MODIFICATION OF TAX RATE (1/YEAR)
TIE2 - TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

EMTR.K(TAX)=(TR.K(TAX)*EFD)/DT 175, A
EMTR - EXOGENOUS MODIFICATION OF TAX RATE (1/YEAR)
TAX - TYPES OF TAX
TR - TAX RATE (DIM)
EFD - EXOGENOUS FRACTIONAL DECREASE (DIM)
DT - SOLUTION INTERVAL (YEARS)

5. REDUCTION IN STANDARD OUTPUT

ERSOGS.K(LG)=PULSE(PROGSP.K(LG),TIE2,EI) 178, A
ERSOGS - EXOGENOUS REDUCTION IN STANDARD OUTPUT OF
GOVT SERVICES PER CAPITA (OUTPUT UNITS/
PERSON/YEAR)
LG - LEVEL OF GOVT
FULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
PROGSP - PULSE REDUCTION IN OUTPUT OF GOVT SERVICES
PER CAPITA (OUTPUT UNITS/PERSON/YEAR)
TIE2 - TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

PROGSP.K(LG)=(SOGSP.K(LG)*EFD)/DT 179, A
PROGSP - PULSE REDUCTION IN OUTPUT OF GOVT SERVICES
PER CAPITA (OUTPUT UNITS/PERSON/YEAR)
LG - LEVEL OF GOVT
SOGSP - STANDARD OUTPUT OF GOVT SERVICES PER PERSON
(OUTPUT UNITS/PERSON/YEAR)
EFD - EXOGENOUS FRACTIONAL DECREASE (DIM)
DT - SOLUTION INTERVAL (YEARS)

ERSOGT.K(LG)=PULSE(PROGTP.K(LG),TIE2,EI) 180, A
ERSOGT - EXOGENOUS REDUCTION IN STANDARD OUTPUT OF
GOVT TRANSFERS PER CAPITA (OUTPUT UNITS/
PERSON/YEAR)
LG - LEVEL OF GOVT
PULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
PROGTP - PULSE REDUCTION IN OUTPUT OF GOVT TRANSFERS
PER PERSON (OUTPUT UNITS/PERSON/YEAR)
TIE2 - TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

PROGTP.K(LG)=(SOGTP.K(LG)*EFD)/DT 181, A
PROGTP - PULSE REDUCTION IN OUTPUT OF GOVT TRANSFERS
PER PERSON (OUTPUT UNITS/PERSON/YEAR)
LG - LEVEL OF GOVT
SOGTP - STANDARD OUTPUT OF GOVT TRANSFERS PER
PERSON (OUTPUT UNITS/PERSON/YEAR)
EFD - EXOGENOUS FRACTIONAL DECREASE (DIM)
DT - SOLUTION INTERVAL (YEARS)

TEST 3: TRANSFER OF EMPLOYEES FROM PRIV TO PUBLIC

ETEPG.K(LG)=PULSE(PTEPG.K(LG),TIE3,EI) 182, A
ETEPG - EXOGENOUS TRANSFER OF EMPLOYEES FROM
PRIVATE TO GOVT SECTOR (PEOPLE/YEAR)
LG - LEVEL OF GOVT
PULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
PTEPG - PULSE TRANSFER OF EMPLOYEES FROM PRIVATE
SECTOR TO GOVT (PEOPLE/YEAR)
TIE3 - TIME TO IMPLEMENT EXPERIMENT 3 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

PTEPG.K(LG)=(GE.K(LG)*FET)/DT 183, A
TIE3=1000 183.1, C
PTEPG - PULSE TRANSFER OF EMPLOYEES FROM PRIVATE
SECTOR TO GOVT (PEOPLE/YEAR)
LG - LEVEL OF GOVT
GE - GOVERNMENT EMPLOYEES (PEOPLE)
FET - FRACTION OF EMPLOYEES TRANSFERRED (DIM)
DT - SOLUTION INTERVAL (YEARS)
TIE3 - TIME TO IMPLEMENT EXPERIMENT 3 (YEAR)

Tests 4 through 6 consist of making step-changes in components of the exogenous state sector. Test 4 alters the Fraction of Elderly FE in the population. Test 5 alters the Fraction of Children FC. And Test 6 alters the Level of Technology T. Each test is activated by setting TIE4, TIE5, and TIE6, respectively equal to some value within the range of the simulation time horizon.

TEST 4: ALTER FRACTION OF ELDERLY

TIE4=1000 183.6, C
TIE4 - TIME TO IMPLEMENT EXPERIMENT 4 (YEAR)

TEST 5: ALTER FRACTION OF CHILDREN

TIE5=1000 184.2, C
TIE5 - TIME TO IMPLEMENT EXPERIMENT 5 (YEAR)

TEST 6: ALTER LEVEL OF TECHNOLOGY

TIE6=1000 184.7, C
TIE6 - TIME TO IMPLEMENT EXPERIMENT 6 (YEAR)

Test 7 allows for alteration of Normal Fractional Increase in Government Employees NFIGE (equation 151.6). Effect of Exogenous Change on Fractional Increase EECFI is defined in equation 186 as equal to a CLIP function whose value becomes equal to Exogenous Change in Fractional Increase ECFI when Simulation Time TIME takes on a value in excess of Time to Implement Experiment 7 TIE7. If TIME is less than TIE7, EECFI is equal to 1.0.

EECFI.K=CLIP(ECFI,1,TIME.K,TIE7)	186, A
ECFI=2	186.1, C
TIE7=1000	186.2, C

EECFI - EFFECT OF EXOGENOUS CHANGE ON FRACTIONAL INCREASE (DIM)
CLIP - DYNAMO FUNCTION USED FOR ALTERING PARAMETERS FOR TESTING PURPOSES
ECFI - EXOGENOUS CHANGE IN FRACTIONAL INCREASE (1/YEAR)
TIME - DYNAMO FUNCTION FOR RECORDING ELAPSED SIMULATION TIME (YEARS)
TIE7 - TIME TO IMPLEMENT EXPERIMENT 7 (YEAR)

As equation 5 indicates, EECFI multiplies NFIGE. Thus, as currently configured, when time exceeds TIE7, NFIGE will double (because ECFI = 2.0).

The eighth test is the implementation of a war. War is introduced into the model by making one or more of the values in the table function, Table of Threat to National Security TTNS (see equations 159 and 159.1), non-zero. When TNS takes on a non-zero value, public sentiment against tax rate increases is neutralized in accordance with the magnitude of TNS. So is the market's response to government's desired sale of securities. In addition to these effects, TNS activates two additional influences; the first operates on the hiring of government employees, the second impacts upon private productivity.

As Equation 187 indicates, when TNS takes on non-zero values, the Effect of War on Fractional Increase EWFI rises above 1.0.

EWFI.K=TABLE(TEWFI,TNS.K,0,1,.25)	187, A
TEWFI=1/1.25/1.5/2/2.5	187.1, T

EWFI - EFFECT OF WAR ON FRACTIONAL INCREASE (DIM)
TABLE - TABLE LOOK-UP FUNCTION
TEWFI - TABLE OF EFFECT OF WAR ON FRACTIONAL INCREASE
TNS - INDEX OF THREAT TO NATIONAL SECURITY (DIM)

EWFI is one of the terms that multiplies Normal Fractional Increase in Government Employees NFIGE in equation 5. The effect is intended to proxy the rapid assimilation of employees into the military during a war-time situation.

The second additional influence activated by a non-zero value of TNS is the Effect of War on Productivity EWP, defined in equation 188.

EWP.K=CLIP(1/EGRP.K,1,TNS.K,.01) 188, A
EWP - EFFECT OF WAR ON PRODUCTIVITY (DIM)
CLIP - DYNAMO FUNCTION USED FOR ALTERING
PARAMETERS FOR TESTING PURPOSES
EGRP - EFFECT OF GOVT REGULATION ON PRODUCTIVITY
(DIM)
TNS - INDEX OF THREAT TO NATIONAL SECURITY (DIM)

EWP is intended to neutralize the Effect of Government Regulation on Productivity EGRP during a wartime situation. If the effect were not included, when government added military employees to fight the war, the model would count these employees as normal civilian government workers. And because EGRP depresses productivity as a positive function of the total number of government employees (see equation 146), private productivity would be sharply reduced simply because a war was being waged. However, as equation 188 indicates, as soon as TNS takes on a positive value, EWP becomes equal to the inverse of EGRP. Thus, when EGRP and EWP are multiplied in equation 145, they cancel.

The final testing equation is designed to proxy the effect of a depression. Depression is invoked by transferring employees from

the private sector into the employed pool. Exogenous Decrease in Private Sector Employees EDPSE, defined in equation 189, is used to accomplish this transfer.

EDPSE.K=PULSE(PEDPSE.K,TIE9,EI) 189, A
EDPSE - EXOGENOUS DECREASE IN PRIVATE SECTOR
EMPLOYEES (PEOPLE/YR)
PULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
PEDPSE - PULSE EXOG DECREASE IN PRIVATE SECTOR
EMPLOYEES (PEOPLE/YR)
TIE9 - TIME TO IMPLEMENT EXPERIMENT 9 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

EDPSE becomes equal to Pulse Exogenous Decrease in Private Sector Employees PEDPSE when Time to Implement Experiment 9 TIE9 is set equal to a value within the simulation horizon. PEDPSE is defined, in equation 190, as the product of Private Sector Employees PSE and Fractional Decrease FD, divided by DT.

PEDPSE.K=(PSE.K*FD)/DT 190, A
FD=.25 190.1, C
TIE9=1000 190.2, C
PEDPSE - PULSE EXOG DECREASE IN PRIVATE SECTOR
EMPLOYEES (PEOPLE/YR)
PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)
FD - FRACTIONAL DECREASE (1/YEAR)
DT - SOLUTION INTERVAL (YEARS)
TIE9 - TIME TO IMPLEMENT EXPERIMENT 9 (YEAR)

FD is set equal to .25 in equation 190.1. This means that when the test is activated, 25% of the pool of private employees are transferred (in "one shot") into the unemployed pool.

A1.15 VARIABLES FOR PLOTTING

Equations 192 through 201 are variables that do not figure in generating model behavior. These variables are calculated only for purposes of display.

GSPG.K=SUM(DMB.JK)/GNP.K 192, S
GSPG - GOVERNMENT SPENDING AS A % OF GNP (DIM)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
DMB - DECREASE IN MONEY BALANCE (\$/YEAR)
GNP - GROSS NATIONAL PRODUCT (\$/YEAR)

GEPLF.K=SUM(GE.K)/LF.K 193, A
GEPLF - GOVERNMENT EMPLOYEES AS A % OF LABOR FORCE
(DIM)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
GE - GOVERNMENT EMPLOYEES (PEOPLE)
LF - LABOR FORCE (PEOPLE)

PEPLF.K=PSE.K/LF.K 194, A
PEPLF - PRIVATE EMPLOYEES AS A % OF LABOR FORCE
(DIM)
PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)
LF - LABOR FORCE (PEOPLE)

RSSPTR.K=SUM(SGS.JK)/SUM(IMB.JK) 195, A
RSSPTR - REVENUE FROM SALE OF SECURITIES AS % OF
TOTAL REVENUE (DIM)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
SGS - SALE OF GOVT SECURITIES (\$/YEAR)
IMB - INCREASE IN MONEY BALANCE (\$/YEAR)

TRPTR.K=SUM(TAXREV.K)/SUM(IMB.JK) 196, S
TRPTR - TAX REVENUE AS A % OF TOTAL REVENUE (DIM)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
TAXREV - TAX REVENUES (\$/YEAR)
IMB - INCREASE IN MONEY BALANCE (\$/YEAR)

GPPGNP.K=GPGS.K/GNP.K 197, S
GPPGNP - GOVERNMENT PRODUCTION AS A PERCENT OF GNP
(DIM)
GPGS - GOVT PRODUCTION OF GOODS & SERVICES (\$/
YEAR)
GNP - GROSS NATIONAL PRODUCT (\$/YEAR)

GS.K=SUM(TAXREV.K)-(SUM(PFGP.K)+SUM(TP.K)) 198, A
GS - GOVERNMENT SURPLUS (\$/YEAR)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
TAXREV - TAX REVENUES (\$/YEAR)
PFGP - PAYMENTS TO FACTORS OF GOVT PRODUCTION (\$/
YEAR)
TP - TRANSFER PAYMENTS (\$/YEAR)

UPLF.K=U.K/LF.K 199, A
UPLF - UNEMPLOYMENT AS A PERCENT OF THE LABOR
FORCE (DIM)
U - UNEMPLOYED (PEOPLE)
LF - LABOR FORCE (PEOPLE)

TRSR.K=SUM(TAXREV.K)/(SUM(TP.K)+SUM(PFGP.K)) 200, A
TRSR - TAX REVENUE SPENDING RATIO (DIM)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
TAXREV - TAX REVENUES (\$/YEAR)
TP - TRANSFER PAYMENTS (\$/YEAR)
PFGP - PAYMENTS TO FACTORS OF GOVT PRODUCTION (\$/
YEAR)

GPGSP.K=GPGS.K/POP.K 201, A
GPGSP - GOVT PRODUCTION OF GOODS & SERVICES PER
CAPITA (\$/PERSON/YEAR)
GPGS - GOVT PRODUCTION OF GOODS & SERVICES (\$/
YEAR)
POP - POPULATION (PEOPLE)

A1.16 SIMULATION CONTROL PARAMETERS

Equations 201.5 through 203.2 are used to provide the DYNAMO compiler with the specifications that it needs to execute the simulations. The equations define: the solution interval DT, the length of the simulation LENGTH, the plotting period PLTPER, and the printing period PRTPER.

```
SPEC DT=.25/LENGTH=0                                201.5
      DT      - SOLUTION INTERVAL (YEARS)
      LENGTH - LENGTH OF SIMULATION (YEARS)

PLTPER.K=CLIP(PLP,0,TIME.K,TBPL)                    202, A
PLP=1                                                202.1, C
TBPL=0                                               202.2, C
      PLTPER - PLOT PERIOD FOR SIMULATION PLOTTED OUTPUT
                (YEARS)
      CLIP   - DYNAMO FUNCTION USED FOR ALTERING
                PARAMETERS FOR TESTING PURPOSES
      PLP    - PLOT PERIOD (YEARS)
      TIME   - DYNAMO FUNCTION FOR RECORDING ELAPSED
                SIMULATION TIME (YEARS)
      TBPL   - TIME TO BEGIN PLOTTING (YEAR)

PRTPER.K=CLIP(PRP,0,TIME.K,TBPR)                    203, A
PRP=.05                                              203.1, C
TBPR=2000                                           203.2, C
      PRTPER - PRINT PERIOD FOR PRINTED SIMULATION OUTPUT
                (YEARS)
      CLIP   - DYNAMO FUNCTION USED FOR ALTERING
                PARAMETERS FOR TESTING PURPOSES
      PRP    - PRINT PERIOD (YEARS)
      TIME   - DYNAMO FUNCTION FOR RECORDING ELAPSED
                SIMULATION TIME (YEARS)
      TBPR   - TIME TO BEGIN PRINTING (YEAR)
```

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APPENDIX II

DOCUMENTED MODEL LISTING, UNDOCUMENTED LISTING
ANALYZER LISTING AND VARIABLE DEFINITION FILE

DOCUMENTOR EQUATION LISTING

DIMENSIONS

LG=1, TLG 1, F
 LG -- LEVEL OF GOVT
 TLG -- TOTAL LEVEL OF GOVTS

TAX=1, TTX 2, F
 TAX -- TYPES OF TAX
 TTX -- TOTAL TYPES OF TAX

* * * * *
 * GOVERNMENT SECTOR EQUATIONS *
 * * * * *

GOVERNMENT EMPLOYMENT EQUATIONS

$GE.K(LG) = GE.J(LG) + (DT) (IGE.JK(LG) - DGE.JK(LG))$ 3, L
 GE -- GOVERNMENT EMPLOYEES (PEOPLE)
 LG -- LEVEL OF GOVT
 DT -- SOLUTION INTERVAL (YEARS)
 IGE -- INCREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)
 DGE -- DECREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)

$IGE.KL(LG) = (GE.K(LG) * FIGE.K(LG)) + ETEPG.K(LG)$ 4, R
 IGE -- INCREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)
 LG -- LEVEL OF GOVT
 GE -- GOVERNMENT EMPLOYEES (PEOPLE)
 FIGE -- FRACTIONAL INCREASE IN GOVT EMPLOYEES (1/
 YEAR)
 ETEPG -- EXOGENOUS TRANSFER OF EMPLOYEES FROM
 PRIVATE TO GOVT SECTOR (PEOPLE/YEAR)

$$\text{FIGE.K(LG)} = \text{NFIGE} * \text{EMAFI.K(LG)} * \text{EAFIG.K} * (\text{EWFI.K} * \text{EECFI.K}) \quad 5, A$$

- FIGE -- FRACTIONAL INCREASE IN GOVT EMPLOYEES (1/YEAR)
- LG -- LEVEL OF GOVT
- NFIGE -- NORMAL FRACTIONAL INCREASE IN GOVT EMPLOYEES (1/YEAR)
- EMAFI -- EFFECT OF MONEY ADEQUACY ON FRACTIONAL INCREASE (DIM)
- EAFIG -- EFFECT OF AVAILABILITY OF EMPLOYEES ON FRACTIONAL INCREASE IN GOVT EMPLOYEES (DIM)
- EWFI -- EFFECT OF WAR ON FRACTIONAL INCREASE (DIM)
- EECFI -- EFFECT OF EXOGENOUS CHANGE ON FRACTIONAL INCREASE (DIM)

$$\text{EMAFI.K(LG)} = \text{TABLE}(\text{TEMAFI}, \text{GMA.K(LG)}, 0, 2, .25) \quad 5, A$$

- EMAFI -- EFFECT OF MONEY ADEQUACY ON FRACTIONAL INCREASE (DIM)
- LG -- LEVEL OF GOVT
- TABLE -- TABLE LOOK-UP FUNCTION
- TEMAFI -- TABLE OF EFFECT OF MONEY ADEQUACY ON FRACTIONAL INCREASE
- GMA -- GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

$$\text{EAFIG.K} = \text{TABHL}(\text{TEAEFG}, \text{U.K/MU.K}, 0, 7, .5) \quad 7, A$$

- EAFIG -- EFFECT OF AVAILABILITY OF EMPLOYEES ON FRACTIONAL INCREASE IN GOVT EMPLOYEES (DIM)
- TABHL -- TABLE LOOK-UP FUNCTION
- TEAEFG -- TABLE OF EFFECT OF AVAILABILITY OF EMPLOYEES ON FRACTIONAL INCREASE IN GOVT EMPLOYEES
- U -- UNEMPLOYED (PEOPLE)
- MU -- MINIMUM UNEMPLOYED (PEOPLE)

$$\text{DGE.K(LG)} = (\text{GE.K(LG)} * \text{FDGE.K(LG)}) + \text{ETEGP.K(LG)} \quad 8, R$$

- DGE -- DECREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)
- LG -- LEVEL OF GOVT
- GE -- GOVERNMENT EMPLOYEES (PEOPLE)
- FDGE -- FRACTIONAL DECREASE IN GOVERNMENT EMPLOYEES (PEOPLE/YEAR)
- ETEGP -- EXOGENOUS TRANSFER OF EMPLOYEES FROM GOVT TO PRIVATE SECTOR (PEOPLE/YEAR)

$$\text{FDGE.K(LG)} = (\text{FDPSD.K} * \text{EAGE.K(LG)}) + \text{FDMA.K(LG)} \quad 9, A$$

- FDGE -- FRACTIONAL DECREASE IN GOVERNMENT EMPLOYEES (PEOPLE/YEAR)
- LG -- LEVEL OF GOVT
- FDPSD -- FRACTIONAL DECREASE FROM PRIVATE SECTOR DEMAND (PEOPLE/YEAR)
- EAGE -- EFFECT OF AVAILABILITY OF GOVT EMPLOYEES (DIMENSIONLESS)
- FDMA -- FRACTIONAL DECREASE FROM MONEY ADEQUACY (PEOPLE/YEAR)

FDPSD.K=FDPSED.K*EUCFD.K 10, A
FDPSD - FRACTIONAL DECREASE FROM PRIVATE SECTOR
DEMAND (PEOPLE/YEAR)
FDPSED -- FRACTIONAL DECREASE FROM PRIVATE SECTOR
EMPLOYMENT DISCREPANCY (PEOPLE/YEAR)
EUCFD -- EFFECT OF UNEMPLOYMENT CONDITIONS ON
FRACTIONAL DECREASE (DIM)

FDPSED.K=TABHL(TFDPSD,PSE.K/DESPSE.K,0,1,.25) 11, A
FDPSED - FRACTIONAL DECREASE FROM PRIVATE SECTOR
EMPLOYMENT DISCREPANCY (PEOPLE/YEAR)
TABHL -- TABLE LOOK-UP FUNCTION
TFDPSD - TABLE OF FRACTIONAL DECREASE FROM PRIVATE
SECTOR DEMAND
PSE -- PRIVATE SECTOR EMPLOYEES (PEOPLE)
DESPSE -- DESIRED PRIVATE SECTOR EMPLOYEES (PEOPLE)

EUCFD.K=TABHL(TEUCFD,U.K/MU.K,0,4,1) 12, A
EUCFD - EFFECT OF UNEMPLOYMENT CONDITIONS ON
FRACTIONAL DECREASE (DIM)
TABHL -- TABLE LOOK-UP FUNCTION
TEUCFD - TABLE OF EFFECT OF UNEMPLOYMENT CONDITIONS
ON FRACTIONAL DECREASE
U -- UNEMPLOYED (PEOPLE)
MU -- MINIMUM UNEMPLOYED (PEOPLE)

FDMA.K(LG)=TABHL(TFDMA,GMA.K(LG),0,1,.25) 13, A
FDMA -- FRACTIONAL DECREASE FROM MONEY ADEQUACY
(PEOPLE/YEAR)
LG -- LEVEL OF GOVT
TABHL -- TABLE LOOK-UP FUNCTION
TFDMA -- TABLE OF FRACTIONAL DECREASE FROM MONEY
ADEQUACY
GMA -- GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

EAGE.K(LG)=TABHL(TEAGE,GE.K(LG)/RLGE.K(LG),.4,1.2, 14, A
.1)
EAGE -- EFFECT OF AVAILABILITY OF GOVT EMPLOYEES
(DIMENSIONLESS)
LG -- LEVEL OF GOVT
TABHL -- TABLE LOOK-UP FUNCTION
TEAGE -- TABLE OF EFFECT OF AVAILABILITY OF GOVT
EMPLOYEES
GE -- GOVERNMENT EMPLOYEES (PEOPLE)
RLGE -- REQUIRED LEVEL OF GOVT EMPLOYEES (PEOPLE)

$$RLGE.K(LG) = (DEGS.K(LG)/PGEPS.K) + (DGT.K(LG)/PGEPT.K) \quad 15, A$$

RLGE -- REQUIRED LEVEL OF GOVT EMPLOYEES (PEOPLE)
LG -- LEVEL OF GOVT
DEGS -- DEMAND FOR GOVT SERVICES (OUTPUT UNITS/
YEAR)
PGEPS -- PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
SERVICES (OUTPUT UNITS/PERSON/YEAR)
DGT -- DEMAND FOR GOVT TRANSFERS (OUTPUT UNITS/
YEAR)
PGEPT -- PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
TRANSFERS (OUTPUT UNITS/PERSON/YEAR)

GOVT OUTPUT

1. OUTPUT OF GOVT SERVICES

$$OGSP.K(LG) = OGS.K(LG)/POP.K \quad 16, A$$

OGSP -- OUTPUT OF GOVT SERVICES PER CAPITA (OUTPUT
UNITS/PERSON/YEAR)
LG -- LEVEL OF GOVT
OGS -- OUTPUT OF GOVT SERVICES (OUTPUT UNITS/YEAR)
POP -- POPULATION (PEOPLE)

$$OGS.K(LG) = GEPS.K(LG) * PGEPS.K \quad 17, A$$

OGS -- OUTPUT OF GOVT SERVICES (OUTPUT UNITS/YEAR)
LG -- LEVEL OF GOVT
GEPS -- GOVERNMENT EMPLOYEES PRODUCING SERVICES
(PEOPLE)
PGEPS -- PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
SERVICES (OUTPUT UNITS/PERSON/YEAR)

$$GEPS.K(LG) = GE.K(LG) * FGEASP.K(LG) \quad 18, A$$

GEPS -- GOVERNMENT EMPLOYEES PRODUCING SERVICES
(PEOPLE)
LG -- LEVEL OF GOVT
GE -- GOVERNMENT EMPLOYEES (PEOPLE)
FGEASP -- FRACTION OF GOVT EMPLOYEES ALLOCATED TO
SERVICE PRODUCTION (DIM)

$$FGEASP.K(LG) = ((SOGSP.K(LG)/PGEPS.K) / ((SOGSP.K(LG)/PGEPS.K) + (SOGTP.K(LG)/PGEPT.K))) \quad 19, A$$

FGEASP -- FRACTION OF GOVT EMPLOYEES ALLOCATED TO
SERVICE PRODUCTION (DIM)
LG -- LEVEL OF GOVT
SOGSP -- STANDARD OUTPUT OF GOVT SERVICES PER PERSON
(OUTPUT UNITS/PERSON/YEAR)
PGEPS -- PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
SERVICES (OUTPUT UNITS/PERSON/YEAR)
SOGTP -- STANDARD OUTPUT OF GOVT TRANSFERS PER
PERSON (OUTPUT UNITS/PERSON/YEAR)
PGEPT -- PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
TRANSFERS (OUTPUT UNITS/PERSON/YEAR)

$$\text{SOGSP.K(LG)} = \text{SOGSP.J(LG)} + (\text{DT}/\text{TESOGS.J(LG)}) \quad 20, \text{ L}$$
$$(\text{OGSP.J(LG)} - \text{SOGSP.J(LG)} - \text{ERSOGS.J(LG)})$$

SOGSP - STANDARD OUTPUT OF GOVT SERVICES PER PERSON
(OUTPUT UNITS/PERSON/YEAR)

LG - LEVEL OF GOVT

DT - SOLUTION INTERVAL (YEARS)

TESOGS - TIME TO ESTABLISH STANDARD OUTPUT OF GOVT
SERVICES (YEARS)

OGSP - OUTPUT OF GOVT SERVICES PER CAPITA (OUTPUT
UNITS/PERSON/YEAR)

ERSOGS - EXOGENOUS REDUCTION IN STANDARD OUTPUT OF
GOVT SERVICES PER CAPITA (OUTPUT UNITS/
PERSON/YEAR)

$$\text{TESOGS.K(LG)} = \text{TABHL}(\text{TTESGO}, \text{OGSP.K(LG)}/\text{SOGSP.K(LG)}) \quad 21, \text{ A}$$

, .95, 1, .05)

TESOGS - TIME TO ESTABLISH STANDARD OUTPUT OF GOVT
SERVICES (YEARS)

LG - LEVEL OF GOVT

TABHL - TABLE LOOK-UP FUNCTION

TTESGO - TABLE OF TIME TO ESTABLISH TRADITIONAL
STANDARD OF GOVT OUTPUT PER CAPITA

OGSP - OUTPUT OF GOVT SERVICES PER CAPITA (OUTPUT
UNITS/PERSON/YEAR)

SOGSP - STANDARD OUTPUT OF GOVT SERVICES PER PERSON
(OUTPUT UNITS/PERSON/YEAR)

$$\text{PGEPS.K} = \text{RFGEPS} * \text{ETPGES.K} \quad 22, \text{ A}$$

PGEPS - PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
SERVICES (OUTPUT UNITS/PERSON/YEAR)

RFGEPS - REFERENCE PRODUCTIVITY OF GOVT EMPLOYEES
PRODUCING SERVICES (OUTPUT UNITS/PERSON/
YEAR)

ETPGES - EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF
GOVT EMPLOYEES IN SERVICES (DIM)

$$\text{ETPGES.K} = \text{TABLE}(\text{TETPGS}, \text{T.K}/\text{RLT}, 0, 1.5, .25) \quad 23, \text{ A}$$

ETPGES - EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF
GOVT EMPLOYEES IN SERVICES (DIM)

TABLE - TABLE LOOK-UP FUNCTION

TETPGS - TABLE OF EFFECT OF TECHNOLOGY ON
PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
SERVICES

T - INDEX OF TECHNOLOGY (DIMENSIONLESS)

RLT - REFERENCE LEVEL OF TECHNOLOGY (DIM)

2. OUTPUT OF GOVT TRANSFERS

- OGTP.K(LG)=OGT.K(LG)/POP.K 24, A
OGTP - OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT
UNITS/PERSON/YEAR)
LG - LEVEL OF GOVT
OGT - OUTPUT OF GOVT TRANSFERS (OUTPUT UNITS/
YEAR)
POP - POPULATION (PEOPLE)
- OGT.K(LG)=GEPT.K(LG)*PGEPT.K 25, A
OGT - OUTPUT OF GOVT TRANSFERS (OUTPUT UNITS/
YEAR)
LG - LEVEL OF GOVT
GEPT - GOVT EMPLOYEES PRODUCING TRANSFERS (PEOPLE)
PGEPT - PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
TRANSFERS (OUTPUT UNITS/PERSON/YEAR)
- GEPT.K(LG)=GE.K(LG)*((1-FGEASP.K(LG))) 26, A
GEPT - GOVT EMPLOYEES PRODUCING TRANSFERS (PEOPLE)
LG - LEVEL OF GOVT
GE - GOVERNMENT EMPLOYEES (PEOPLE)
FGEASP - FRACTION OF GOVT EMPLOYEES ALLOCATED TO
SERVICE PRODUCTION (DIM)
- SOGTP.K(LG)=SOGTP.J(LG)+(DT/TESOGT.J(LG)) 27, L
(OGTP.J(LG)-SOGTP.J(LG)-ERSOGT.J(LG))
SOGTP - STANDARD OUTPUT OF GOVT TRANSFERS PER
PERSON (OUTPUT UNITS/PERSON/YEAR)
LG - LEVEL OF GOVT
DT - SOLUTION INTERVAL (YEARS)
TESOGT - TIME TO ESTABLISH STANDARD OUTPUT OF GOVT
TRANSFERS PER CAPITA (YEARS)
OGTP - OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT
UNITS/PERSON/YEAR)
ERSOGT - EXOGENOUS REDUCTION IN STANDARD OUTPUT OF
GOVT TRANSFERS PER CAPITA (OUTPUT UNITS/
PERSON/YEAR)
- TESOGT.K(LG)=TABHL(TTESGO, OGTP.K(LG)/SOGTP.K(LG)) 28, A
, .95, 1, .05)
TESOGT - TIME TO ESTABLISH STANDARD OUTPUT OF GOVT
TRANSFERS PER CAPITA (YEARS)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TTESGO - TABLE OF TIME TO ESTABLISH TRADITIONAL
STANDARD OF GOVT OUTPUT PER CAPITA
OGTP - OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT
UNITS/PERSON/YEAR)
SOGTP - STANDARD OUTPUT OF GOVT TRANSFERS PER
PERSON (OUTPUT UNITS/PERSON/YEAR)

$PGEPT.K = RPGEPT * ETPGET.K$ 29, A
PGEPT - PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
TRANSFERS (OUTPUT UNITS/PERSON/YEAR)
RPGEPT - REFERENCE PRODUCTIVITY OF GOVT EMPLOYEES
PRODUCING TRANSFERS (OUTPUT UNITS/PERSON/
YEAR)
ETPGET - EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF
GOVT EMPLOYEES IN TRANSFERS (DIM)

$ETPGET.K = TABLE(TETPGT, T.K/RLT, 0, 1.5, .25)$ 30, A
ETPGET - EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF
GOVT EMPLOYEES IN TRANSFERS (DIM)
TABLE - TABLE LOOK-UP FUNCTION
TETPGT - TABLE OF EFFECT OF TECHNOLOGY ON
PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
TRANSFERS
T - INDEX OF TECHNOLOGY (DIMENSIONLESS)
RLT - REFERENCE LEVEL OF TECHNOLOGY (DIM)

GOVERNMENT MONEY BALANCE

$GMB.K(LG) = GMB.J(LG) + (DT) (IMB.JK(LG) - DMB.JK(LG) -$ 31, L
 $ERGMB.J(LG))$
GMB - GOVT MONEY BALANCE (DOLLARS)
LG - LEVEL OF GOVT
DT - SOLUTION INTERVAL (YEARS)
IMB - INCREASE IN MONEY BALANCE (\$/YEAR)
DMB - DECREASE IN MONEY BALANCE (\$/YEAR)
ERGMB - EXOGENOUS REDUCTION IN GOVT MONEY BALANCE
(\$/YEAR)

$IMB.KL(LG) = TAXREV.K(LG) + SGS.JK(LG)$ 32, R
IMB - INCREASE IN MONEY BALANCE (\$/YEAR)
LG - LEVEL OF GOVT
TAXREV - TAX REVENUES (\$/YEAR)
SGS - SALE OF GOVT SECURITIES (\$/YEAR)

$DMB.KL(LG) = PFGP.K(LG) + TP.K(LG) + IGSO.K(LG) +$ 33, R
 $RGS.JK(LG)$
DMB - DECREASE IN MONEY BALANCE (\$/YEAR)
LG - LEVEL OF GOVT
PFGP - PAYMENTS TO FACTORS OF GOVT PRODUCTION (\$/
YEAR)
TP - TRANSFER PAYMENTS (\$/YEAR)
IGSO - INTEREST ON GOVT SECURITIES OUTSTANDING (\$/
YEAR)
RGS - RETIREMENT OF GOVT SECURITIES (\$/YEAR)

$PFGP.K(LG) = GE.K(LG) * FPGE.K(LG)$ 34, A
PFGP - PAYMENTS TO FACTORS OF GOVT PRODUCTION (\$/
YEAR)
LG - LEVEL OF GOVT
GE - GOVERNMENT EMPLOYEES (PEOPLE)
FPGE - FACTOR PAYMENTS PER GOVT EMPLOYEE (\$/
PERSON/YEAR)

$FPGE.K(LG) = RFPGE(LG) * EMAFPE.K(LG)$ 35, A
FPGE - FACTOR PAYMENTS PER GOVT EMPLOYEE (\$/
PERSON/YEAR)
LG - LEVEL OF GOVT
RFPGE - REFERENCE FACTOR PAYMENT PER GOVT EMPLOYEE
(\$/PERSON/YEAR)
EMAFPE - EFFECT OF MONEY ADEQUACY ON FACTOR PAYMENTS
PER EMPLOYEE (DIM)

$EMAFPE.K(LG) = TABLE(TEMAFP, GMA.K(LG), 0, 2, .25)$ 36, A
EMAFPE - EFFECT OF MONEY ADEQUACY ON FACTOR PAYMENTS
PER EMPLOYEE (DIM)
LG - LEVEL OF GOVT
TABLE - TABLE LOOK-UP FUNCTION
TEMAFP - TABLE OF EFFECT OF MONEY ADEQUACY ON FACTOR
PAYMENTS
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

$TP.K(LG) = POU.K(LG) + PU.K(LG)$ 37, A
TP - TRANSFER PAYMENTS (\$/YEAR)
LG - LEVEL OF GOVT
POU - PAYMENTS FOR OTHER THAN UNEMPLOYMENT (\$/
YEAR)
PU - PAYMENTS FOR UNEMPLOYMENT (\$/YEAR)

$POU.K(LG) = OGT.K(LG) * COU.K(LG)$ 38, A
POU - PAYMENTS FOR OTHER THAN UNEMPLOYMENT (\$/
YEAR)
LG - LEVEL OF GOVT
OGT - OUTPUT OF GOVT TRANSFERS (OUTPUT UNITS/
YEAR)
COU - COMPENSATION PER OUTPUT UNIT (\$/OUTPUT
UNIT)

$COU.K(LG) = BCOU.K(LG) * EMATPC.K(LG)$ 39, A
COU - COMPENSATION PER OUTPUT UNIT (\$/OUTPUT
UNIT)
LG - LEVEL OF GOVT
BCOU - BASE COMPENSATION PER OUTPUT UNIT (\$/OUTPUT
UNIT)
EMATPC - EFFECT OF MONEY ADEQUACY ON TRANSFER
PAYMENT COMPENSATION (DIM)

$BCOU.K(LG) = RCOU(LG) * APPGSP.K / RLPPP$ 40, A
BCOU - BASE COMPENSATION PER OUTPUT UNIT (\$/OUTPUT UNIT)
LG - LEVEL OF GOVT
RCOU - REFERENCE COMPENSATION PER OUTPUT UNIT (\$/OUTPUT UNIT)
APPGSP - AVERAGE PRIVATE PRODUCTION OF GOODS AND SERVICES PER CAPITA (\$/PERSON/YEAR)
RLPPP - REFERENCE LEVEL OF PRIVATE PRODUCTION PER CAPITA (\$/PERSON/YEAR)

$EMATPC.K(LG) = TABLE(TEMAC, GMA.K(LG), 0, 2, .25)$ 41, A
EMATPC - EFFECT OF MONEY ADEQUACY ON TRANSFER PAYMENT COMPENSATION (DIM)
LG - LEVEL OF GOVT
TABLE - TABLE LOOK-UP FUNCTION
TEMAC - TABLE OF EFFECT OF MONEY ADEQUACY ON COMPENSATION
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

$PU.K(LG) = EU.K(LG) * CU.K(LG)$ 42, A
PU - PAYMENTS FOR UNEMPLOYMENT (\$/YEAR)
LG - LEVEL OF GOVT
EU - ELIGIBLE UNEMPLOYED (PEOPLE)
CU - COMPENSATION PER UNEMPLOYED (\$/PERSON/YEAR)

$EU.K(LG) = U.K * FUELG.K(LG)$ 43, A
EU - ELIGIBLE UNEMPLOYED (PEOPLE)
LG - LEVEL OF GOVT
U - UNEMPLOYED (PEOPLE)
FUELG - FRACTION OF UNEMPLOYED ELIGIBLE BY LEVEL OF GOVT (DIM)

$FUELG.K(LG) = RFUELG(LG) * EMAPEU.K(LG)$ 44, A
FUELG - FRACTION OF UNEMPLOYED ELIGIBLE BY LEVEL OF GOVT (DIM)
LG - LEVEL OF GOVT
RFUELG - REFERENCE FRACTION OF UNEMPLOYED ELIGIBLE BY LEVEL OF GOVT (DIM)
EMAPEU - EFFECT OF MONEY ADEQUACY ON POPULATION OF ELIGIBLE UNEMPLOYED (DIM)

$EMAPEU.K(LG) = TABHL(TEMAEP, GMA.K(LG), 0, 2, .25)$ 45, A
EMAPEU - EFFECT OF MONEY ADEQUACY ON POPULATION OF ELIGIBLE UNEMPLOYED (DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TEMAEP - TABLE OF EFFECT OF MONEY ADEQUACY ON ELIGIBLE POPULATION
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

- $CU.K(LG) = BCU.K * EMATPC.K(LG)$ 46, A
CU - COMPENSATION PER UNEMPLOYED (\$/PERSON/YEAR)
LG - LEVEL OF GOVT
BCU - BASE COMPENSATION PER UNEMPLOYED (\$/PERSON/YEAR)
EMATPC - EFFECT OF MONEY ADEQUACY ON TRANSFER PAYMENT COMPENSATION (DIM)
- $BCU.K = APPGSP.K * UCFPP$ 47, A
BCU - BASE COMPENSATION PER UNEMPLOYED (\$/PERSON/YEAR)
APPGSP - AVERAGE PRIVATE PRODUCTION OF GOODS AND SERVICES PER CAPITA (\$/PERSON/YEAR)
UCFPP - UNEMPLOMENT COMPENSATION AS A FRACTION OF PRIVATE PRODUCTION (DIM)
- $GMA.K(LG) = GMB.K(LG) / (ADPAY.K(LG) * DMCOV)$ 48, A
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)
LG - LEVEL OF GOVT
GMB - GOVT MONEY BALANCE (DOLLARS)
ADPAY - AVERAGE DESIRED PAYMENTS (\$/YEAR)
DMCOV - DESIRED MONEY COVERAGE (YEARS)
- $ADPAY.K(LG) = ADPAY.J(LG) + (DT/TADP) (DPAY.J(LG) - ADPAY.J(LG) - ERADPY.J(LG))$ 49, L
ADPAY - AVERAGE DESIRED PAYMENTS (\$/YEAR)
LG - LEVEL OF GOVT
DT - SOLUTION INTERVAL (YEARS)
TADP - TIME TO AVERAGE DESIRED PAYMENTS (YEARS)
DPAY - DESIRED PAYMENTS (\$/YEAR)
ERADPY - EXOGENOUS REDUCTION IN AVERAGE DESIRED PAYMENTS (\$/YEAR)
- $DPAY.K(LG) = ADMB.K(LG) * EMADP.K(LG)$ 50, A
DPAY - DESIRED PAYMENTS (\$/YEAR)
LG - LEVEL OF GOVT
ADMB - AVERAGE DECREASE IN MONEY BALANCE (\$/YEAR)
EMADP - EFFECT OF MONEY ADEQUACY ON DESIRED PAYMENTS (DIM)

$$\text{ADMB.K(LG)} = \text{ADMB.J(LG)} + (\text{DT}/\text{TADMB}) (\text{DMB.JK(LG)} - \text{ADMB.J(LG)} - \text{ERDMB.J(LG)}) \quad 51, L$$

ADMB ↔ AVERAGE DECREASE IN MONEY BALANCE (\$/YEAR)
LG ↔ LEVEL OF GOVT
DT ↔ SOLUTION INTERVAL (YEARS)
TADMB ↔ TIME TO AVERAGE DECREASE IN MONEY BALANCE (YEARS)
DMB ↔ DECREASE IN MONEY BALANCE (\$/YEAR)
ERDMB ↔ EXOGENOUS REDUCTION IN DECREASE IN MONEY BALANCE (\$/YEAR)

$$\text{EMADP.K(LG)} = \text{TABHL}(\text{TEMADP}, \text{GMA.K(LG)}, 0, 1, .25) \quad 52, A$$

EMADP ↔ EFFECT OF MONEY ADEQUACY ON DESIRED PAYMENTS (DIM)
LG ↔ LEVEL OF GOVT
TABHL ↔ TABLE LOOK-UP FUNCTION
TEMADP ↔ TABLE OF EFFECT OF MONEY ADEQUACY ON DESIRED PAYMENTS
GMA ↔ GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

GOVERNMENT DEBT EQUATIONS

$$\text{OGSY.K(LG)} = \text{OGSY.J(LG)} + (\text{DT}) (\text{SGS.JK(LG)} - \text{RGS.JK(LG)} - \text{DGS.JK(LG)} - \text{EDGS.J(LG)}) \quad 53, L$$

OGSY ↔ OUTSTANDING GOVT SECURITIES (\$)
LG ↔ LEVEL OF GOVT
DT ↔ SOLUTION INTERVAL (YEARS)
SGS ↔ SALE OF GOVT SECURITIES (\$/YEAR)
RGS ↔ RETIREMENT OF GOVT SECURITIES (\$/YEAR)
DGS ↔ DEFAULT ON GOVT SECURITIES (\$/YEAR)
EDGS ↔ EXOGENOUS DECREASE IN GOVT SECURITIES (\$/YEAR)

$$\text{SGS.KL(LG)} = \text{DSGS.K(LG)} * \text{EMRDS.K(LG)} \quad 54, R$$

SGS ↔ SALE OF GOVT SECURITIES (\$/YEAR)
LG ↔ LEVEL OF GOVT
DSGS ↔ DESIRED SALE OF GOVT SECURITIES (\$/YEAR)
EMRDS ↔ EFFECT OF MARKET RESPONSE TO DESIRED SALE (DIM)

$$\text{DSGS.K(LG)} = \text{ARGS.K(LG)} * \text{EDSTRR.K(LG)} * \text{EMADS.K(LG)} \quad 55, A$$

DSGS ↔ DESIRED SALE OF GOVT SECURITIES (\$/YEAR)
LG ↔ LEVEL OF GOVT
ARGS ↔ AVERAGE RETIREMENT OF GOVT SECURITIES (\$/YEAR)
EDSTRR ↔ EFFECT OF DEBT SERVICE TAX REVENUE RATIO (DIM)
EMADS ↔ EFFECT OF MONEY ADEQUACY ON DESIRED SALE (DIM)

ARGS.K(LG)=ARGS.J(LG)+(DT/TARGS)(RGS.JK(LG)-
ARGS.J(LG)) 56, L

ARGS - AVERAGE RETIREMENT OF GOVT SECURITIES (\$/
YEAR)
LG - LEVEL OF GOVT
DT - SOLUTION INTERVAL (YEARS)
TARGS - TIME TO AVERAGE RETIREMENT OF GOVT
SECURITIES (YEARS)
RGS - RETIREMENT OF GOVT SECURITIES (\$/YEAR)

EDSTRR.K(LG)=TABHL(TESTR, DSTRR.K(LG)/DSTRRG(LG), 0, 57, A
2.5, .25)

EDSTRR - EFFECT OF DEBT SERVICE TAX REVENUE RATIO
(DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TESTR - TABLE OF EFFECT OF DEBT SERVICE TAX REVENUE
RATIO
DSTRR - DEBT SERVICE TAX REVENUE RATIO (DIM)
DSTRRG - DEBT SERVICE TAX REVENUE RATIO GOAL (DIM)

DSTRR.K(LG)=DS.K(LG)/TAXREV.K(LG) 58, A

DSTRR - DEBT SERVICE TAX REVENUE RATIO (DIM)
LG - LEVEL OF GOVT
DS - DEBT SERVICE (\$/YEAR)
TAXREV - TAX REVENUES (\$/YEAR)

DS.K(LG)=(IGSO.K(LG)+ARGS.K(LG)) 59, A

DS - DEBT SERVICE (\$/YEAR)
LG - LEVEL OF GOVT
IGSO - INTEREST ON GOVT SECURITIES OUTSTANDING (\$/
YEAR)
ARGS - AVERAGE RETIREMENT OF GOVT SECURITIES (\$/
YEAR)

EMADS.K(LG)=TABLE(TEMADS, GMA.K(LG), 0, 2, .25) 60, A

EMADS - EFFECT OF MONEY ADEQUACY ON DESIRED SALE
(DIM)
LG - LEVEL OF GOVT
TABLE - TABLE LOOK-UP FUNCTION
TEMADS - TABLE OF EFFECT OF MONEY ADEQUACY ON
DESIRED SALE
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

EMRDS.K(LG)=TABHL(TEMRDS, MR.K(LG), 0, 1, .2) 61, A

EMRDS - EFFECT OF MARKET RESPONSE TO DESIRED SALE
(DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TEMRDS - TABLE OF EFFECT OF MARKET RESPONSE ON
DESIRED SALE
MR - MARKET RESPONSE (DIM)

MR.K(LG)=(MRDF.K(LG)*MRFAPS.K*MRDTP.K(LG)*
MRSR.K(LG))+MRTNS.K(LG) 62, A

MR - MARKET RESPONSE (DIM)
LG - LEVEL OF GOVT
MRDF - MARKET RESPONSE TO DEFAULT FRACTION (DIM)
MRFAPS - MARKET RESPONSE TO FUNDS AVAILAIBLE TO
PURCHASE SECURITIES (DIM)
MRDTP - MARKET RESPONSE TO DEPARTURE FROM TARGET
DEBT POSITION (DIM)
MRSR - MARKET RESPONSE TO SERVICE RATIO (DIM)
MRTNS - MARKET RESPONSE TO THREAT TO NATIONAL
SECURITY (DIM)

MRDF.K(LG)=TABHL(TMRDF,DF.K(LG)/ADF(LG),1,3,.25) 63, A

MRDF - MARKET RESPONSE TO DEFAULT FRACTION (DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TMRDF - TABLE OF MARKET RESPONSE TO DEFAULT
FRACTION
DF - DEFAULT FRACTION (DIM)
ADF - ACCEPTABLE DEFAULT FRACTION (DIM)

MRFAPS.K=TABLE(TMRFAP,TASGS.K/FAPS.K,0,1,.2) 64, A

MRFAPS - MARKET RESPONSE TO FUNDS AVAILAIBLE TO
PURCHASE SECURITIES (DIM)
TABLE - TABLE LOOK-UP FUNCTION
TMRFAP - TABLE OF MARKET RESPONSE TO FUNDS AVAILAIBLE
FOR THE PURCHASE OF SECURITIES
TASGS - TOTAL AVERAGE SALE OF GOVT SECURITIES (\$/
YEAR)
FAPS - FUNDS AVAILAIBLE FOR THE PURCHASE OF
SECURITIES (\$/YEAR)

TASGS.K=SUM(ASGS.K) 65, A

TASGS - TOTAL AVERAGE SALE OF GOVT SECURITIES (\$/
YEAR)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
ASGS - AVERAGE SALE OF GOVT SECURITIES (\$/YEAR)

ASGS.K(LG)=ASGS.J(LG)+(DT/TAVSGS)(SGS.JK(LG)-
ASGS.J(LG)) 66, L

ASGS - AVERAGE SALE OF GOVT SECURITIES (\$/YEAR)
LG - LEVEL OF GOVT
DT - SOLUTION INTERVAL (YEARS)
TAVSGS - TIME TO AVERAGE SALE OF GOVT SECURITIES
(YEARS)
SGS - SALE OF GOVT SECURITIES (\$/YEAR)

MRDTP.K(LG)=TABHL(TMRDTP,DTDP.K(LG),1,3,.25) 67, A
MRDTP - MARKET RESPONSE TO DEPARTURE FROM TARGET
DEBT POSITION (DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TMRDTP - TABLE OF MARKET RESPONSE TO DEPARTURE FROM
TRADITIONAL DEBT POSITION
DTDP - DEPARTURE FROM TRADITIONAL DEBT POSITION
(DIM)

DTDP.K(LG)=DSTRR.K(LG)/DSTRRG(LG) 68, A
DTDP - DEPARTURE FROM TRADITIONAL DEBT POSITION
(DIM)
LG - LEVEL OF GOVT
DSTRR - DEBT SERVICE TAX REVENUE RATIO (DIM)
DSTRRG - DEBT SERVICE TAX REVENUE RATIO GOAL (DIM)

MRSR.K(LG)=TABHL(TMRSR,SR.K(LG),0,1,.25) 59, A
MRSR - MARKET RESPONSE TO SERVICE RATIO (DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TMRSR - TABLE OF MARKET RESPONSE TO SERVICE RATIO
SR - SERVICE RATIO (DIM)

MRTNS.K(LG)=TABHL(TMRTNS(*,LG),TNS.K,0,1,.25) 70, A
MRTNS - MARKET RESPONSE TO THREAT TO NATIONAL
SECURITY (DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TMRTNS - TABLE OF MARKET RESPONSE TO THREAT TO
NATIONAL SECURITY
TNS - INDEX OF THREAT TO NATIONAL SECURITY (DIM)

RGS.KL(LG)=OGSY.K(LG)/ATGS 71, R
RGS - RETIREMENT OF GOVT SECURITIES (\$/YEAR)
LG - LEVEL OF GOVT
OGSY - OUTSTANDING GOVT SECURITIES (\$)
ATGS - AVERAGE TERM OF GOVT SECURITIES (YEARS)

DGS.KL(LG)=OGSY.K(LG)*DF.K(LG) 72, R
DGS - DEFAULT ON GOVT SECURITIES (\$/YEAR)
LG - LEVEL OF GOVT
OGSY - OUTSTANDING GOVT SECURITIES (\$)
DF - DEFAULT FRACTION (DIM)

DF.K(LG)=RDF(LG)*EMADF.K(LG) 73, A
DF - DEFAULT FRACTION (DIM)
LG - LEVEL OF GOVT
RDF - REFERENCE DEFAULT FRACTION (DIM)
EMADF - EFFECT OF MONEY ADEQUACY ON DEFAULT
FRACTION (DIM)

EMADF.K(LG)=TABLE(TEMADF,GMA.K(LG),0,2,.25) 74, A
EMADF - EFFECT OF MONEY ADEQUACY ON DEFAULT
FRACTION (DIM)
LG - LEVEL OF GOVT
TABLE - TABLE LOOK-UP FUNCTION
TEMADF - TABLE OF EFFECT OF MONEY ADEQUACY ON
DEFAULT FRACTION
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

IGSO.K(LG)=OGSY.K(LG)*IRGS 75, A
IGSO - INTEREST ON GOVT SECURITIES OUTSTANDING (\$/
YEAR)
LG - LEVEL OF GOVT
OGSY - OUTSTANDING GOVT SECURITIES (\$)
IRGS - INTEREST RATE ON GOVT SECURITIES (1/YEAR)

TAX RATE SETTING

TR.K(TAX)=TR.J(TAX)+(DT)(CTR.JK(TAX)-ECTR.J(TAX)) 76, L
TR - TAX RATE (DIM)
TAX - TYPES OF TAX
DT - SOLUTION INTERVAL (YEARS)
CTR - CHANGE IN TAX RATE (1/YEAR)

CTR.KL(TAX)=TR.K(TAX)*FCTR.K(TAX) 77, R
CTR - CHANGE IN TAX RATE (1/YEAR)
TAX - TYPES OF TAX
TR - TAX RATE (DIM)
FCTR - FRACTIONAL CHANGE IN TAX RATE (1/YEAR)

FCTR.K(TAX)=FCTMA.K(TAX)+FCTPS.K(TAX)+FCTFA.K(TAX) 78, A
FCTR - FRACTIONAL CHANGE IN TAX RATE (1/YEAR)
TAX - TYPES OF TAX
FCTMA - FRACTIONAL CHANGE IN TAX FROM MONEY
ADEQUACY (1/YEAR)
FCTPS - FRACTIONAL CHANGE IN TAX FROM PUBLIC
SENTIMENT (1/YEAR)
FCTFA - FRACTIONAL CHANGE IN TAX FROM FISCAL ACTION
(1/YEAR)

FCTMA.K(TAX)=TABHL(TFCTMA(*,TAX),GMAFG.K(TAX),0,1, 79, A
.25)
FCTMA - FRACTIONAL CHANGE IN TAX FROM MONEY
ADEQUACY (1/YEAR)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
TFCTMA - TABLE OF FRACTIONAL CHANGE IN TAX FROM
MONEY ADEQUACY
GMAFG - GOVT MONEY ADEQUACY PERCEIVED BY GOVT (DIM)

$FCTPS.K(TAX) = (FCLT.K(TAX) + FCCTR.K(TAX) + FCPGMA.K(TAX)) * ETNSPS.K(TAX)$ 80, A

FCTPS - FRACTIONAL CHANGE IN TAX FROM PUBLIC SENTIMENT (1/YEAR)
TAX - TYPES OF TAX
FCLT - FRACTIONAL CHANGE FROM LEVEL OF TAX (1/YEAR)
FCCTR - FRACTIONAL CHANGE FROM CHANGE IN TAX RATE (1/YEAR)
FCPGMA - FRACTIONAL CHANGE FROM PERCEIVED GOVT MONEY ADEQUACY (1/YEAR)
ETNSPS - EFFECT OF THREAT TO NATIONAL SECURITY ON PUBLIC SENTIMENT (DIM)

$FCLT.K(TAX) = TABHL(TFCLT(*, TAX), PTR.K(TAX) / ATR.K(TAX), 1, 2, .2)$ 81, A

FCLT - FRACTIONAL CHANGE FROM LEVEL OF TAX (1/YEAR)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
TFCLT - TABLE OF FRACTIONAL CHANGE FROM LEVEL OF TAX
PTR - PERCEIVED TAX RATE (DIM)
ATR - ACCEPTABLE TAX RATE (DIM)

$PTR.K(TAX) = TR.K(TAX) * BPTR(TAX)$ 82, A

PTR - PERCEIVED TAX RATE (DIM)
TAX - TYPES OF TAX
TR - TAX RATE (DIM)
BPTR - BIAS IN PERCEIVING TAX RATE (DIM)

$ATR.K(TAX) = ATRURC(TAX) * ELOATR.K(TAX) * ECOATR.K(TAX) * ESRATR.K(TAX)$ 83, A

ATR - ACCEPTABLE TAX RATE (DIM)
TAX - TYPES OF TAX
ATRURC - ACCEPTABLE TAX RATE UNDER REFERENCE CONDITIONS (DIM)
ELOATR - EFFECT OF LEVEL OF OUTPUT ON ACCEPTABLE TAX RATE (DIM)
ECOATR - EFFECT OF CHANGE IN LEVEL OF OUTPUT ON ACCEPTABLE TAX RATE (DIM)
ESRATR - EFFECT OF SERVICE RATIO ON ACCEPTABLE TAX RATE (DIM)

$ELOATR.K(TAX) = TABHL(TELOAT(*, TAX), PPGSP.K/RLPPP, 0, 3, .25)$ 84, A

ELOATR - EFFECT OF LEVEL OF OUTPUT ON ACCEPTABLE TAX RATE (DIM)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
TELOAT - TABLE OF EFFECT OF LEVEL OF OUTPUT ON ACCEPTABLE TAX RATE
PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER CAPITA (\$/PERSON/YEAR)
RLPPP - REFERENCE LEVEL OF PRIVATE PRODUCTION PER CAPITA (\$/PERSON/YEAR)

$ECOATR.K(TAX) = TABHL(TECOAT(*, TAX), PPGSP.K/APPSP.K, 85, A$
 $.5, 1.2, .1)$

ECOATR - EFFECT OF CHANGE IN LEVEL OF OUTPUT ON
ACCEPTABLE TAX RATE (DIM)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
TECOAT - TABLE OF EFFECT OF CHANGE IN LEVEL OF
OUTPUT ON ACCEPTABLE TAX RATE
PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER
CAPITA (\$/PERSON/YEAR)
APPSP - AVERAGE PRIVATE PRODUCTION OF GOODS AND
SERVICES PER CAPITA (\$/PERSON/YEAR)

$ESRATR.K(TAX) = TABHL(ESRAT, SRT.K(TAX), 0, 1.8, .2) \quad 86, A$

ESRATR - EFFECT OF SERVICE RATIO ON ACCEPTABLE TAX
RATE (DIM)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
ESRAT - TABLE OF EFFECT OF SERVICE RATIO ON
ACCEPTABLE TAX RATE
SRT - SERVICE RATIO BY TAX (DIM)

$FCCTR.K(TAX) = TABHL(FCCTR, PCTR.K(TAX), 0, .5, .1) \quad 87, A$

FCCTR - FRACTIONAL CHANGE FROM CHANGE IN TAX RATE
(1/YEAR)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
FCCTR - TABLE OF FRACTIONAL CHANGE IN TAX RATE
PCTR - PERCEIVED CHANGE IN TAX RATE (1/YEAR)

$PCTR.K(TAX) = ((TR.K(TAX) - TTR.K(TAX)) / (TTR.K(TAX) *$
 $TETTR)) * BPTR(TAX) \quad 88, A$

PCTR - PERCEIVED CHANGE IN TAX RATE (1/YEAR)
TAX - TYPES OF TAX
TR - TAX RATE (DIM)
TTR - TRADITIONAL TAX RATE (DIM)
TETTR - TIME TO ESTABLISH TRADITIONAL TAX RATE
(YEARS)
BPTR - BIAS IN PERCEIVING TAX RATE (DIM)

$TTR.K(TAX) = TTR.J(TAX) + (DT/TETTR) (TR.J(TAX) -$
 $TTR.J(TAX) - ECTR.J(TAX)) \quad 89, L$

TTR - TRADITIONAL TAX RATE (DIM)
TAX - TYPES OF TAX
DT - SOLUTION INTERVAL (YEARS)
TETTR - TIME TO ESTABLISH TRADITIONAL TAX RATE
(YEARS)
TR - TAX RATE (DIM)

FCFGMA.K(TAX)=TABHL(TFCPGM(*,TAX),PGMA.K(TAX),1,3, 90, A
.25)

FCFGMA - FRACTIONAL CHANGE FROM PERCEIVED GOVT MONEY
ADEQUACY (1/YEAR)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
TFCPGM - TABLE OF FRACTIONAL CHANGE FROM PERCEIVED
GOVT MONEY ADEQUACY
PGMA - PERCEIVED GOVT MONEY ADEQUACY (DIM)

PGMA.K(TAX)=PGMA.J(TAX)+(DT/TFGMA)(GMAT.J(TAX)- 91, L
PGMA.J(TAX))

PGMA - PERCEIVED GOVT MONEY ADEQUACY (DIM)
TAX - TYPES OF TAX
DT - SOLUTION INTERVAL (YEARS)
TFGMA - TIME TO PERCEIVE GOVT MONEY ADEQUACY
(YEARS)
GMAT - GOVT MONEY ADEQUACY BY TAX (DIM)

GMAT.K(1)=GMA.K(1) 92, A

GMAT - GOVT MONEY ADEQUACY BY TAX (DIM)
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)

ETNSPS.K(TAX)=TABHL(TETNSS(*,TAX),TNS.K,0,1,.25) 93, A

ETNSPS - EFFECT OF THREAT TO NATIONAL SECURITY ON
PUBLIC SENTIMENT (DIM)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
TETNSS - TABLE OF EFFECT OF THREAT TO NATIONAL
SECURITY ON PUBLIC SENTIMENT
TNS - INDEX OF THREAT TO NATIONAL SECURITY (DIM)

FCTFA.K(TAX)=TABHL(TFCTFA(*,TAX),PPGSP.K/RLPPP,.6, 94, A
1,.05)

FCTFA - FRACTIONAL CHANGE IN TAX FROM FISCAL ACTION
(1/YEAR)
TAX - TYPES OF TAX
TABHL - TABLE LOOK-UP FUNCTION
TFCTFA - TABLE OF FRACTIONAL CHANGE IN TAX FROM
FISCAL ACTION
PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER
CAPITA (\$/PERSON/YEAR)
RLPPP - REFERENCE LEVEL OF PRIVATE PRODUCTION PER
CAPITA (\$/PERSON/YEAR)

TAXREV.K(1)=TRBT.K(1) 95, A

TAXREV - TAX REVENUES (\$/YEAR)
TRBT - TAX REVENUE BY TAX (\$/YEAR)

TRBT.K(TAX)=TR.K(TAX)*TB.K(TAX) 96, A

TRBT - TAX REVENUE BY TAX (\$/YEAR)
TAX - TYPES OF TAX
TR - TAX RATE (DIM)
TB - TAX BASE (\$/YEAR)

TB.K(TAX)=GNP.K*TBF(TAX) 97, A
TB - TAX BASE (\$/YEAR)
TAX - TYPES OF TAX
GNP - GROSS NATIONAL PRODUCT (\$/YEAR)
TBF - TAX BASE FRACTION (DIM)

* * * * *
* REST-OF-THE-SOCIOECONOMY SECTOR *
* * * * *

POPULATION

POP.K=RPOP 99, A
RPOP=200E6 99.1, C
POP - POPULATION (PEOPLE)
RPOP - REFERENCE POPULATION (PEOPLE)

FE.K=CLIP(AFE,RFE,TIME.K,TIE4) 100, A
AFE=.4 100.1, C
RFE=.2 100.2, C
FE - FRACTION OF ELDERLY (DIM)
CLIP - DYNAMO FUNCTION USED FOR ALTERING
PARAMETERS FOR TESTING PURPOSES
AFE - ALTERED FRACTION OF ELDERLY (DIM)
RFE - REFERENCE FRACTION OF ELDERLY (DIM)
TIME - DYNAMO FUNCTION FOR RECORDING ELAPSED
SIMULATION TIME (YEARS)
TIE4 - TIME TO IMPLEMENT EXPERIMENT 4 (YEAR)

FC.K=CLIP(AFC,RFC,TIME.K,TIE5) 101, A
AFC=.2 101.1, C
RFC=.3 101.2, C
FC - FRACTION OF CHILDREN (DIM)
CLIP - DYNAMO FUNCTION USED FOR ALTERING
PARAMETERS FOR TESTING PURPOSES
AFC - ALTERED FRACTION OF CHILDREN (DIM)
RFC - REFERENCE FRACTION OF CHILDREN (DIM)
TIME - DYNAMO FUNCTION FOR RECORDING ELAPSED
SIMULATION TIME (YEARS)
TIE5 - TIME TO IMPLEMENT EXPERIMENT 5 (YEAR)

FCRA.K=RFCRA 102, A
RFCRA=.5 102.1, C
FCRA - FRACTION OF CHILD-REARING ADULTS (DIM)
RFCRA - REFERENCE FRACTION OF CHILD-REARING ADULTS
(DIM)

PCRA.K=POP.K*FCRA.K 103, A
PCRA - POPULATION OF CHILD-REARING ADULTS (PEOPLE)
POP - POPULATION (PEOPLE)
FCRA - FRACTION OF CHILD-REARING ADULTS (DIM)

LABOR MARKET

$LF.K=PCRA.K*LFF.K$	104, A
LF	↖ LABOR FORCE (PEOPLE)
PCRA	↖ POPULATION OF CHILD-REARING ADULTS (PEOPLE)
LFF	↖ LABOR FORCE FRACTION (DIM)
$LFF.K=RLFF$	105, A
$RLFF=.4$	105.1, C
LFF	↖ LABOR FORCE FRACTION (DIM)
RLFF	↖ REFERENCE LABOR FORCE FRACTION (DIM)
$U.K=U.J+(DT)(DPSE.JK+DGE.JK(1)-IPSE.JK-IGE.JK(1))$	106, L
$U=LF-(PSE+SUM(GE))$	106.1, N
U	↖ UNEMPLOYED (PEOPLE)
DT	↖ SOLUTION INTERVAL (YEARS)
DPSE	↖ DECREASE IN PRIVATE SECTOR EMPLOYEES (PEOPLE/YEAR)
DGE	↖ DECREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)
IPSE	↖ INCREASE IN PRIVATE SECTOR EMPLOYEES (PEOPLE/YEAR)
IGE	↖ INCREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)
LF	↖ LABOR FORCE (PEOPLE)
PSE	↖ PRIVATE SECTOR EMPLOYEES (PEOPLE)
SUM	↖ DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF AN ARRAY
GE	↖ GOVERNMENT EMPLOYEES (PEOPLE)
$MU.K=LF.K*MUF$	107, A
$MUF=.02$	107.1, C
MU	↖ MINIMUM UNEMPLOYED (PEOPLE)
LF	↖ LABOR FORCE (PEOPLE)
MUF	↖ MINIMUM UNEMPLOYMENT FRACTION (DIM)

PRIVATE SECTOR EMPLOYMENT

$PSE.K=PSE.J+(DT)(IPSE.JK-DPSE.JK)$	108, L
$PSE=LF*PSEF$	108.1, N
$PSEF=.8$	108.2, C
PSE	↖ PRIVATE SECTOR EMPLOYEES (PEOPLE)
DT	↖ SOLUTION INTERVAL (YEARS)
IPSE	↖ INCREASE IN PRIVATE SECTOR EMPLOYEES (PEOPLE/YEAR)
DPSE	↖ DECREASE IN PRIVATE SECTOR EMPLOYEES (PEOPLE/YEAR)
LF	↖ LABOR FORCE (PEOPLE)
PSEF	↖ PRIVATE SECTOR EMPLOYMENT FRACTION (DIM)

IPSE.KL=(PSE.K*FIPSE.K)+SUM(ETEGP.K) 109, R
IPSE - INCREASE IN PRIVATE SECTOR EMPLOYEES
(PEOPLE/YEAR)
PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)
FIPSE - FRACTIONAL INCREASE IN PRIVATE SECTOR
EMPLOYEES (1/YEAR)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
ETEGP - EXOGENOUS TRANSFER OF EMPLOYEES FROM GOVT
TO PRIVATE SECTOR (PEOPLE/YEAR)

FIPSE.K=FIED.K+FIAE.K 110, A
FIPSE - FRACTIONAL INCREASE IN PRIVATE SECTOR
EMPLOYEES (1/YEAR)
FIED - FRACTIONAL INCREASE FROM EMPLOYMENT
DISCREPANCY (1/YEAR)
FIAE - FRACTIONAL INCREASE FROM AVAILABLE
EMPLOYEES (1/YEAR)

FIED.K=TABHL(TFIED,DESPSE.K/PSE.K,1,5,1) 111, A
TFIED=0/.25/.5/.75/1 111.1, T
FIED - FRACTIONAL INCREASE FROM EMPLOYMENT
DISCREPANCY (1/YEAR)
TABHL - TABLE LOOK-UP FUNCTION
TFIED - TABLE OF FRACTIONAL INCREASE FROM
EMPLOYMENT DISCREPANCY
DESPSE - DESIRED PRIVATE SECTOR EMPLOYEES (PEOPLE)
PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)

FIAE.K=FIED.K*EUCFI.K 112, A
FIAE - FRACTIONAL INCREASE FROM AVAILABLE
EMPLOYEES (1/YEAR)
FIED - FRACTIONAL INCREASE FROM EMPLOYMENT
DISCREPANCY (1/YEAR)
EUCFI - EFFECT OF UNEMPLOYMENT CONDITIONS ON
FRACTIONAL INCREASE (DIM)

EUCFI.K=TABHL(TEUCFI,U.K/MU.K,0,7,.5) 113, A
TEUCFI=-1/-1/-0.9/-0.5/-0.2/0/.1/.2/.3/.4/.5/.55/.58/
.59/.6 113.1, T
EUCFI - EFFECT OF UNEMPLOYMENT CONDITIONS ON
FRACTIONAL INCREASE (DIM)
TABHL - TABLE LOOK-UP FUNCTION
TEUCFI - TABLE OF EFFECT OF UNEMPLOYMENT CONDITIONS
ON FRACTIONAL INCREASE
U - UNEMPLOYED (PEOPLE)
MU - MINIMUM UNEMPLOYED (PEOPLE)

DESPSE.K=DPO.K/PPE.K 114, A
DESPSE - DESIRED PRIVATE SECTOR EMPLOYEES (PEOPLE)
DPO - DEMAND FOR PRIVATE OUTPUT (\$/YEAR)
PPE - PRODUCTIVITY OF PRIVATE EMPLOYEES (\$/
PERSON/YEAR)

DPSE.KL=(PSE.K*FDPSE.K)+SUM(ETEPG.K)+EDPSE.K 115, R
DPSE - DECREASE IN PRIVATE SECTOR EMPLOYEES
(PEOPLE/YEAR)
PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)
FDPSE - FRACTIONAL DECREASE IN PRIVATE SECTOR
EMPLOYEES (1/YEAR)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
ETEPG - EXOGENOUS TRANSFER OF EMPLOYEES FROM
PRIVATE TO GOVT SECTOR (PEOPLE/YEAR)
EDPSE - EXOGENOUS DECREASE IN PRIVATE SECTOR
EMPLOYEES (PEOPLE/YR)

FDPSE.K=(FDGD.K*EAPE.K) 116, A
FDPSE - FRACTIONAL DECREASE IN PRIVATE SECTOR
EMPLOYEES (1/YEAR)
FDGD - FRACTIONAL DECREASE FROM GOVT DEMAND (1/
YEAR)
EAPE - EFFECT OF AVAILABILITY OF PRIVATE EMPLOYEES
(DIM)

FDGD.K=FDGMA.K*EUCFD.K 117, A
FDGD - FRACTIONAL DECREASE FROM GOVT DEMAND (1/
YEAR)
FDGMA - FRACTIONAL DECREASE FROM GOVT MONEY
ADEQUACY (1/YEAR)
EUCFD - EFFECT OF UNEMPLOYMENT CONDITIONS ON
FRACTIONAL DECREASE (DIM)

FDGMA.K=TABHL(TFDGMA,CGMA.K,.75,2.5,.25) 118, A
TFDGMA=0/.015/.02/.025/.03/.035/.038/.04 118.1, T
FDGMA - FRACTIONAL DECREASE FROM GOVT MONEY
ADEQUACY (1/YEAR)
TABHL - TABLE LOOK-UP FUNCTION
TFDGMA - TABLE OF FRACTIONAL DECREASE FROM GOVT
MONEY ADEQUACY
CGMA - COMBINED GOVT MONEY ADEQUACY (DIM)

CGMA.K=SUM(GMA.K)/TOTLG 119, A
TOTLG=1 119.1, C
CGMA - COMBINED GOVT MONEY ADEQUACY (DIM)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)
TOTLG - TOTAL LEVELS OF GOVT (DIM)

EAPE.K=TABHL(TEAPE, PSE.K/DESPSE.K, 0, 3, .25) 120, A
TEAPE=0/.1/.4/.75/1/1.25/1.5/2/2.5/3/3.5/4/4.5 120.1, T

EAPE - EFFECT OF AVAILABILITY OF PRIVATE EMPLOYEES
(DIM)

TABHL - TABLE LOOK-UP FUNCTION

TEAPE - TABLE OF EFFECT OF AVAILABILITY OF PRIVATE
SECTOR EMPLOYEES

PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)

DESPSE - DESIRED PRIVATE SECTOR EMPLOYEES (PEOPLE)

DEMAND DETERMINANTS

1. GOVERNMENT OUTPUT

A. SERVICES

DEGS.K(LG)=POP.K*PCDGS.K(LG) 121, A

DEGS - DEMAND FOR GOVT SERVICES (OUTPUT UNITS/
YEAR)

LG - LEVEL OF GOVT

POP - POPULATION (PEOPLE)

PCDGS - PER CAPITA DEMAND FOR GOVT SERVICES (OUTPUT
UNITS/PERSON/YEAR)

PCDGS.K(LG)=RLGOSP(LG)*ELOGSD.K(LG)*EPODGO.K*
EPCDGS.K*EFEDGS.K 122, A

RLGOSP(1)=OGS(1)/RPOP 122.1, N

PCDGS - PER CAPITA DEMAND FOR GOVT SERVICES (OUTPUT
UNITS/PERSON/YEAR)

LG - LEVEL OF GOVT

RLGOSP - REFERENCE LEVEL OF GOVT OUTPUT OF SERVICES
PER CAPITA (OUTPUT UNITS/PERSON/YEAR)

ELOGSD - EFFECT OF LEVEL OF OUTPUT OF GOVT SERVICES
ON DEMAND (DIM)

EPODGO - EFFECT OF PRIVATE OUTPUT ON DEMAND FOR GOVT
OUTPUT (DIM)

EPCDGS - EFFECT OF FRACTION OF CHILDREN ON DEMAND
FOR GOVT SERVICES (DIM)

EFEDGS - EFFECT OF FRACTION OF ELDERLY ON DEMAND FOR
GOVT SERVICES (DIM)

OGS - OUTPUT OF GOVT SERVICES (OUTPUT UNITS/YEAR)

RPOP - REFERENCE POPULATION (PEOPLE)

ELOGSD.K(LG)=TABHL(TEODGO, SOGSP.K(LG)/RLGOSP(LG), 0, 123, A
5, .5)

TEODGO=.4/.6/1/1.5/2/2.5/3/3.5/4/4.5/5 123.1, T

ELOGSD - EFFECT OF LEVEL OF OUTPUT OF GOVT SERVICES
ON DEMAND (DIM)

LG - LEVEL OF GOVT

TABHL - TABLE LOOK-UP FUNCTION

TEODGO - TABLE OF EFFECT OF OUTPUT ON DEMAND FOR
GOVT OUTPUT

SOGSP - STANDARD OUTPUT OF GOVT SERVICES PER PERSON
(OUTPUT UNITS/PERSON/YEAR)

RLGOSP - REFERENCE LEVEL OF GOVT OUTPUT OF SERVICES
PER CAPITA (OUTPUT UNITS/PERSON/YEAR)

EPODGO.K=TABHL(TEPODGO, PPGSP.K/RLPPP, 0, 2, .25) 124, A

TEPODGO=0/0/.25/.6/1/1.05/1.1/1.15/1.2 124.1, T

EPODGO - EFFECT OF PRIVATE OUTPUT ON DEMAND FOR GOVT
OUTPUT (DIM)

TABHL - TABLE LOOK-UP FUNCTION

TEPODGO - TABLE OF EFFECT OF PRIVATE OUTPUT ON DEMAND
FOR GOVT OUTPUT

PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER
CAPITA (\$/PERSON/YEAR)

RLPPP - REFERENCE LEVEL OF PRIVATE PRODUCTION PER
CAPITA (\$/PERSON/YEAR)

EFCDGS.K=TABLE(TEFCD, FC.K/RFC, 0, 2, .25) 125, A

TEFCD=0/.25/.5/.75/1/1.25/1.5/1.75/2 125.1, T

EFCDGS - EFFECT OF FRACTION OF CHILDREN ON DEMAND
FOR GOVT SERVICES (DIM)

TABLE - TABLE LOOK-UP FUNCTION

TEFCD - TABLE OF EFFECT OF FRACTION OF CHILDREN ON
DEMAND FOR GOVT SERVICES

FC - FRACTION OF CHILDREN (DIM)

RFC - REFERENCE FRACTION OF CHILDREN (DIM)

EFEDGS.K=TABLE(TEFED, FE.K/RFE, 0, 2, .25) 126, A

TEFED=0/.25/.5/.75/1/1.25/1.5/1.75/2 126.1, T

EFEDGS - EFFECT OF FRACTION OF ELDERLY ON DEMAND FOR
GOVT SERVICES (DIM)

TABLE - TABLE LOOK-UP FUNCTION

TEFED - TABLE OF FRACTION OF ELDERLY ON DEMAND FOR
GOVT SERVICES

FE - FRACTION OF ELDERLY (DIM)

RFE - REFERENCE FRACTION OF ELDERLY (DIM)

B. TRANSFERS

- DGT.K(LG)=POP.K*PCDGT.K(LG) 127, A
DGT - DEMAND FOR GOVT TRANSFERS (OUTPUT UNITS/
YEAR)
LG - LEVEL OF GOVT
POP - POPULATION (PEOPLE)
PCDGT - PER CAPITA DEMAND FOR GOVT TRANSFERS
(OUTPUT UNITS/PERSON/YEAR)
- PCDGT.K(LG)=RLGOTP(LG)*ELOGTD.K(LG)*EPODGO.K* 128, A
EFEDGT.K*EURDGT.K(LG)
RLGOTP(1)=OGT(1)/RPOP 128.2, N
PCDGT - PER CAPITA DEMAND FOR GOVT TRANSFERS
(OUTPUT UNITS/PERSON/YEAR)
LG - LEVEL OF GOVT
ELOGTD - EFFECT OF LEVEL OF OUTPUT OF GOVT TRANSFERS
ON DEMAND (DIM)
EPODGO - EFFECT OF PRIVATE OUTPUT ON DEMAND FOR GOVT
OUTPUT (DIM)
EFEDGT - EFFECT OF FRACTION OF ELDERLY ON DEMAND FOR
GOVT TRANSFERS (DIM)
EURDGT - EFFECT OF UNEMPLOYMENT RATE ON DEMAND FOR
GOVT TRANSFERS (DIM)
OGT - OUTPUT OF GOVT TRANSFERS (OUTPUT UNITS/
YEAR)
RPOP - REFERENCE POPULATION (PEOPLE)
- ELOGTD.K(LG)=TABHL(TEODGO, SOGTP.K(LG)/RLGOTP(LG), 0, 129, A
5, .5)
ELOGTD - EFFECT OF LEVEL OF OUTPUT OF GOVT TRANSFERS
ON DEMAND (DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TEODGO - TABLE OF EFFECT OF OUTPUT ON DEMAND FOR
GOVT OUTPUT
SOGTP - STANDARD OUTPUT OF GOVT TRANSFERS PER
PERSON (OUTPUT UNITS/PERSON/YEAR)
- EFEDGT.K=TABLE(TEFEDT, FE.K/RFE, 0, 2, .25) 130, A
TEFEDT=0/.25/.5/.75/1/1.25/1.5/1.75/2 130.1, T
EFEDGT - EFFECT OF FRACTION OF ELDERLY ON DEMAND FOR
GOVT TRANSFERS (DIM)
TABLE - TABLE LOOK-UP FUNCTION
TEFEDT - TABLE OF EFFECT OF FRACTION OF ELDERLY ON
DEMAND FOR TRANSFERS
FE - FRACTION OF ELDERLY (DIM)
RFE - REFERENCE FRACTION OF ELDERLY (DIM)

EURDGT.K(LG)=TABHL(TEURDT(*,LG),U.K/MU.K,1,6,.5) 131, A
TEURDT(*,1)=.4/.6/.8/1/1.2/1.4/1.6/1.8/2/2.2/2.4 131.1, T
EURDGT - EFFECT OF UNEMPLOYMENT RATE ON DEMAND FOR
GOVT TRANSFERS (DIM)
LG - LEVEL OF GOVT
TABHL - TABLE LOOK-UP FUNCTION
TEURDT - TABLE OF EFFECT OF UNEMPLOYMENT ON DEMAND
FOR GOVT TRANSFERS
U - UNEMPLOYED (PEOPLE)
MU - MINIMUM UNEMPLOYED (PEOPLE)

2. PRIVATE OUTPUT

DPO.K=POP.K*PCDPO.K 132, A
DPO - DEMAND FOR PRIVATE OUTPUT (\$/YEAR)
POP - POPULATION (PEOPLE)
PCDPO - PER CAPITA DEMAND FOR PRIVATE OUTPUT (\$/
PERSON/YEAR)

PCDPO.K=DPCDPO.K*EPCID.K 133, A
PCDPO - PER CAPITA DEMAND FOR PRIVATE OUTPUT (\$/
PERSON/YEAR)
DPCDPO - DESIRED PER CAPITA DEMAND FOR PRIVATE
OUTPUT (\$/PERSON/YEAR)
EPCID - EFFECT OF PER CAPITA INCOME ON DEMAND (DIM)

DPCDPO.K=RLPPP*EOD.K 134, A
RLPPP=RPPGS/RPOP 134.1, N
DPCDPO - DESIRED PER CAPITA DEMAND FOR PRIVATE
OUTPUT (\$/PERSON/YEAR)
RLPPP - REFERENCE LEVEL OF PRIVATE PRODUCTION PER
CAPITA (\$/PERSON/YEAR)
EOD - EFFECT OF OUTPUT ON DEMAND (DIM)
RPPGS - REFERENCE PRIVATE PRODUCTION OF GOODS &
SERVICES (\$/YEAR)
RPOP - REFERENCE POPULATION (PEOPLE)

EOD.K=TABHL(TEOD,PPGSP.K/RLPPP,1,5,1) 135, A
TEOD=1/2/3/4/5 135.1, T
EOD - EFFECT OF OUTPUT ON DEMAND (DIM)
TABHL - TABLE LOOK-UP FUNCTION
TEOD - TABLE OF EFFECT OF OUTPUT ON DEMAND
PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER
CAPITA (\$/PERSON/YEAR)
RLPPP - REFERENCE LEVEL OF PRIVATE PRODUCTION PER
CAPITA (\$/PERSON/YEAR)

EPCID.K=TABHL(TEPCID,PCDI.K/DPCDPO.K,0,1.5,.1) 136, A
TEPCID=.5/.52/.54/.56/.6/.65/.7/.75/.85/.95/1/1.1/ 136.1, T
1.2/1.3/1.4/1.5

EPCID = EFFECT OF PER CAPITA INCOME ON DEMAND (DIM)

TABHL = TABLE LOOK-UP FUNCTION

TEPCID = TABLE OF EFFECT OF PER CAPITA INCOME ON DEMAND

PCDI = PER CAPITA DISPOSABLE INCOME (\$/PERSON/YEAR)

DPCDPO = DESIRED PER CAPITA DEMAND FOR PRIVATE OUTPUT (\$/PERSON/YEAR)

PCDI.K=DI.K/POP.K 137, A

PCDI = PER CAPITA DISPOSABLE INCOME (\$/PERSON/YEAR)

DI = DISPOSABLE INCOME (\$/YEAR)

POP = POPULATION (PEOPLE)

DI.K=(PPGS.K+GPGS.K+SUM(TP.K)-SUM(TAXREV.K)) 138, A

DI = DISPOSABLE INCOME (\$/YEAR)

PPGS = PRIVATE PRODUCTION OF GOODS & SERVICES (\$/YEAR)

GPGS = GOVT PRODUCTION OF GOODS & SERVICES (\$/YEAR)

SUM = DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF AN ARRAY

TP = TRANSFER PAYMENTS (\$/YEAR)

TAXREV = TAX REVENUES (\$/YEAR)

PRIVATE PRODUCTION AND GNP

GNP.K=PPGS.K+GPGS.K 139, A

GNP=RTO 139.1, N

RTO=1E12 139.2, C

GNP = GROSS NATIONAL PRODUCT (\$/YEAR)

PPGS = PRIVATE PRODUCTION OF GOODS & SERVICES (\$/YEAR)

GPGS = GOVT PRODUCTION OF GOODS & SERVICES (\$/YEAR)

RTO = REFERENCE TOTAL OUTPUT (\$/YEAR)

AGNP.K=AGNP.J+(DT/TAGNP)(GNP.J-AGNP.J) 140, L

AGNP=GNP 140.1, N

TAGNP=1 140.2, C

AGNP = AVERAGE GROSS NATIONAL PRODUCT (\$/YEAR)

DT = SOLUTION INTERVAL (YEARS)

TAGNP = TIME TO AVERAGE GNP (YEARS)

GNP = GROSS NATIONAL PRODUCT (\$/YEAR)

PPGS.K=PSE.K*PPE.K 141, A
PPGS=RTO*POFRTO 141.1, N
RPPGS=PPGS 141.2, N
POFRTO=.7 141.3, C
PPGS - PRIVATE PRODUCTION OF GOODS & SERVICES (\$/
YEAR)
PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)
PPE - PRODUCTIVITY OF PRIVATE EMPLOYEES (\$/
PERSON/YEAR)
RTO - REFERENCE TOTAL OUTPUT (\$/YEAR)
POFRTO - PRIVATE OUTPUT AS A FRACTION OF REFERENCE
TOTAL OUTPUT (DIM)
RPPGS - REFERENCE PRIVATE PRODUCTION OF GOODS &
SERVICES (\$/YEAR)

PPGSP.K=PPGS.K/POP.K 142, A
PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER
CAPITA (\$/PERSON/YEAR)
PPGS - PRIVATE PRODUCTION OF GOODS & SERVICES (\$/
YEAR)
POP - POPULATION (PEOPLE)

APPGSP.K=SMOOTH(PPGSP.K, TAPP) 143, A
APPGSP=PPGS/RPOP 143.1, N
TAPP=1 143.2, C
APPGSP - AVERAGE PRIVATE PRODUCTION OF GOODS AND
SERVICES PER CAPITA (\$/PERSON/YEAR)
SMOOTH - DYNAMO FUNCTION FOR CALCULATING FIRST-ORDER
EXPONENTIAL AVERAGE
PPGSP - PRIVATE PRODUCTION OF GOODS & SERVICES PER
CAPITA (\$/PERSON/YEAR)
TAPP - TIME TO AVERAGE PRIVATE PRODUCTION (YEARS)
PPGS - PRIVATE PRODUCTION OF GOODS & SERVICES (\$/
YEAR)
RPOP - REFERENCE POPULATION (PEOPLE)

GPGS.K=SUM(PFGP.K) 144, A
GPGS - GOVT PRODUCTION OF GOODS & SERVICES (\$/
YEAR)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
PFGP - PAYMENTS TO FACTORS OF GOVT PRODUCTION (\$/
YEAR)

PRODUCTIVITY OF PRIVATE EMPLOYEES

$PPE.K = RPPE * EGRP.K * ETP.K * EWP.K$ 145, A
 $RPPE = (PPGS/PSE) * (1/EGRP)$ 145.1, N
 PPE ↖ PRODUCTIVITY OF PRIVATE EMPLOYEES (\$/
 PERSON/YEAR)
 RPPE ↖ REFERENCE PRODUCTIVITY OF PRIVATE EMPLOYEES
 (\$/PERSON/YEAR)
 EGRP ↖ EFFECT OF GOVT REGULATION ON PRODUCTIVITY
 (DIM)
 ETP ↖ EFFECT OF TECHNOLOGY ON PRODUCTIVITY (DIM)
 EWP ↖ EFFECT OF WAR ON PRODUCTIVITY (DIM)
 PPGS ↖ PRIVATE PRODUCTION OF GOODS & SERVICES (\$/
 YEAR)
 PSE ↖ PRIVATE SECTOR EMPLOYEES (PEOPLE)

1. EFFECT OF GOVT REGULATION

$EGRP.K = TABLE(TEGRP, (EGE.K/LF.K), 0, 1, .1)$ 146, A
 $TEGRP = 1/.98/.95/.92/.85/.75/.6/.45/.2/.05/0$ 146.1, T
 EGRP ↖ EFFECT OF GOVT REGULATION ON PRODUCTIVITY
 (DIM)
 TABLE ↖ TABLE LOOK-UP FUNCTION
 TEGRP ↖ TABLE OF EFFECT OF GOVT REGULATION ON
 PRODUCTIVITY
 EGE ↖ EFFECTIVE GOVT EMPLOYEES (PEOPLE)
 LF ↖ LABOR FORCE (PEOPLE)

$EGE.K = EGE.J + (DT/TGEO) (TGE.J - EGE.J)$ 147, L
 $EGE = SUM(GE)$ 147.1, N
 $TGEO = 5$ 147.2, C
 EGE ↖ EFFECTIVE GOVT EMPLOYEES (PEOPLE)
 DT ↖ SOLUTION INTERVAL (YEARS)
 TGEO ↖ TIME FOR GOVT EMPLOYEES TO ORGANIZE
 (YEARS)
 TGE ↖ TOTAL GOVT EMPLOYEES (PEOPLE)
 SUM ↖ DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
 AN ARRAY
 GE ↖ GOVERNMENT EMPLOYEES (PEOPLE)

$TGE.K = SUM(GE.K)$ 148, A
 TGE ↖ TOTAL GOVT EMPLOYEES (PEOPLE)
 SUM ↖ DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
 AN ARRAY
 GE ↖ GOVERNMENT EMPLOYEES (PEOPLE)

2. EFFECT OF TECHNOLOGY

ETP.K=TABLE(TETP,T.K/RLT,0,1.5,.25) 149, A
TETP=.1/.25/.5/.75/1/1.25/1.5 149.1, T
ETP - EFFECT OF TECHNOLOGY ON PRODUCTIVITY (DIM)
TABLE - TABLE LOOK-UP FUNCTION -
TETP - TABLE OF EFFECT OF TECHNOLOGY ON
 PRODUCTIVITY
T - INDEX OF TECHNOLOGY (DIMENSIONLESS)
RLT - REFERENCE LEVEL OF TECHNOLOGY (DIM)

T.K=CLIP(ALT,RLT,TIME.K,TIE6) 150, A
ALT=RLT*TAF 150.1, N
TAF=1.1 150.2, C
RLT=1 150.3, C
T - INDEX OF TECHNOLOGY (DIMENSIONLESS)
CLIP - DYNAMO FUNCTION USED FOR ALTERING
 PARAMETERS FOR TESTING PURPOSES
ALT - ALTERED LEVEL OF TECHNOLOGY (DIM)
RLT - REFERENCE LEVEL OF TECHNOLOGY (DIM)
TIME - DYNAMO FUNCTION FOR RECORDING ELAPSED
 SIMULATION TIME (YEARS)
TIE6 - TIME TO IMPLEMENT EXPERIMENT 6 (YEAR)
TAF - TECHNOLOGY ALTERATION FRACTION (DIM)

* PARAMETERS FOR GOVERNMENT SECTOR *

EMPLOYMENT

GE(1)=LF*GEF*IEPLGF(1)	151.3, N
GEF=.15	151.4, C
IEPLGF(1)=1	151.5, C
NFIGE=.05	151.6, C
TEMAFI=0/.25/.6/.8/1/1.2/1.25/1.28/1.3	151.7, T
TEAEFG=0/0/.1/.5/.8/1/1.02/1.04/1.06/1.08/1.1/1.12/ 1.13/1.14/1.15	151.8, T
TFDPSD=1/.75/.5/.25/0	151.9, T
TEUCFD=1/.9/.6/.3/.1	152.1, T
TEAGE=0/.2/.4/.6/.8/.9/1/1.01/1.015	152.2, T
TFDMA=1/.3/.1/.04/0	152.3, T

- GE ↔ GOVERNMENT EMPLOYEES (PEOPLE)
- LF ↔ LABOR FORCE (PEOPLE)
- GEF ↔ GOVT EMPLOYMENT FRACTION (DIM)
- IEPLGF ↔ INITIAL EMPLOYEES PER LEVEL OF GOVT
 FRACTION (OUTPUT UNITS/PERSON/YEAR)
- NFIGE ↔ NORMAL FRACTIONAL INCREASE IN GOVT
 EMPLOYEES (1/YEAR)
- TEMAFI ↔ TABLE OF EFFECT OF MONEY ADEQUACY ON
 FRACTIONAL INCREASE
- TEAEFG ↔ TABLE OF EFFECT OF AVAILABILITY OF
 EMPLOYEES ON FRACTIONAL INCREASE IN GOVT
 EMPLOYEES
- TFDPSD ↔ TABLE OF FRACTIONAL DECREASE FROM PRIVATE
 SECTOR DEMAND
- TEUCFD ↔ TABLE OF EFFECT OF UNEMPLOYMENT CONDITIONS
 ON FRACTIONAL DECREASE
- TEAGE ↔ TABLE OF EFFECT OF AVAILABILITY OF GOVT
 EMPLOYEES
- TFDMA ↔ TABLE OF FRACTIONAL DECREASE FROM MONEY
 ADEQUACY

GOVT OUTPUT

RPGEPS=1	152.7, N
TETPGS=.85/.88/.9/.95/1/1.05/1.1	152.8, T
RPGEPT=4	152.9, N
TETPGT=.5/.65/.8/.9/1/1.1/1.2	153.1, T
FGEASP(1)=1-(RPGEPS/(RPGEPS+RPGEPT))	153.2, N
SOGSP(1)=OGSP(1)	153.3, N
SOGTP(1)=OGTP(1)	153.4, N
TTESGO=15/1	153.5, T

RPGEPS - REFERENCE PRODUCTIVITY OF GOVT EMPLOYEES
PRODUCING SERVICES (OUTPUT UNITS/PERSON/
YEAR)

TETPGS - TABLE OF EFFECT OF TECHNOLOGY ON
PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
SERVICES

RPGEPT - REFERENCE PRODUCTIVITY OF GOVT EMPLOYEES
PRODUCING TRANSFERS (OUTPUT UNITS/PERSON/
YEAR)

TETPGT - TABLE OF EFFECT OF TECHNOLOGY ON
PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING
TRANSFERS

FGEASP - FRACTION OF GOVT EMPLOYEES ALLOCATED TO
SERVICE PRODUCTION (DIM)

SOGSP - STANDARD OUTPUT OF GOVT SERVICES PER PERSON
(OUTPUT UNITS/PERSON/YEAR)

OGSP - OUTPUT OF GOVT SERVICES PER CAPITA (OUTPUT
UNITS/PERSON/YEAR)

SOGTP - STANDARD OUTPUT OF GOVT TRANSFERS PER
PERSON (OUTPUT UNITS/PERSON/YEAR)

OGTP - OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT
UNITS/PERSON/YEAR)

TTESGO - TABLE OF TIME TO ESTABLISH TRADITIONAL
STANDARD OF GOVT OUTPUT PER CAPITA

MONEY BALANCE

$GMB(1) = GMA(1) * (EMADP(1) * ADMB(1) * DMCOV)$	153.9, N
$GMA(1) = .75$	154.1, N
$RFPGE(1) = (((RTO - RPPGS) * FRGOLG(1)) / GE(1)) / EMAFPE(1)$	154.2, N
$FRGOLG(1) = 1$	154.3, C
$TEMAFP = 0/.2/.7/.9/1/1.15/1.3/1.45/1.6$	154.4, T
$RCOU(1) = (PU(1) * RPOUPU(1)) / OGT(1)$	154.5, N
$RPOUPU(1) = 4$	154.6, C
$TEMAC = 0/.2/.7/.9/1/1.15/1.3/1.45/1.6$	154.7, T
$RFUELG(1) = .8$	154.8, C
$TEMAEP = 0/.45/.85/.9375/1/1.1/1.16/1.2/1.21$	154.9, T
$UCFPP = .05$	155.1, C
$TADP = 1$	155.2, C
$DMCOV = 1$	155.3, C
$TADMB = 1$	155.4, C
$ADMB(1) = PFGP(1) + TP(1) + IGSO(1) + RGS(1)$	155.5, N
$ADPAY(1) = ADMB(1) * EMADP(1)$	155.6, N
$TEMADP = 2/1.75/1.5/1.25/1$	155.7, T

- GMB ↔ GOVT MONEY BALANCE (DOLLARS)
- GMA ↔ GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)
- EMADP ↔ EFFECT OF MONEY ADEQUACY ON DESIRED
 PAYMENTS (DIM)
- ADMB ↔ AVERAGE DECREASE IN MONEY BALANCE (\$/YEAR)
- DMCOV ↔ DESIRED MONEY COVERAGE (YEARS)
- RFPGE ↔ REFERENCE FACTOR PAYMENT PER GOVT EMPLOYEE
 (\$/PERSON/YEAR)
- RTO ↔ REFERENCE TOTAL OUTPUT (\$/YEAR)
- RPPGS ↔ REFERENCE PRIVATE PRODUCTION OF GOODS &
 SERVICES (\$/YEAR)
- FRGOLG ↔ FRACTION OF REFERENCE GOVT OUTPUT BY LEVEL
 OF GOVT (DIM)
- GE ↔ GOVERNMENT EMPLOYEES (PEOPLE)
- EMAFPE ↔ EFFECT OF MONEY ADEQUACY ON FACTOR PAYMENTS
 PER EMPLOYEE (DIM)
- TEMAFP ↔ TABLE OF EFFECT OF MONEY ADEQUACY ON FACTOR
 PAYMENTS
- RCOU ↔ REFERENCE COMPENSATION PER OUTPUT UNIT (\$/
 OUTPUT UNIT)
- PU ↔ PAYMENTS FOR UNEMPLOYMENT (\$/YEAR)
- RPOUPU ↔ RATIO OF PAYMENTS FOR OTHER THAN
 UNEMPLOYMENT COMPENSATION TO PAYMENTS FOR
 UNEMPLOYMENT COMPENSATION (DIM)
- OGT ↔ OUTPUT OF GOVT TRANSFERS (OUTPUT UNITS/
 YEAR)
- TEMAC ↔ TABLE OF EFFECT OF MONEY ADEQUACY ON
 COMPENSATION
- RFUELG ↔ REFERENCE FRACTION OF UNEMPLOYED ELIGIBLE
 BY LEVEL OF GOVT (DIM)
- TEMAEP ↔ TABLE OF EFFECT OF MONEY ADEQUACY ON
 ELIGIBLE POPULATION

UCFPP - UNEMPLOMENT COMPENSATION AS A FRACTION OF PRIVATE PRODUCTION (DIM)
TADP - TIME TO AVERAGE DESIRED PAYMENTS (YEARS)
TADMB - TIME TO AVERAGE DECREASE IN MONEY BALANCE (YEARS)
PFGP - PAYMENTS TO FACTORS OF GOVT PRODUCTION (\$/YEAR)
TP - TRANSFER PAYMENTS (\$/YEAR)
IGSO - INTEREST ON GOVT SECURITIES OUTSTANDING (\$/YEAR)
RGS - RETIREMENT OF GOVT SECURITIES (\$/YEAR)
ADPAY - AVERAGE DESIRED PAYMENTS (\$/YEAR)
TEMADP - TABLE OF EFFECT OF MONEY ADEQUACY ON DESIRED PAYMENTS

DEBT

OGSY(1)=1E11	156.2, N
ARGS(1)=OGSY(1)/ATGS	156.3, N
TARGS=3	156.4, C
TEDSTR=2.5/1.75/1.5/1.25/1/.95/.9/.85/.75/.6/.45	156.5, T
DSTRRG(1)=DS(1)/TAXREV(1)	156.6, N
TEMADS=2/1.75/1.5/1.25/1/.95/.9/.85/.8	156.7, T
TEMRDS=0/.2/.4/.6/.8/1	156.8, T
TMRDF=1/.98/.96/.93/.9/.8/.6/.3/0	156.9, T
ADF(1)=DF(1)/2	157.1, N
TMRFAP=1/1/1/.75/.4/.05	157.2, T

OGSY - OUTSTANDING GOVT SECURITIES (\$)
ARGS - AVERAGE RETIREMENT OF GOVT SECURITIES (\$/YEAR)
ATGS - AVERAGE TERM OF GOVT SECURITIES (YEARS)
TARGS - TIME TO AVERAGE RETIREMENT OF GOVT SECURITIES (YEARS)
TEDSTR - TABLE OF EFFECT OF DEBT SERVICE TAX REVENUE RATIO
DSTRRG - DEBT SERVICE TAX REVENUE RATIO GOAL (DIM)
DS - DEBT SERVICE (\$/YEAR)
TAXREV - TAX REVENUES (\$/YEAR)
TEMADS - TABLE OF EFFECT OF MONEY ADEQUACY ON DESIRED SALE
TEMRDS - TABLE OF EFFECT OF MARKET RESPONSE ON DESIRED SALE
TMRDF - TABLE OF MARKET RESPONSE TO DEFAULT FRACTION
ADF - ACCEPTABLE DEFAULT FRACTION (DIM)
DF - DEFAULT FRACTION (DIM)
TMRFAP - TABLE OF MARKET RESPONSE TO FUNDS AVAILABLE FOR THE PURCHASE OF SECURITIES

FAPS.K=AGNP.K*FOAPS 158, A
 FOAPS=.15 158.1, C
 TAVSGS=1 158.2, C
 ASGS(1)=ARGS(1)*EMADS(1)*MRDF(1) 158.3, N
 TMRDTP=1/.95/.9/.8/.7/.55/.3/.1/0 158.4, T
 TMRSR=4/2.5/1.75/1.25/1 158.5, T
 TMRTNS(*,1)=0/.25/.8/.95/1 158.6, T

FAPS - FUNDS AVAILABLE FOR THE PURCHASE OF
 SECURITIES (\$/YEAR)
 AGNP - AVERAGE GROSS NATIONAL PRODUCT (\$/YEAR)
 FOAPS - FRACTION OF OUTPUT AVAILABLE FOR PURCHASE
 OF SECURITIES (DIM)
 TAVSGS - TIME TO AVERAGE SALE OF GOVT SECURITIES
 (YEARS)
 ASGS - AVERAGE SALE OF GOVT SECURITIES (\$/YEAR)
 ARGS - AVERAGE RETIREMENT OF GOVT SECURITIES (\$/
 YEAR)
 EMADS - EFFECT OF MONEY ADEQUACY ON DESIRED SALE
 (DIM)
 MRDF - MARKET RESPONSE TO DEFAULT FRACTION (DIM)
 TMRDTP - TABLE OF MARKET RESPONSE TO DEPARTURE FROM
 TRADITIONAL DEBT POSITION
 TMRSR - TABLE OF MARKET RESPONSE TO SERVICE RATIO
 TMRTNS - TABLE OF MARKET RESPONSE TO THREAT TO
 NATIONAL SECURITY

TNS.K=TABHL(TTNS,TIME.K,0,10,1) 159, A
 TTNS=0/0/0/0/0/0/0/0/0/0/0 159.1, T
 ATGS=2.5 159.2, C
 RDF(1)=IRGS/EMADF(1) 159.3, N
 TEMADF=4/1.75/1.5/1.25/1/.9/.8/.75/.73 159.4, T
 IRGS=.05 159.5, C

TNS - INDEX OF THREAT TO NATIONAL SECURITY (DIM)
 TABHL - TABLE LOOK-UP FUNCTION
 TIME - DYNAMO FUNCTION FOR RECORDING ELAPSED
 SIMULATION TIME (YEARS)
 ATGS - AVERAGE TERM OF GOVT SECURITIES (YEARS)
 RDF - REFERENCE DEFAULT FRACTION (DIM)
 IRGS - INTEREST RATE ON GOVT SECURITIES (1/YEAR)
 EMADF - EFFECT OF MONEY ADEQUACY ON DEFAULT
 FRACTION (DIM)
 TEMADF - TABLE OF EFFECT OF MONEY ADEQUACY ON
 DEFAULT FRACTION

TAX RATE

TR(1)=.480 159.9, N
 TR - TAX RATE (DIM)

GMAPG.K(1)=GMA.K(1)	160, A
TFCTMA(*,1)=.5/.25/.1/.05/0	160.1, T
TFCLT(*,1)=0/-.05/-.12/-.3/-.5/-.9	160.2, T
ATRURC(1)=.4	160.3, N
BPTR(1)=1	160.4, C
TELOAT(*,1)=0/.25/.5/.75/1/1.1/1.2/1.3/1.4/1.5/ 1.55/1.58/1.6	160.5, T
TECOAT(*,1)=.1/.2/.4/.6/.8/1/1.1/1.15	160.6, T
TESRAT=2/1.5/1.35/1.2/1.1/1/.8/.6/.3/.1	160.7, T
GMAPG - GOVT MONEY ADEQUACY PERCEIVED BY GOVT (DIM)	
GMA - GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)	
TFCTMA - TABLE OF FRACTIONAL CHANGE IN TAX FROM MONEY ADEQUACY	
TFCLT - TABLE OF FRACTIONAL CHANGE FROM LEVEL OF TAX	
ATRURC - ACCEPTABLE TAX RATE UNDER REFERENCE CONDITIONS (DIM)	
BPTR - BIAS IN PERCEIVING TAX RATE (DIM)	
TELOAT - TABLE OF EFFECT OF LEVEL OF OUTPUT ON ACCEPTABLE TAX RATE	
TECOAT - TABLE OF EFFECT OF CHANGE IN LEVEL OF OUTPUT ON ACCEPTABLE TAX RATE	
TESRAT - TABLE OF EFFECT OF SERVICE RATIO ON ACCEPTABLE TAX RATE	
SRT.K(1)=SR.K(1)	161, A
SRT - SERVICE RATIO BY TAX (DIM)	
SR - SERVICE RATIO (DIM)	
SR.K(LG)=((OGSP.K(LG)/PCDGS.K(LG)) *SWF) + ((OGTP.K(LG)/PCDGT.K(LG)) * (1-SWF))	162, A
SWF=.5	162.2, C
TFCCTR=0/-.02/-.05/-.15/-.3/-.8	162.3, T
TTR(1)=TR(1)	162.4, N
TETTR=2	162.5, C
PGMA(1)=GMA(1)	162.6, N
TPGMA=2	162.7, C
TFCPGM(*,1)=0/-.02/-.05/-.1/-.2/-.4/-.8/-1.5/-2.2	162.8, T
TETNSS(*,1)=1/.4/.15/.05/0	162.9, T
TFCTFA(*,1)=-.9/-.7/-.5/-.35/-.2/-.1/-.03/-.01/0	163.1, T

- TBF(1) = (GPGS+TP(1))/(GNP*TR(1)) 163.2, N
- SR ↔ SERVICE RATIO (DIM)
 - LG ↔ LEVEL OF GOVT
 - OGSP ↔ OUTPUT OF GOVT SERVICES PER CAPITA (OUTPUT UNITS/PERSON/YEAR)
 - PCDGS ↔ PER CAPITA DEMAND FOR GOVT SERVICES (OUTPUT UNITS/PERSON/YEAR)
 - SWF ↔ SERVICE RATIO WEIGHTING FACTOR (DIM)
 - OGTP ↔ OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT UNITS/PERSON/YEAR)
 - PCDGT ↔ PER CAPITA DEMAND FOR GOVT TRANSFERS (OUTPUT UNITS/PERSON/YEAR)
 - TFCCTR ↔ TABLE OF FRACTIONAL CHANGE IN TAX RATE
 - TTR ↔ TRADITIONAL TAX RATE (DIM)
 - TR ↔ TAX RATE (DIM)
 - TETTR ↔ TIME TO ESTABLISH TRADITIONAL TAX RATE (YEARS)
 - PGMA ↔ PERCEIVED GOVT MONEY ADEQUACY (DIM)
 - GMA ↔ GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)
 - TFGMA ↔ TIME TO PERCEIVE GOVT MONEY ADEQUACY (YEARS)
 - TFCPGM ↔ TABLE OF FRACTIONAL CHANGE FROM PERCEIVED GOVT MONEY ADEQUACY
 - TETNSS ↔ TABLE OF EFFECT OF THREAT TO NATIONAL SECURITY ON PUBLIC SENTIMENT
 - TFCTFA ↔ TABLE OF FRACTIONAL CHANGE IN TAX FROM FISCAL ACTION
 - TBF ↔ TAX BASE FRACTION (DIM)
 - GPGS ↔ GOVT PRODUCTION OF GOODS & SERVICES (\$/YEAR)
 - TP ↔ TRANSFER PAYMENTS (\$/YEAR)
 - GNP ↔ GROSS NATIONAL PRODUCT (\$/YEAR)

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TESTING EQUATIONS

TEST 1: REDUCTION IN EMPLOYMENT

- ETEGP.K(LG) = PULSE(PTEGP.K(LG), TIE1, EI) 165, A
- ETEGP ↔ EXOGENOUS TRANSFER OF EMPLOYEES FROM GOVT TO PRIVATE SECTOR (PEOPLE/YEAR)
 - LG ↔ LEVEL OF GOVT
 - PULSE ↔ DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS RATES FOR TESTING PURPOSES
 - TIE1 ↔ TIME TO IMPLEMENT EXPERIMENT 1 (YEAR)
 - EI ↔ EXPERIMENTAL INTERVAL (YEARS)

PTEGP.K(LG)=(GE.K(LG)*FET)/DT 166, A
FET=.5 166.1, C
TIE1=1000 166.2, C
EI=1000 166.3, C
LG ↖ LEVEL OF GOVT
GE ↖ GOVERNMENT EMPLOYEES (PEOPLE)
FET ↖ FRACTION OF EMPLOYEES TRANSFERRED (DIM)
DT ↖ SOLUTION INTERVAL (YEARS)
TIE1 ↖ TIME TO IMPLEMENT EXPERIMENT 1 (YEAR)
EI ↖ EXPERIMENTAL INTERVAL (YEARS)

TEST 2: REDUCTION IN SIZE OF GOVT

1. INCLUDE TRANSFER OF EMPLOYEES (I.E., TEST 1)
2. REDUCTION IN MONEY BALANCE

ERGM.B.K(LG)=PULSE(EDGMB.K(LG),TIE2,EI) 168, A
ERGM.B ↖ EXOGENOUS REDUCTION IN GOVT MONEY BALANCE
(\$/YEAR)
LG ↖ LEVEL OF GOVT
PULSE ↖ DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
EDGMB ↖ EXOGENOUS DECREASE IN GOVT MONEY BALANCE
(\$/YEAR)
TIE2 ↖ TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
EI ↖ EXPERIMENTAL INTERVAL (YEARS)

EDGMB.K(LG)=(GMB.K(LG)*EFDMB)/DT 169, A
EFDMB=.35 169.1, C
TIE2=1000 169.2, C
EDGMB ↖ EXOGENOUS DECREASE IN GOVT MONEY BALANCE
(\$/YEAR)
LG ↖ LEVEL OF GOVT
GMB ↖ GOVT MONEY BALANCE (DOLLARS)
EFDMB ↖ EXOGENOUS FRACTIONAL DECREASE IN GOVT MONEY
BALANCE (DIM)
DT ↖ SOLUTION INTERVAL (YEARS)
TIE2 ↖ TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)

ERDM.B.K(LG)=PULSE(EDDM.B.K(LG),TIE2,EI) 170, A
ERDM.B ↖ EXOGENOUS REDUCTION IN DECREASE IN MONEY
BALANCE (\$/YEAR)
LG ↖ LEVEL OF GOVT
PULSE ↖ DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
EDDM.B ↖ EXOGENOUS DECREASE IN DECREASE IN MONEY
BALANCE (\$/YEAR)
TIE2 ↖ TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
EI ↖ EXPERIMENTAL INTERVAL (YEARS)

EDDMB.K(LG)=(ADMB.K(LG)*EFD)/DT 171, A
EFD=.5 171.1, C
EDDMB ⇨ EXOGENOUS DECREASE IN DECREASE IN MONEY
BALANCE (\$/YEAR)
LG ⇨ LEVEL OF GOVT
ADMB ⇨ AVERAGE DECREASE IN MONEY BALANCE (\$/YEAR)
EFD ⇨ EXOGENOUS FRACTIONAL DECREASE (DIM)
DT ⇨ SOLUTION INTERVAL (YEARS)

ERADPY.K(LG)=PULSE(EDADPY.K(LG),TIE2,EI) 172, A
ERADPY ⇨ EXOGENOUS REDUCTION IN AVERAGE DESIRED
PAYMENTS (\$/YEAR)
LG ⇨ LEVEL OF GOVT
PULSE ⇨ DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
EDADPY ⇨ EXOGENOUS DECREASE IN AVERAGE DESIRED
PAYMENTS (\$/YEAR)
TIE2 ⇨ TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
EI ⇨ EXPERIMENTAL INTERVAL (YEARS)

EDADPY.K(LG)=(ADPAY.K(LG)*EFD)/DT 173, A
EDADPY ⇨ EXOGENOUS DECREASE IN AVERAGE DESIRED
PAYMENTS (\$/YEAR)
LG ⇨ LEVEL OF GOVT
ADPAY ⇨ AVERAGE DESIRED PAYMENTS (\$/YEAR)
EFD ⇨ EXOGENOUS FRACTIONAL DECREASE (DIM)
DT ⇨ SOLUTION INTERVAL (YEARS)

3. REDUCTION IN TAX RATES

ECTR.K(TAX)=PULSE(EMTR.K(TAX),TIE2,EI) 174, A
TAX ⇨ TYPES OF TAX
PULSE ⇨ DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
EMTR ⇨ EXOGENOUS MODIFICATION OF TAX RATE (1/YEAR)
TIE2 ⇨ TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
EI ⇨ EXPERIMENTAL INTERVAL (YEARS)

EMTR.K(TAX)=(TR.K(TAX)*EFD)/DT 175, A
EMTR ⇨ EXOGENOUS MODIFICATION OF TAX RATE (1/YEAR)
TAX ⇨ TYPES OF TAX
TR ⇨ TAX RATE (DIM)
EFD ⇨ EXOGENOUS FRACTIONAL DECREASE (DIM)
DT ⇨ SOLUTION INTERVAL (YEARS)

4. REDUCTION IN GOVT SECURITIES OUTSTANDING

EDGS.K(LG)=PULSE(ERGS.K(LG),TIE2,EI) 176, A
EDGS - EXOGENOUS DECREASE IN GOVT SECURITIES (\$/
YEAR)
LG - LEVEL OF GOVT
PULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
ERGS - EXOGENOUS REDUCTION IN GOVT SECURITIES (\$/
YEAR) (OUTPUT UNITS/PERSON/YEAR)
TIE2 - TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

ERGS.K(LG)=(OGSY.K(LG)*EFD)/DT 177, A
ERGS - EXOGENOUS REDUCTION IN GOVT SECURITIES (\$/
YEAR) (OUTPUT UNITS/PERSON/YEAR)
LG - LEVEL OF GOVT
OGSY - OUTSTANDING GOVT SECURITIES (\$)
EFD - EXOGENOUS FRACTIONAL DECREASE (DIM)
DT - SOLUTION INTERVAL (YEARS)

5. REDUCTION IN STANDARD OUTPUT

ERSOGS.K(LG)=PULSE(PROGSP.K(LG),TIE2,EI) 178, A
ERSOGS - EXOGENOUS REDUCTION IN STANDARD OUTPUT OF
GOVT SERVICES PER CAPITA (OUTPUT UNITS/
PERSON/YEAR)
LG - LEVEL OF GOVT
PULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
PROGSP - PULSE REDUCTION IN OUTPUT OF GOVT SERVICES
PER CAPITA (OUTPUT UNITS/PERSON/YEAR)
TIE2 - TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

PROGSP.K(LG)=(SOGSP.K(LG)*EFD)/DT 179, A
PROGSP - PULSE REDUCTION IN OUTPUT OF GOVT SERVICES
PER CAPITA (OUTPUT UNITS/PERSON/YEAR)
LG - LEVEL OF GOVT
SOGSP - STANDARD OUTPUT OF GOVT SERVICES PER PERSON
(OUTPUT UNITS/PERSON/YEAR)
EFD - EXOGENOUS FRACTIONAL DECREASE (DIM)
DT - SOLUTION INTERVAL (YEARS)

ERSOGT.K(LG)=PULSE(PROGTP.K(LG),TIE2,EI) 180, A
ERSOGT - EXOGENOUS REDUCTION IN STANDARD OUTPUT OF
GOVT TRANSFERS PER CAPITA (OUTPUT UNITS/
PERSON/YEAR)
LG - LEVEL OF GOVT
PULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
PROGTP - PULSE REDUCTION IN OUTPUT OF GOVT TRANSFERS
PER PERSON (OUTPUT UNITS/PERSON/YEAR)
TIE2 - TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

PROGTP.K(LG)=(SOGTP.K(LG)*EFD)/DT 181, A
PROGTP - PULSE REDUCTION IN OUTPUT OF GOVT TRANSFERS
PER PERSON (OUTPUT UNITS/PERSON/YEAR)
LG - LEVEL OF GOVT
SOGTP - STANDARD OUTPUT OF GOVT TRANSFERS PER
PERSON (OUTPUT UNITS/PERSON/YEAR)
EFD - EXOGENOUS FRACTIONAL DECREASE (DIM)
DT - SOLUTION INTERVAL (YEARS)

TEST 3: TRANSFER OF EMPLOYEES FROM PRIV TO PUBLIC

ETEPG.K(LG)=PULSE(PTEPG.K(LG),TIE3,EI) 182, A
ETEPG - EXOGENOUS TRANSFER OF EMPLOYEES FROM
PRIVATE TO GOVT SECTOR (PEOPLE/YEAR)
LG - LEVEL OF GOVT
PULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
PTEPG - PULSE TRANSFER OF EMPLOYEES FROM PRIVATE
SECTOR TO GOVT (PEOPLE/YEAR)
TIE3 - TIME TO IMPLEMENT EXPERIMENT 3 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

PTEPG.K(LG)=(GE.K(LG)*FET)/DT 183, A
TIE3=1000 183.1, C
PTEPG - PULSE TRANSFER OF EMPLOYEES FROM PRIVATE
SECTOR TO GOVT (PEOPLE/YEAR)
LG - LEVEL OF GOVT
GE - GOVERNMENT EMPLOYEES (PEOPLE)
FET - FRACTION OF EMPLOYEES TRANSFERRED (DIM)
DT - SOLUTION INTERVAL (YEARS)
TIE3 - TIME TO IMPLEMENT EXPERIMENT 3 (YEAR)

TEST 4: ALTER FRACTION OF ELDERLY

TIE4=1000 183.6, C
TIE4 → TIME TO IMPLEMENT EXPERIMENT 4 (YEAR)

TEST 5: ALTER FRACTION OF CHILDREN

TIE5=1000 184.2, C
TIE5 → TIME TO IMPLEMENT EXPERIMENT 5 (YEAR)

TEST 6: ALTER LEVEL OF TECHNOLOGY

TIE6=1000 184.7, C
TIE6 → TIME TO IMPLEMENT EXPERIMENT 6 (YEAR)

TEST 7: ALTER GOVT EMPLOYMENT GROWTH FRACTION

EECFI.K=CLIP(ECFI, 1, TIME.K, TIE7) 186, A
ECFI=2 186.1, C
TIE7=1000 186.2, C

- EECFI → EFFECT OF EXOGENOUS CHANGE ON FRACTIONAL INCREASE (DIM)
- CLIP → DYNAMO FUNCTION USED FOR ALTERING PARAMETERS FOR TESTING PURPOSES
- ECFI → EXOGENOUS CHANGE IN FRACTIONAL INCREASE (1/YEAR)
- TIME → DYNAMO FUNCTION FOR RECORDING ELAPSED SIMULATION TIME (YEARS)
- TIE7 → TIME TO IMPLEMENT EXPERIMENT 7 (YEAR)

TEST 8: WAR
ALTER TTNS

EWFI.K=TABLE(TEWFI, TNS.K, 0, 1, .25) 187, A
TEWFI=1/1.25/1.5/2/2.5 187.1, T

- EWFI → EFFECT OF WAR ON FRACTIONAL INCREASE (DIM)
- TABLE → TABLE LOOK-UP FUNCTION
- TEWFI → TABLE OF EFFECT OF WAR ON FRACTIONAL INCREASE
- TNS → INDEX OF THREAT TO NATIONAL SECURITY (DIM)

EWP.K=CLIP(1/EGRP.K,1,TNS.K,.01) 188, A
EWP - EFFECT OF WAR ON PRODUCTIVITY (DIM)
CLIP - DYNAMO FUNCTION USED FOR ALTERING
PARAMETERS FOR TESTING PURPOSES
EGRP - EFFECT OF GOVT REGULATION ON PRODUCTIVITY
(DIM)
TNS - INDEX OF THREAT TO NATIONAL SECURITY (DIM)

TEST 9: DEPRESSION TEST

EDPSE.K=PULSE(PEDPSE.K,TIE9,EI) 189, A
EDPSE - EXOGENOUS DECREASE IN PRIVATE SECTOR
EMPLOYEES (PEOPLE/YR)
PULSE - DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS
RATES FOR TESTING PURPOSES
PEDPSE - PULSE EXOG DECREASE IN PRIVATE SECTOR
EMPLOYEES (PEOPLE/YR)
TIE9 - TIME TO IMPLEMENT EXPERIMENT 9 (YEAR)
EI - EXPERIMENTAL INTERVAL (YEARS)

PEDPSE.K=(PSE.K*FD)/DT 190, A
FD=.25 190.1, C
TIE9=1000 190.2, C

PEDPSE - PULSE EXOG DECREASE IN PRIVATE SECTOR
EMPLOYEES (PEOPLE/YR)
PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)
FD - FRACTIONAL DECREASE (1/YEAR)
DT - SOLUTION INTERVAL (YEARS)
TIE9 - TIME TO IMPLEMENT EXPERIMENT 9 (YEAR)

CALCULATED VARIABLES

GSPG.K=SUM(DMB.JK)/GNP.K 192, S
GSPG - GOVERNMENT SPENDING AS A % OF GNP (DIM)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
DMB - DECREASE IN MONEY BALANCE (\$/YEAR)
GNP - GROSS NATIONAL PRODUCT (\$/YEAR)

GEPLF.K=SUM(GE.K)/LF.K 193, A
GEPLF - GOVERNMENT EMPLOYEES AS A % OF LABOR FORCE
(DIM)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF
AN ARRAY
GE - GOVERNMENT EMPLOYEES (PEOPLE)
LF - LABOR FORCE (PEOPLE)

- PEPLF.K=PSE.K/LF.K 194, A
PEPLF - PRIVATE EMPLOYEES AS A % OF LABOR FORCE (DIM)
PSE - PRIVATE SECTOR EMPLOYEES (PEOPLE)
LF - LABOR FORCE (PEOPLE)
- RSSPTR.K=SUM(SCS.JK)/SUM(IMB.JK) 195, A
RSSPTR - REVENUE FROM SALE OF SECURITIES AS % OF TOTAL REVENUE (DIM)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF AN ARRAY
SCS - SALE OF GOVT SECURITIES (\$/YEAR)
IMB - INCREASE IN MONEY BALANCE (\$/YEAR)
- TRPTR.K=SUM(TAXREV.K)/SUM(IMB.JK) 196, S
TRPTR - TAX REVENUE AS A % OF TOTAL REVENUE (DIM)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF AN ARRAY
TAXREV - TAX REVENUES (\$/YEAR)
IMB - INCREASE IN MONEY BALANCE (\$/YEAR)
- GPPGNP.K=GPGS.K/GNP.K 197, S
GPPGNP - GOVERNMENT PRODUCTION AS A PERCENT OF GNP (DIM)
GPGS - GOVT PRODUCTION OF GOODS & SERVICES (\$/YEAR)
GNP - GROSS NATIONAL PRODUCT (\$/YEAR)
- GS.K=SUM(TAXREV.K)-(SUM(PFGP.K)+SUM(TP.K)) 198, A
GS - GOVERNMENT SURPLUS (\$/YEAR)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF AN ARRAY
TAXREV - TAX REVENUES (\$/YEAR)
PFGP - PAYMENTS TO FACTORS OF GOVT PRODUCTION (\$/YEAR)
TP - TRANSFER PAYMENTS (\$/YEAR)
- UPLF.K=U.K/LF.K 199, A
UPLF - UNEMPLOYMENT AS A PERCENT OF THE LABOR FORCE (DIM)
U - UNEMPLOYED (PEOPLE)
LF - LABOR FORCE (PEOPLE)
- TRSR.K=SUM(TAXREV.K)/(SUM(TP.K)+SUM(PFGP.K)) 200, A
TRSR - TAX REVENUE SPENDING RATIO (DIM)
SUM - DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF AN ARRAY
TAXREV - TAX REVENUES (\$/YEAR)
TP - TRANSFER PAYMENTS (\$/YEAR)
PFGP - PAYMENTS TO FACTORS OF GOVT PRODUCTION (\$/YEAR)

GPGSP.K=GPGS.K/POP.K 201, A
GPGSP = GOVT PRODUCTION OF GOODS & SERVICES PER
CAPITA (\$/PERSON/YEAR)
GPGS = GOVT PRODUCTION OF GOODS & SERVICES (\$/
YEAR)
POP = POPULATION (PEOPLE)

SIMULATION CONTROL PARAMETERS

SPEC DT=.25/LENGTH=0 201.5
DT = SOLUTION INTERVAL (YEARS)
LENGTH = LENGTH OF SIMULATION (YEARS)

PLTPER.K=CLIP(PLP, 0, TIME.K, TBPL) 202, A
PLP=1 202.1, C
TBPL=0 202.2, C
PLTPER - PLOT PERIOD FOR SIMULATION PLOTTED OUTPUT
(YEARS)
CLIP = DYNAMO FUNCTION USED FOR ALTERING
PARAMETERS FOR TESTING PURPOSES
PLP = PLOT PERIOD (YEARS)
TIME = DYNAMO FUNCTION FOR RECORDING ELAPSED
SIMULATION TIME (YEARS)
TBPL = TIME TO BEGIN PLOTTING (YEAR)

PRTPER.K=CLIP(PRP, 0, TIME.K, TBPR) 203, A
PRP=.05 203.1, C
TBPR=2000 203.2, C
PRTPER = PRINT PERIOD FOR PRINTED SIMULATION OUTPUT
(YEARS)
CLIP = DYNAMO FUNCTION USED FOR ALTERING
PARAMETERS FOR TESTING PURPOSES
PRP = PRINT PERIOD (YEARS)
TIME = DYNAMO FUNCTION FOR RECORDING ELAPSED
SIMULATION TIME (YEARS)
TBPR = TIME TO BEGIN PRINTING (YEAR)

UNDOCUMENTED EQUATION LISTING

TOF:

00010 * GOVERNMENT GROWTH IN A FIXED ECONOMY
00020 NOTE A MODEL OF THE FACTORS AFFECTING THE GROWTH
00030 NOTE OF GOVERNMENT IN A FIXED ECONOMY
00040 NOTE
00050 NOTE
00060 NOTE

00070 NOTE DIMENSIONS

00080 I TLG=1
00090 I TTX=1
00100 FOR LG=1,TLG
00110 FOR TAX=1,TTX

00120 NOTE

00130 NOTE

00140 NOTE * * * * *

00150 NOTE * GOVERNMENT SECTOR EQUATIONS *

00160 NOTE * * * * *

00170 NOTE

00180 NOTE

00190 NOTE GOVERNMENT EMPLOYMENT EQUATIONS

00200 NOTE

00210 L GE.K(LG)=GE.J(LG)+(DT)(IGE.JK(LG)-DGE.JK(LG))
00220 R IGE.KL(LG)=(GE.K(LG)*FIGE.K(LG))+ETEPG.K(LG)
00230 A FIGE.K(LG)=NFIGE*EMAFI.K(LG)*EAEFIG.K*(EWFI.K*EECFI.K)
00240 A EMAFI.K(LG)=TABLE(TEMAFI,GMA.K(LG),0,2,.25)
00250 A EAEFIG.K=TABHL(TEAEFG,U.K/MU.K,0,7,.5)
00260 R DGE.KL(LG)=(GE.K(LG)*FDGE.K(LG))+ETEGP.K(LG)
00270 A FDGE.K(LG)=(FDPSD.K*EAGE.K(LG))+FDMA.K(LG)
00280 A FDPSD.K=FDPSD.K*EUCFD.K
00290 A FDPSD.K=TABHL(TFDPSD,PSE.K/DESPSE.K,0,1,.25)
00300 A EUCFD.K=TABHL(TEUCFD,U.K/MU.K,0,4,1)
00310 A FDMA.K(LG)=TABHL(TFDMA,GMA.K(LG),0,1,.25)
00320 A EAGE.K(LG)=TABHL(TEAGE,GE.K(LG)/RLGE.K(LG),.4,1.2,.1)
00330 A RLGE.K(LG)=(DEGS.K(LG)/PGEPS.K)+(DGT.K(LG)/PGEPT.K)

00340 NOTE

00350 NOTE

00360 NOTE GOVT OUTPUT

00370 NOTE

00380 NOTE

1. OUTPUT OF GOVT SERVICES
00390 A OGS.K(LG)=OGS.K(LG)/POP.K
00400 A OGS.K(LG)=GEPS.K(LG)*PGEPS.K
00410 A GEPS.K(LG)=GE.K(LG)*FGEASP.K(LG)
00420 A FGEASP.K(LG)=((SOGSP.K(LG)/PGEPS.K)/((SOGSP.K(LG)/PGEPS.K)+(SOGTP.K(LG)/PGEPT.K)))
00430 X
00440 L SOGSP.K(LG)=SOGSP.J(LG)+(DT/TESOGS.J(LG))(OGSP.J(LG)-SOGSP.J(LG))
00450 X -ERSOGS.J(LG)
00460 A TESOGS.K(LG)=TABHL(TTESGO,OGSP.K(LG)/SOGSP.K(LG),.95,1,.05)
00470 A PGEPS.K=RPGEPS*ETPGES.K
00480 A ETPGES.K=TABLE(TETPGS,T.K/RLT,0,1.5,.25)
00490 NOTE

00500 NOTE

2. OUTPUT OF GOVT TRANSFERS
00510 A OGTP.K(LG)=OGT.K(LG)/POP.K
00520 A OGT.K(LG)=GEPT.K(LG)*PGEPT.K
00530 A GEPT.K(LG)=GE.K(LG)*((1-FGEASP.K(LG)))
00540 L SOGTP.K(LG)=SOGTP.J(LG)+(DT/TESOGT.J(LG))(OGTP.J(LG)-SOGTP.J(LG))
00550 X -ERSOGT.J(LG)
00560 A TESOGT.K(LG)=TABHL(TTESGO,OGTP.K(LG)/SOGTP.K(LG),.95,1,.05)
00570 A PGEPT.K=RPGEPT*ETPGET.K
00580 A ETPGET.K=TABLE(TETPGT,T.K/RLT,0,1.5,.25)
00590 NOTE

00600 NOTE

00610 NOTE

00620 NOTE GOVERNMENT MONEY BALANCE

00630 NOTE

00630 L GMB.K(LG)=GMB.J(LG)+(DT)(IMB.JK(LG)-DMB.JK(LG)-ERGMB.J(LG))
00640 R IMB.KL(LG)=TAXREV.K(LG)+SGS.JK(LG)

00650 A DMB.K(LG)=PFPG.K(LG)+TP.K(LG)+IGSO.K(LG)+RGS.JK(LG)
 00660 A PFPG.K(LG)=GE.K(LG)*FPGE.K(LG)
 00670 A FPGE.K(LG)=RFPGE(LG)*EMAFPE.K(LG)
 00680 A EMAFPE.K(LG)=TABLE(TEMAFP,GMA.K(LG),0,2,.25)
 00690 A TP.K(LG)=POU.K(LG)+PU.K(LG)
 00700 A POU.K(LG)=OGT.K(LG)*COU.K(LG)
 00710 A COU.K(LG)=BCOU.K(LG)*EMATPC.K(LG)
 00720 A BCOU.K(LG)=RCOU(LG)*APPGSP.K/RLPPP
 00730 A EMATPC.K(LG)=TABLE(TEMAC,GMA.K(LG),0,2,.25)
 00740 A PU.K(LG)=EU.K(LG)*CU.K(LG)
 00750 A EU.K(LG)=U.K*FUELG.K(LG)
 00760 A FUELG.K(LG)=RFUELG(LG)*EMAPEU.K(LG)
 00770 A EMAPEU.K(LG)=TABHL(TEMAEP,GMA.K(LG),0,2,.25)
 00780 A CU.K(LG)=BCU.K*EMATPC.K(LG)
 00790 A BCU.K=APPGSP.K*UCFPP
 00800 A GMA.K(LG)=GMB.K(LG)/(ADPAY.K(LG)*DMCOV)
 00810 L ADPAY.K(LG)=ADPAY.J(LG)+(DT/TADP)(DPAY.J(LG)-ADPAY.J(LG))
 00820 X -ERADPY.J(LG)
 00830 A DPAY.K(LG)=ADMB.K(LG)*EMADP.K(LG)
 00840 L ADMB.K(LG)=ADMB.J(LG)+(DT/TADMB)(DMB.JK(LG)-ADMB.J(LG))
 00850 X -ERDMB.J(LG)
 00860 A EMADP.K(LG)=TABHL(TEMADP,GMA.K(LG),0,1,.25)

00870 NOTE
 00880 NOTE
 00890 NOTE
 00900 NOTE

GOVERNMENT DEBT EQUATIONS

00910 L OGSY.K(LG)=OGSY.J(LG)+(DT)(SGS.JK(LG)-RGS.JK(LG)-DGS.JK(LG))
 00920 X -EDGS.J(LG)
 00930 R SGS.KL(LG)=DSGS.K(LG)*EMRDS.K(LG)
 00940 A DSGS.K(LG)=ARGS.K(LG)*EDSTRR.K(LG)*EMADS.K(LG)
 00950 L ARGS.K(LG)=ARGS.J(LG)+(DT/TARGS)(RGS.JK(LG)-ARGS.J(LG))
 00960 A EDSTRR.K(LG)=TABHL(TEDSTR,DSTRR.K(LG)/DSTRRG(LG),0,2.5,.25)
 00970 A DSTRR.K(LG)=DS.K(LG)/TAXREV.K(LG)
 00980 A DS.K(LG)=(IGSO.K(LG)+ARGS.K(LG))
 00990 A EMADS.K(LG)=TABLE(TEMADS,GMA.K(LG),0,2,.25)
 01000 A EMRDS.K(LG)=TABHL(TEMRDS,MR.K(LG),0,1,.2)
 01010 A MR.K(LG)=(MRDF.K(LG)*MRFAPS.K*MRDTP.K(LG)*MRSR.K(LG))+MRTNS.K(LG)
 01020 A MRDF.K(LG)=TABHL(TMRDF,DF.K(LG)/ADF(LG),1,3,.25)
 01030 A MRFAPS.K=TABLE(TMRFAP,TASGS.K/FAPS.K,0,1,.2)
 01040 A TASGS.K=SUM(ASGS.K)
 01050 L ASGS.K(LG)=ASGS.J(LG)+(DT/TAVSGS)(SGS.JK(LG)-ASGS.J(LG))
 01060 A MRDTP.K(LG)=TABHL(TMRDTP,DTDP.K(LG),1,3,.25)
 01070 A DTDP.K(LG)=DSTRR.K(LG)/DSTRRG(LG)
 01080 A MRSR.K(LG)=TABHL(TMRSR,SR.K(LG),0,1,.25)
 01090 A MRTNS.K(LG)=TABHL(TMRTNS(*,LG),TNS.K,0,1,.25)
 01100 R RGS.KL(LG)=OGSY.K(LG)/ATGS
 01110 R DGS.KL(LG)=OGSY.K(LG)*DF.K(LG)
 01120 A DF.K(LG)=RDF(LG)*EMADF.K(LG)
 01130 A EMADF.K(LG)=TABLE(TEMADF,GMA.K(LG),0,2,.25)
 01140 A IGSO.K(LG)=OGSY.K(LG)*IRGS

01150 NOTE
 01160 NOTE
 01170 NOTE
 01180 NOTE

TAX RATE SETTING

01190 L TR.K(TAX)=TR.J(TAX)+(DT)(CTR.JK(TAX)-ECTR.J(TAX))
 01200 R CTR.KL(TAX)=TR.K(TAX)*FCTR.K(TAX)
 01210 A FCTR.K(TAX)=FCTMA.K(TAX)+FCTPS.K(TAX)+FCTFA.K(TAX)
 01220 A FCTMA.K(TAX)=TABHL(TFCTMA(*,TAX),GMAPG.K(TAX),0,1,.25)
 01230 A FCTPS.K(TAX)=(FCLT.K(TAX)+FCCTR.K(TAX)+FCPGMA.K(TAX))
 01240 X *ETNSPS.K(TAX)
 01250 A FCLT.K(TAX)=TABHL(TFCLT(*,TAX),PTR.K(TAX)/ATR.K(TAX),1,2,.2)
 01260 A PTR.K(TAX)=TR.K(TAX)*BPTR(TAX)
 01270 A ATR.K(TAX)=ATRURC(TAX)*ELOATR.K(TAX)*ECOATR.K(TAX)*ESRATR.K(TAX)
 01280 A ELOATR.K(TAX)=TABHL(TELOAT(*,TAX),PPGSP.K/RLPPP,0,3,.25)
 01290 A ECOATR.K(TAX)=TABHL(TECOAT(*,TAX),PPGSP.K/APPGSP.K,.5,1.2,.1)
 01300 A ESRATR.K(TAX)=TABHL(TESRAT(*,TAX),0,1,0,1)

01320 A $PSTR.K(TAX) = ((TR.K(TAX) - TTR.K(TAX)) / (TTR.K(TAX) * TETTR)) * BPTR(TAX)$

01330 L $TTR.K(TAX) = TTR.J(TAX) + (DT/TETTR) (TR.J(TAX) - TTR.J(TAX) - ECTR.J(TAX))$

01340 A $FCPGMA.K(TAX) = TABHL(TFCPGM(*, TAX), PGMA.K(TAX), 1, 3, .25)$

01350 L $PGMA.K(TAX) = PGMA.J(TAX) + (DT/TPGMA) (GMAT.J(TAX) - PGMA.J(TAX))$

01360 A $GMAT.K(1) = GMA.K(1)$

01370 A $ETNSPS.K(TAX) = TABHL(TETNSS(*, TAX), TNS.K, 0, 1, .25)$

01380 A $FCTFA.K(TAX) = TABHL(TFCTFA(*, TAX), PPGSP.K/RLPPP, .6, 1, .05)$

01390 A $TAXREV.K(1) = TRBT.K(1)$

01400 A $TRBT.K(TAX) = TR.K(TAX) * TB.K(TAX)$

01410 A $TB.K(TAX) = GNP.K * TBF(TAX)$

01420 NOTE

01430 NOTE

01440 NOTE

01450 NOTE

01460 NOTE

01470 NOTE

01480 NOTE

01490 NOTE

01500 NOTE

01510 NOTE

* * * * *

* REST-OF-THE-SOCIOECONOMY SECTOR *

* * * * *

POPULATION

01520 A $POP.K = RPOP$

01530 C $RPOP = 200E6$

01540 A $FE.K = CLIP(AFE, RFE, TIME.K, TIE4)$

01550 C $AFE = .4$

01560 C $RFE = .2$

01570 A $FC.K = CLIP(AFC, RFC, TIME.K, TIES)$

01580 C $AFC = .4$

01590 C $RFC = .3$

01600 A $FCRA.K = RFCRA$

01610 C $RFCRA = .5$

01620 A $PCRA.K = POP.K * FCRA.K$

01630 NOTE

01640 NOTE

01650 NOTE

LABOR MARKET

01660 NOTE

01670 A $LF.K = PCRA.K * LFF.K$

01680 A $LFF.K = RLFF$

01690 C $RLFF = .4$

01700 L $U.K = U.J + (DT) (DPSE.JK + DGE.JK(1) - IPSE.JK - IGE.JK(1))$

01710 N $U = LF - (PSE + SUM(GE))$

01720 A $MU.K = LF.K * MUF$

01730 C $MUF = .02$

01740 NOTE

01750 NOTE

01760 NOTE

PRIVATE SECTOR EMPLOYMENT

01770 NOTE

01780 L $PSE.K = PSE.J + (DT) (IPSE.JK - DPSE.JK)$

01790 N $PSE = LF * PSEF$

01800 C $PSEF = .8$

01810 R $IPSE.KL = (PSE.K * FIPSE.K) + SUM(ETEGP.K)$

01820 A $FIPSE.K = FIED.K + FIAE.K$

01830 A $FIED.K = TABHL(TFIED, DESPSE.K/PSE.K, 1, 5, 1)$

01840 T $TFIED = 0/.25/.5/.75/1$

01850 A $FIAE.K = FIED.K * EUCFI.K$

01860 A $EUCFI.K = TABHL(TEUCFI, U.K/MU.K, 0, 7, .5)$

01870 T $TEUCFI = -1/-1/-.9/-.5/-.2/0/.1/.2/.3/.4/.5/.55/.58/.59/.6$

01880 A $DESPSE.K = DPO.K/PPE.K$

01890 R $DPSE.KL = (PSE.K * FDPSE.K) + SUM(ETEPG.K) + EDPSE.K$

01900 A $FDPSE.K = (FDGD.K * EAPE.K)$

01910 A $FDGD.K = FDGMA.K * EUCFD.K$

01920 A $FDGMA.K = TABHL(TFDGMA, CGMA.K, .75, 2.5, .25)$

01930 T $TFDGMA = 0/.015/.02/.025/.03/.035/.038/.04$

01940 A $CGMA.K = SUM(GMA.K) / TOTLG$

01950 C $TOTLG = 1$

01960 A $EAPE.K = TABHL(TEAPE, PSE.K/DESPSE.K, 0.3, .25)$

01980 NOTE
01990 NOTE
02000 NOTE DEMAND DETERMINANTS
02010 NOTE
02020 NOTE 1. GOVERNMENT OUTPUT
02030 NOTE
02040 NOTE A. SERVICES
02050 A $DEGS.K(LG) = POP.K * PCDGS.K(LG)$
02060 A $PCDGS.K(LG) = RLGOSP(LG) * ELOGSD.K(LG) * EPODGO.K * EFCDGS.K * EFEDGS.K$
02070 N $RLGOSP(1) = OGS(1) / RPOP$
02080 A $ELOGSD.K(LG) = TABHL(TEODGO, SOGSP.K(LG) / RLGOSP(LG), 0, 5, .5)$
02090 T $TEODGO = .4 / .6 / 1 / 1.5 / 2 / 2.5 / 3 / 3.5 / 4 / 4.5 / 5$
02100 A $EPODGO.K = TABHL(TEPODGO, PPGSP.K / RLFPP, 0, 2, .25)$
02110 T $TEPODGO = 0 / 0 / .25 / .6 / 1 / 1.05 / 1.1 / 1.15 / 1.2$
02120 A $EFCDGS.K = TABLE(TEFCD, FC.K / RFC, 0, 2, .25)$
02130 T $TEFCD = 0 / .25 / .5 / .75 / 1 / 1.25 / 1.5 / 1.75 / 2$
02140 A $EFEDGS.K = TABLE(TEFED, FE.K / RFE, 0, 2, .25)$
02150 T $TEFED = 0 / .25 / .5 / .75 / 1 / 1.25 / 1.5 / 1.75 / 2$
02160 NOTE
02170 NOTE B. TRANSFERS
02180 A $DGT.K(LG) = POP.K * PCDGT.K(LG)$
02190 A $PCDGT.K(LG) = RLGOTP(LG) * ELOGTD.K(LG) * EPODGO.K * EFEDGT.K$
02200 X $*EURDGT.K(LG)$
02210 N $RLGOTP(1) = OGT(1) / RPOP$
02220 A $ELOGTD.K(LG) = TABHL(TEODGO, SOGTP.K(LG) / RLGOTP(LG), 0, 5, .5)$
02230 A $EFEDGT.K = TABLE(TEFEDT, FE.K / RFE, 0, 2, .25)$
02240 T $TEFEDT = 0 / .25 / .5 / .75 / 1 / 1.25 / 1.5 / 1.75 / 2$
02250 A $EURDGT.K(LG) = TABHL(TEURDT(*, LG), U.K / MU.K, 1, 6, .5)$
02260 T $TEURDT(*, 1) = .4 / .6 / .8 / 1 / 1.2 / 1.4 / 1.6 / 1.8 / 2 / 2.2 / 2.4$
02270 NOTE
02280 NOTE 2. PRIVATE OUTPUT
02290 NOTE
02300 A $DPO.K = POP.K * PCDPO.K$
02310 A $PCDPO.K = DPCDPO.K * EPCID.K$
02320 A $DPCDPO.K = RLPPP * EOD.K$
02330 N $RLPPP = RPPGS / RPOP$
02340 A $EOD.K = TABHL(TEOD, PPGSP.K / RLPPP, 1, 5, 1)$
02350 T $TEOD = 1 / 2 / 3 / 4 / 5$
02360 A $EPCID.K = TABHL(TEPCID, PCDI.K / DPCDPO.K, 0, 1, 5, .1)$
02370 T $TEPCID = .5 / .52 / .54 / .56 / .6 / .65 / .7 / .75 / .85 / .95 / 1 / 1.1 / 1.2 / 1.3 / 1.4 / 1.5$
02380 A $PCDI.K = DI.K / POP.K$
02390 A $DI.K = (PPGS.K + GPGS.K + SUM(TP.K) - SUM(TAXREV.K))$
02400 NOTE
02410 NOTE
02420 NOTE PRIVATE PRODUCTION AND GNP
02430 NOTE
02440 A $GNP.K = PPGS.K + GPGS.K$
02450 N $GNP = RTO$
02460 C $RTO = 1E12$
02470 L $AGNP.K = AGNP.J + (DT / TAGNP) (GNP.J - AGNP.J)$
02480 N $AGNP = GNP$
02490 C $TAGNP = 1$
02500 A $PPGS.K = PSE.K * PPE.K$
02510 N $PPGS = RTO * POFRTO$
02520 N $RPPGS = PPGS$
02530 C $POFRTO = .7$
02540 A $PPGSP.K = PPGS.K / POP.K$
02550 A $APPGSP.K = SMOOTH(PPGSP.K, TAPP)$
02560 N $APPGSP = PPGS / RPOP$
02570 C $TAPP = 1$
02580 A $GPGS.K = SUM(PFGP.K)$
02590 NOTE
02600 NOTE
02610 NOTE PRODUCTIVITY OF PRIVATE EMPLOYEES
02620 NOTE

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02530 A PPE.K=K*PPE*EGRP.K*ETP.K*EWP.K
02640 N RPPE=(PPGS/PSE)*(1/EGRP)
02650 NOTE
02660 NOTE 1. EFFECT OF GOVT REGULATION
02670 A EGRP.K=TABLE(TEGRP,(EGE.K/LF.K),0,1,.1)
02680 T TEGRP=1/.98/.95/.92/.85/.75/.6/.45/.2/.05/0
02690 L EGE.K=EGE.J+(DT/TGEO)(TGE.J-EGE.J)
02700 N EGE=SUM(GE)
02710 C TGEO=5
02720 A TGE.K=SUM(GE.K)
02730 NOTE
02740 NOTE 2. EFFECT OF TECHNOLOGY
02750 A ETP.K=TABLE(TETP,T.K/RLT,0,1.5,.25)
02760 T TETP=.1/.25/.5/.75/1/1.25/1.5
02770 A T.K=CLIP(ALT,RLT,TIME.K,TIE6)
02780 N ALT=RLT*TAF
02790 C TAF=1.1
02800 C RLT=1
02810 NOTE
02820 NOTE
02830 NOTE
02840 NOTE
02850 NOTE
02860 NOTE
02870 NOTE
02880 NOTE EMPLOYMENT
02890 N GE(1)=LF*GEF*IEPLGF(1)
02900 C GEF=.15
02910 C IEPLGF(1)=1
02920 C NFIGE=.05
02930 T TEMAFI=0/.25/.6/.8/1/1.2/1.25/1.28/1.3
02940 T TEAEFG=0/0/.1/.5/.8/1/1.02/1.04/1.06/1.08/1.1/1.12/1.13/1.14/1.15
02950 T TFDPSD=1/.75/.5/.25/0
02960 T TEUCFD=1/.9/.6/.3/.1
02970 T TEAGE=0/.2/.4/.6/.8/.9/1/1.01/1.015
02980 T TFDMA=1/.3/.1/.04/0
02990 NOTE
03000 NOTE
03010 NOTE GOVT OUTPUT
03020 N RPGEPS=1
03030 T TETPGS=.85/.88/.9/.95/1/1.05/1.1
03040 N RPGEPT=4
03050 T TETPGT=.5/.65/.8/.9/1/1.1/1.2
03060 N FGEASP(1)=1-(RPGEPS/(RPGEPS+RPGEPT))
03070 N SOGSP(1)=OGSP(1)
03080 N SOGTP(1)=OGTP(1)
03090 T TTESGO=15/1
03100 NOTE
03110 NOTE
03120 NOTE MONEY BALANCE
03130 N GMB(1)=GMA(1)*(EMADP(1)*ADMB(1)*DMCOV)
03140 N GMA(1)=.75
03150 N RFPGE(1)=((RTO-RPPGS)*FRGOLG(1))/GE(1)/EMAFPE(1)
03160 C FRGOLG(1)=1
03170 T TEMAFP=0/.2/.7/.9/1/1.15/1.3/1.45/1.6
03180 N RCOU(1)=(PU(1)*RPOUPU(1))/OGT(1)
03190 C RPOUPU(1)=4
03200 T TEMAC=0/.2/.7/.9/1/1.15/1.3/1.45/1.6
03210 C RFUELG(1)=.8
03220 T TEMAEF=0/.45/.85/.9375/1/1.1/1.16/1.2/1.21
03230 C UCFPP=.05
03240 C TADP=1
03250 C DMCOV=1
03260 C TADMB=1
03270 N ADMB(1)=FFGP(1)+TP(1)+IGSO(1)+RGS(1)
03280 N ADPAY(1)=ADMB(1)*EMADP(1)

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* PARAMETERS FOR GOVERNMENT SECTOR *
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03300 NOTE
03310 NOTE
03320 NOTE DEBT
03330 N OGSY(1)=1E11
03340 N ARGS(1)=OGSY(1)/ATGS
03350 C TARGS=3
03360 T TEDSTR=2.5/1.75/1.5/1.25/1/.95/.9/.85/.75/.6/.45
03370 N DSTRRG(1)=DS(1)/TAXREV(1)
03380 T TEMADS=2/1.75/1.5/1.25/1/.95/.9/.85/.8
03390 T TEMRDS=0/.2/.4/.6/.8/1
03400 T TMRDF=1/.98/.96/.93/.9/.8/.6/.3/0
03410 N ADF(1)=DF(1)/2
03420 T TMRFAP=1/1/1/.75/.4/.05
03430 A FAPS.K=AGNP.K*FOAPS
03440 C FOAPS=.15
03450 C AVSGS=1
03460 N ASGS(1)=ARGS(1)*EMADS(1)*MRDF(1)
03470 T TMRDTP=1/.95/.9/.8/.7/.55/.3/.1/0
03480 T TMRSR=4/2.5/1.75/1.25/1
03490 T TMRTNS(*,1)=0/.25/.8/.95/1
03500 A TNS.K=TABHL(TTNS,TIME.K,0,10,1)
03510 T TTNS=0/0/0/0/0/0/0/0/0/0/0
03520 C ATGS=2.5
03530 N RDF(1)=IRGS/EMADF(1)
03540 T TEMADF=4/1.75/1.5/1.25/1/.9/.8/.75/.73
03550 C IRGS=.05
03560 NOTE
03570 NOTE
03580 NOTE TAX RATE
03590 N TR(1)=.480
03600 A GMAPG.K(1)=GMA.K(1)
03610 T TFCTMA(*,1)=.5/.25/.1/.05/0
03620 T TFCLT(*,1)=0/-.05/-.12/-.3/-.5/-.9
03630 N ATRURC(1)=.4
03640 C BPTR(1)=1
03650 T TELOAT(*,1)=0/.25/.5/.75/1/1.1/1.2/1.3/1.4/1.5/1.55/1.58/1.6
03660 T TECOAT(*,1)=.1/.2/.4/.6/.8/1/1.1/1.15
03670 T TESRAT=2/1.5/1.35/1.2/1.1/1/.8/.6/.3/.1
03680 A SRT.K(1)=SR.K(1)
03690 A SR.K(LG)=((OGSP.K(LG)/PCDGS.K(LG))*SWF)+((OGTP.K(LG)/
03700 X PCDGT.K(LG))*(1-SWF)
03710 C SWF=.5
03720 T TFCCTR=0/-.02/-.05/-.15/-.3/-.8
03730 N TTR(1)=TR(1)
03740 C TETTR=2
03750 N PGMA(1)=GMA(1)
03760 C TPGMA=2
03770 T TFCPGM(*,1)=0/-.02/-.05/-.1/-.2/-.4/-.8/-1.5/-2.2
03780 T TETNSS(*,1)=1/.4/.15/.05/0
03790 T TFCTFA(*,1)=-.9/-.7/-.5/-.35/-.2/-.1/-.03/-.01/0
03800 N TBF(1)=(GPGS+TP(1))/(GNP*TR(1))
03810 NOTE
03820 NOTE
03830 NOTE * * * * *
03840 NOTE * * * * *
03850 NOTE
03860 NOTE TESTING EQUATIONS
03870 NOTE
03880 NOTE
03890 NOTE TEST 1: REDUCTION IN EMPLOYMENT
03900 NOTE
03910 A ETEGP.K(LG)=PULSE(PTEGP.K(LG),TIE1,EI)
03920 A PTEGP.K(LG)=(GE.K(LG)*FET)/DT
03930 C FET=.5
03940 C TIE1=1000

03950 NOTE
03970 NOTE
03980 NOTE - TEST 2: REDUCTION IN SIZE OF GOVT
03990 NOTE
04000 NOTE 1. INCLUDE TRANSFER OF EMPLOYEES (I.E., TEST 1)
04010 NOTE
04020 NOTE 2. REDUCTION IN MONEY BALANCE
04030 NOTE
04040 A $ERGMB.K(LG) = PULSE(EDGMB.K(LG), TIE2, EI)$
04050 A $EDGMB.K(LG) = (GMB.K(LG) * EFDMB) / DT$
04060 C $EFDMB = .35$
04070 C $TIE2 = 1000$
04080 A $ERDMB.K(LG) = PULSE(EDDMB.K(LG), TIE2, EI)$
04090 A $EDDMB.K(LG) = (ADMB.K(LG) * EFD) / DT$
04100 C $EFD = .5$
04110 A $ERADPY.K(LG) = PULSE(EDADPY.K(LG), TIE2, EI)$
04120 A $EDADPY.K(LG) = (ADPAY.K(LG) * EFD) / DT$
04130 NOTE
04140 NOTE 3. REDUCTION IN TAX RATES
04150 A $ECTR.K(TAX) = PULSE(EMTR.K(TAX), TIE2, EI)$
04160 A $EMTR.K(TAX) = (TR.K(TAX) * EFD) / DT$
04170 NOTE
04180 NOTE 4. REDUCTION IN GOVT SECURITIES OUTSTANDING
04190 A $EDGS.K(LG) = PULSE(ERGS.K(LG), TIE2, EI)$
04200 A $ERGS.K(LG) = (OGSY.K(LG) * EFD) / DT$
04210 NOTE
04220 NOTE
04230 NOTE 5. REDUCTION IN STANDARD OUTPUT
04240 A $ERSOGS.K(LG) = PULSE(PROGSP.K(LG), TIE2, EI)$
04250 A $PROGSP.K(LG) = (SOGSP.K(LG) * EFD) / DT$
04260 A $ERSOGT.K(LG) = PULSE(PROGTP.K(LG), TIE2, EI)$
04270 A $PROGTP.K(LG) = (SOGTP.K(LG) * EFD) / DT$
04280 NOTE
04290 NOTE
04300 NOTE TEST 3: TRANSFER OF EMPLOYEES FROM PRIV TO PUBLIC
04310 NOTE
04320 A $ETEPG.K(LG) = PULSE(PTEPG.K(LG), TIE3, EI)$
04330 A $PTEPG.K(LG) = (GE.K(LG) * FET) / DT$
04340 C $TIE3 = 1000$
04350 NOTE
04360 NOTE
04370 NOTE TEST 4: ALTER FRACTION OF ELDERLY
04380 NOTE
04390 C $TIE4 = 1000$
04400 NOTE
04410 NOTE
04420 NOTE TEST 5: ALTER FRACTION OF CHILDREN
04430 NOTE
04440 C $TIE5 = 1000$
04450 NOTE
04460 NOTE
04470 NOTE TEST 6: ALTER LEVEL OF TECHNOLOGY
04480 NOTE
04490 C $TIE6 = 1000$
04500 NOTE
04510 NOTE
04520 NOTE TEST 7: ALTER GOVT EMPLOYMENT GROWTH FRACTION
04530 NOTE
04540 A $EFCFI.K = CLIP(ECFI, 1, TIME.K, TIE7)$
04550 C $EFCFI = 2$
04560 C $TIE7 = 1000$
04570 NOTE
04580 NOTE
04590 NOTE TEST 8: WAR
04600 NOTE

04620 A EWFI.K=TABLE(TEWFI,TNS.K,0,1,.25)
04630 T TEWFI=1/1.25/1.5/2/2.5
04640 A EWP.K=CLIP(1/EGRP.K,1,TNS.K,.01)
04650 NOTE
04660 NOTE
04670 NOTE * TEST 9: DEPRESSION TEST
04680 NOTE
04690 A EDPSE.K=PULSE(PEDPSE.K,TIE9,EI)
04700 A PEDPSE.K=(PSE.K*FD)/DT
04710 C FD=.25
04720 C TIE9=1000

04730 NOTE
04740 NOTE
04750 NOTE
04760 NOTE
04770 NOTE
04780 NOTE
04790 NOTE
04800 NOTE

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VARIABLES FOR PLOTTING

04810 S GSPG.K=SUM(DMB.JK)/GNP.K
04820 A GEPLF.K=SUM(GE.K)/LF.K
04830 A PEPLF.K=PSE.K/LF.K
04840 A RSSPTR.K=SUM(SGS.JK)/SUM(IMB.JK)
04850 S TRPTR.K=SUM(TAXREV.K)/SUM(IMB.JK)
04860 S GPPGNP.K=GPGS.K/GNP.K
04870 A GS.K=SUM(TAXREV.K)-(SUM(PFGP.K)+SUM(TP.K))
04880 A UPLF.K=U.K/LF.K
04890 A TRSR.K=SUM(TAXREV.K)/(SUM(TP.K)+SUM(PFGP.K))
04900 A GPGSP.K=GPGS.K/POP.K

04910 NOTE
04920 NOTE
04930 NOTE
04940 NOTE
04950 SPEC
04960 A
04970 C
04980 C
04990 A
05000 C
05010 C

SIMULATION CONTROL PARAMETERS

DT=.25/LENGTH=0
PLTPER.K=CLIP(PLP,0,TIME.K,TBPL)
PLP=1
TBPL=0
PRTPER.K=CLIP(PRP,0,TIME.K,TBPR)
PRP=.05
TBPR=2000

ANALYZER LISTING

NAME	NO	T	DEFINITION	WHERE USED
ADP	157.1	N	ACCEPTABLE DEFAULT FRACTION (DIM)	MRDF, A, 63
ADMB	51	L	AVERAGE DECREASE IN MONEY BALANCE (\$/YEAR)	DPAY, A, 50/GMB, N, 153.9/ADPAY, N, 155.6/EDMB, A, 171
	155.5	N		
ADPAY	49	L	AVERAGE DESIRED PAYMENTS (\$/YEAR)	GMA, A, 48/EDADPY, A, 173
	155.6	N		
AFC	101.1	C	ALTERED FRACTION OF CHILDREN (DIM)	FC, A, 101
AFE	100.1	C	ALTERED FRACTION OF ELDERLY (DIM)	FE, A, 100
AGNP	140	L	AVERAGE GROSS NATIONAL PRODUCT (\$/YEAR)	FAPS, A, 158
	140.1	N		
ALT	150.1	N	ALTERED LEVEL OF TECHNOLOGY (FIM)	T, A, 150
APQSP	143	A	AVERAGE PRIVATE PRODUCTION OF GOODS AND SERVICES PER CAPITA (\$/PERSON/YEAR)	BCOU, A, 40/BCU, A, 47/ECOATR, A, 85
	143.1	N		
ARGS	56	L	AVERAGE RETIREMENT OF GOVT SECURITIES (\$/YEAR)	DSCS, A, 55/DS, A, 59/ASGS, N, 158.3
	156.3	N		
ASGS	66	L	AVERAGE SALE OF GOVT SECURITIES (\$/YEAR)	TASGS, A, 65
	158.3	N		
ATGS	159.2	C	AVERAGE TERM OF GOVT SECURITIES (YEARS)	RGS, R, 71/ARGS, N, 156.3
ATR	83	A	ACCEPTABLE TAX RATE (DIM)	FCLT, A, 81
ATRURC	160.3	N	ACCEPTABLE TAX RATE UNDER REFERENCE CONDITIONS (DIM)	ATR, A, 83
BCOU	40	A	BASE COMPENSATION PER OUTPUT UNIT (\$/OUTPUT UNIT)	COU, A, 39
BCU	47	A	BASE COMPENSATION PER UNEMPLOYED (\$/PERSON/YEAR)	CU, A, 46
BPTR	160.4	C	BIAS IN PERCEIVING TAX RATE (DIM)	PTR, A, 82/PCTR, A, 88
CGMA	119	A	COMBINED GOVT MONEY ADEQUACY (DIM)	FDGMA, A, 118
CLIP			DYNAMO FUNCTION USED FOR ALTERING PARAMETERS FOR TESTING PURPOSES	FE, A, 100/FC, A, 101/T, A, 150/EBCFI, A, 186/EWP, A, 188/PLTPER, A, 202/PRTPER, A, 203
COU	39	A	COMPENSATION PER OUTPUT UNIT (\$/OUTPUT UNIT)	FOU, A, 38
CTR	77	R	CHANGE IN TAX RATE (1/YEAR)	TR, L, 76
CU	46	A	COMPENSATION PER UNEMPLOYED (\$/PERSON/YEAR)	PU, A, 42
DGCS	121	A	DEMAND FOR GOVT SERVICES (OUTPUT UNITS/YEAR)	RIGE, A, 15
DESPSE	114	A	DESIRED PRIVATE SECTOR EMPLOYEES (PEOPLE)	FDPSED, A, 11/FIED, A, 111/EAPE, A, 120
DF	73	A	DEFAULT FRACTION (DIM)	MRDF, A, 63/DGS, R, 72/ADF, N, 157.1
DGE	8	R	DECREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)	GE, L, 3/U, L, 106
DGS	72	R	DEFAULT ON GOVT SECURITIES (\$/YEAR)	OCSY, L, 53
DGT	127	A	DEMAND FOR GOVT TRANSFERS (OUTPUT UNITS/YEAR)	RLGE, A, 15
DI	138	A	DISPOSABLE INCOME (\$/YEAR)	PCDI, A, 137
DMB	33	R	DECREASE IN MONEY BALANCE (\$/YEAR)	GMB, L, 31/ADMB, L, 51/GSPG, S, 192
DMCOV	155.3	C	DESIRED MONEY COVERAGE (YEARS)	GMA, A, 48/GMB, N, 153.9
DPAY	50	A	DESIRED PAYMENTS (\$/YEAR)	ADPAY, L, 49
DFCDPO	134	A	DESIRED PER CAPITA DEMAND FOR PRIVATE OUTPUT (\$/PERSON/YEAR)	FCDPO, A, 133/EPCID, A, 136
DPO	132	A	DEMAND FOR PRIVATE OUTPUT (\$/YEAR)	DESPSE, A, 114
DPSE	115	R	DECREASE IN PRIVATE SECTOR EMPLOYEES (PEOPLE/YEAR)	U, L, 106/PSE, L, 108
DG	59	A	DEBT SERVICE (\$/YEAR)	DSTRR, A, 58/DSTRRG, N, 156.6
DGCS	55	A	DESIRED SALE OF GOVT SECURITIES (\$/YEAR)	SGS, R, 54
DSTRR	58	A	DEBT SERVICE TAX REVENUE RATIO (DIM)	EDSTRR, A, 57/DTDP, A, 68
DSTRRG	156.6	N	DEBT SERVICE TAX REVENUE RATIO GOAL (DIM)	EDSTRR, A, 57/DTDP, A, 68

DT		SOLUTION INTERVAL (YEARS)	GE, L, 3/SOGSP, L, 20/SOGTP, L, 27/GMB, L, 31/ADPAY, L, 49/ADMB, L, 51 OGSY, L, 53/ARGS, L, 56/ASGS, L, 66/TR, L, 76/TTR, L, 89/PGMA, L, 91 U, L, 106/PSE, L, 108/AGNP, L, 140/EGE, L, 147/PTEGP, A, 166/EDGMB, A, 169/EDDMB, A, 171/EDADPY, A, 173/EMTR, A, 175/ERGS, A, 177 PROGSP, A, 179/PROGTP, A, 181/PTEFG, A, 183/PEPSE, A, 190/SPEC, 201.5
DTDP	68	A DEPARTURE FROM TRADITIONAL DEBT POSITION (DIM)	MRDTP, A, 67
EAFIG	7	A EFFECT OF AVAILABILITY OF EMPLOYEES ON FRACTIONAL INCREASE IN GOVT EMPLOYEES (DIM)	FIGE, A, 5
EAGE	14	A EFFECT OF AVAILABILITY OF GOVT EMPLOYEES (DIMENSIONLESS)	FDGE, A, 9
EAPE	120	A EFFECT OF AVAILABILITY OF PRIVATE EMPLOYEES (DIM)	FDPSE, A, 116
ECFI	186.1	C EXOGENOUS CHANGE IN FRACTIONAL INCREASE (1/YEAR)	ECFI, A, 186
EQATR	85	A EFFECT OF CHANGE IN LEVEL OF OUTPUT ON ACCEPTABLE TAX RATE (DIM)	ATR, A, 83
ECTR	174	A	TR, L, 76/TTR, L, 89
EDADPY	173	A EXOGENOUS DECREASE IN AVERAGE DESIRED PAYMENTS (\$/YEAR)	ERADPY, A, 172
EDDMB	171	A EXOGENOUS DECREASE IN DECREASE IN MONEY BALANCE (\$/YEAR)	ERDMB, A, 170
EDGMB	169	A EXOGENOUS DECREASE IN GOVT MONEY BALANCE (\$/YEAR)	ERGMB, A, 168
EDGS	176	A EXOGENOUS DECREASE IN GOVT SECURITIES (\$/YEAR)	OGSY, L, 53
EDPSE	189	A EXOGENOUS DECREASE IN PRIVATE SECTOR EMPLOYEES (PEOPLE/YR)	DPSE, R, 115
EDSTR	57	A EFFECT OF DEBT SERVICE TAX REVENUE RATIO (DIM)	DCGS, A, 55
EECFI	186	A EFFECT OF EXOGENOUS CHANGE ON FRACTIONAL INCREASE (DIM)	FIGE, A, 5
EFCDS	125	A EFFECT OF FRACTION OF CHILDREN ON DEMAND FOR GOVT SERVICES (DIM)	PCDS, A, 122
EFD	171.1	C EXOGENOUS FRACTIONAL DECREASE (DIM)	EDDMB, A, 171/EDADPY, A, 173/EMTR, A, 175/ERGS, A, 177/PROGSP, A, 179 PROGTP, A, 181
EFDMB	169.1	C EXOGENOUS FRACTIONAL DECREASE IN GOVT MONEY BALANCE (DIM)	EDGMB, A, 169
EFEDGS	126	A EFFECT OF FRACTION OF ELDERLY ON DEMAND FOR GOVT SERVICES (DIM)	PCDS, A, 122
EFEDGT	130	A EFFECT OF FRACTION OF ELDERLY ON DEMAND FOR GOVT TRANSFERS (DIM)	PCDGT, A, 128
EGE	147	L EFFECTIVE GOVT EMPLOYEES (PEOPLE)	EGRP, A, 146
EGRP	147.1	N	
EGRP	146	A EFFECT OF GOVT REGULATION ON PRODUCTIVITY (DIM)	PPE, A, 145/RPPE, N, 145.1/EWP, A, 188
EI	166.3	C EXPERIMENTAL INTERVAL (YEARS)	ETEGP, A, 165/ERGMB, A, 168/ERDMB, A, 170/ERADPY, A, 172/ECTR, A, 174 EDGS, A, 176/ERSOGS, A, 178/ERSOGT, A, 180/ETEPG, A, 182/EDPSE, A, 189
EQATR	84	A EFFECT OF LEVEL OF OUTPUT ON ACCEPTABLE TAX RATE (DIM)	ATR, A, 83
ELOGSD	123	A EFFECT OF LEVEL OF OUTPUT OF GOVT SERVICES ON DEMAND (DIM)	PCDS, A, 122
ELOGTD	129	A EFFECT OF LEVEL OF OUTPUT OF GOVT TRANSFERS ON DEMAND (DIM)	PCDGT, A, 128

EMADF	74	A	EFFECT OF MONEY ADEQUACY ON DEFAULT FRACTION (DIM)	DF, A, 7J/RDF, N, 159.3
EMADP	52	A	EFFECT OF MONEY ADEQUACY ON DESIRED PAYMENTS (DIM)	DPAY, A, 50/GMB, N, 153.9/ADPAY, N, 155.6
EMADS	60	A	EFFECT OF MONEY ADEQUACY ON DESIRED SALE (DIM)	DSGS, A, 55/ASGS, N, 158.3
EMAFI	6	A	EFFECT OF MONEY ADEQUACY ON FRACTIONAL INCREASE (DIM)	FIGE, A, 5
EMAFPE	36	A	EFFECT OF MONEY ADEQUACY ON FACTOR PAYMENTS PER EMPLOYEE (DIM)	FPGE, A, 35/RFPGE, N, 154.2
EMAPEU	45	A	EFFECT OF MONEY ADEQUACY ON POPULATION OF ELIGIBLE UNEMPLOYED (DIM)	FUELG, A, 44
EMATFC	41	A	EFFECT OF MONEY ADEQUACY ON TRANSFER PAYMENT COMPENSATION (DIM)	COU, A, 39/CU, A, 46
EMRDS	61	A	EFFECT OF MARKET RESPONSE TO DESIRED SALE (DIM)	SGS, R, 54
EMTR	175	A	EXOGENOUS MODIFICATION OF TAX RATE (1/YEAR)	ECTR, A, 174
EOD	135	A	EFFECT OF OUTPUT ON DEMAND (DIM)	DPCDFO, A, 134
EPCID	136	A	EFFECT OF PER CAPITA INCOME ON DEMAND (DIM)	PCDFO, A, 133
EPODGO	124	A	EFFECT OF PRIVATE OUTPUT ON DEMAND FOR GOVT OUTPUT (DIM)	PCDGS, A, 122/PCDGT, A, 128
ERADPY	172	A	EXOGENOUS REDUCTION IN AVERAGE DESIRED PAYMENTS (\$/YEAR)	ADPAY, L, 49
ERDMB	170	A	EXOGENOUS REDUCTION IN DECREASE IN MONEY BALANCE (\$/YEAR)	ADMB, L, 51
ERDMR	168	A	EXOGENOUS REDUCTION IN GOVT MONEY BALANCE (\$/YEAR)	GMB, L, 31
ERGS	177	A	EXOGENOUS REDUCTION IN GOVT SECURITIES (\$/YEAR) (OUTPUT UNITS/PERSON/YEAR)	EDGS, A, 176
ERSOGS	178	A	EXOGENOUS REDUCTION IN STANDARD OUTPUT OF GOVT SERVICES PER CAPITA (OUTPUT UNITS/PERSON/YEAR)	SOGSP, L, 20
ERSOGT	180	A	EXOGENOUS REDUCTION IN STANDARD OUTPUT OF GOVT TRANSFERS PER CAPITA (OUTPUT UNITS/PERSON/YEAR)	SOGTP, L, 27
ESRATR	86	A	EFFECT OF SERVICE RATIO ON ACCEPTABLE TAX RATE (DIM)	ATR, A, 83
ETECP	165	A	EXOGENOUS TRANSFER OF EMPLOYEES FROM GOVT TO PRIVATE SECTOR (PEOPLE/YEAR)	DGE, R, 8/IPSE, R, 109
ETEPG	182	A	EXOGENOUS TRANSFER OF EMPLOYEES FROM PRIVATE TO GOVT SECTOR (PEOPLE/YEAR)	IGE, R, 4/DPSE, R, 115
ETNSPS	93	A	EFFECT OF THREAT TO NATIONAL SECURITY ON PUBLIC SENTIMENT (DIM)	FCTPS, A, 80
ETP	149	A	EFFECT OF TECHNOLOGY ON PRODUCTIVITY (DIM)	PPE, A, 145
ETPGES	23	A	EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF GOVT EMPLOYEES IN SERVICES (DIM)	PGEPS, A, 22
ETPGET	30	A	EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF GOVT EMPLOYEES IN TRANSFERS (DIM)	PGEPT, A, 29
EU	43	A	ELIGIBLE UNEMPLOYED (PEOPLE)	PU, A, 42
EUCFD	12	A	EFFECT OF UNEMPLOYMENT CONDITIONS ON FRACTIONAL DECREASE (DIM)	FDPSD, A, 10/FDGD, A, 117
EUCFI	113	A	EFFECT OF UNEMPLOYMENT CONDITIONS ON FRACTIONAL INCREASE (DIM)	FIAE, A, 112
EURDGT	131	A	EFFECT OF UNEMPLOYMENT RATE ON DEMAND FOR GOVT TRANSFERS (DIM)	PCDGT, A, 128
EWFI	187	A	EFFECT OF WAR ON FRACTIONAL INCREASE (DIM)	FIGE, A, 5
EWPI	188	A	EFFECT OF WAR ON PRODUCTIVITY (DIM)	PPE, A, 145

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FAPS	158	A	FUNDS AVAILABLE FOR THE PURCHASE OF SECURITIES (\$/YEAR)	MRFAPS, A, 64
FC	101	A	FRACTION OF CHILDREN (DIM)	EFCDGS, A, 125
FOCTR	87	A	FRACTIONAL CHANGE FROM CHANGE IN TAX RATE (1/YEAR)	FCTPS, A, 80
FCLT	81	A	FRACTIONAL CHANGE FROM LEVEL OF TAX (1/YEAR)	FCTPS, A, 80
FCFGMA	90	A	FRACTIONAL CHANGE FROM PERCEIVED GOVT MONEY ADEQUACY (1/YEAR)	FCTPS, A, 80
FCRA	102	A	FRACTION OF CHILD-REARING ADULTS (DIM)	PCRA, A, 103
FCTFA	94	A	FRACTIONAL CHANGE IN TAX FROM FISCAL ACTION (1/YEAR)	FCTR, A, 78
FCIMA	79	A	FRACTIONAL CHANGE IN TAX FROM MONEY ADEQUACY (1/YEAR)	FCTR, A, 78
FCTPS	80	A	FRACTIONAL CHANGE IN TAX FROM PUBLIC SENTIMENT (1/YEAR)	FCTR, A, 78
FCTR	78	A	FRACTIONAL CHANGE IN TAX RATE (1/YEAR)	CTR, R, 77
FD	190.1	C	FRACTIONAL DECREASE (1/YEAR)	PEDPSE, A, 190
FDGD	117	A	FRACTIONAL DECREASE FROM GOVT DEMAND (1/YEAR)	FDPSE, A, 116
FDGE	9	A	FRACTIONAL DECREASE IN GOVERNMENT EMPLOYEES (PEOPLE/YEAR)	DGE, R, 8
FDGMA	118	A	FRACTIONAL DECREASE FROM GOVT MONEY ADEQUACY (1/YEAR)	FDGD, A, 117
FDMA	13	A	FRACTIONAL DECREASE FROM MONEY ADEQUACY (PEOPLE/YEAR)	FDGE, A, 9
FDPSD	10	A	FRACTIONAL DECREASE FROM PRIVATE SECTOR DEMAND (PEOPLE/YEAR)	FDGE, A, 9
FDPSE	116	A	FRACTIONAL DECREASE IN PRIVATE SECTOR EMPLOYEES (1/YEAR)	DPSE, R, 115
FDPSD	11	A	FRACTIONAL DECREASE FROM PRIVATE SECTOR EMPLOYMENT DISCREPANCY (PEOPLE/YEAR)	FDPSD, A, 10
FE	100	A	FRACTION OF ELDERLY (DIM)	EFEDGS, A, 126/EFEDGT, A, 130
FET	166.1	C	FRACTION OF EMPLOYEES TRANSFERRED (DIM)	PTEGP, A, 166/PTEFG, A, 183
FGEASP	19	A	FRACTION OF GOVT EMPLOYEES ALLOCATED TO SERVICE PRODUCTION (DIM)	GEPS, A, 18/GEPT, A, 26
FIAE	112	A	FRACTIONAL INCREASE FROM AVAILABLE EMPLOYEES (1/YEAR)	FIPSE, A, 110
FIPD	111	A	FRACTIONAL INCREASE FROM EMPLOYMENT DISCREPANCY (1/YEAR)	FIPSE, A, 110/FIAE, A, 112
FIGE	5	A	FRACTIONAL INCREASE IN GOVT EMPLOYEES (1/YEAR)	IGE, R, 4
FIPSE	110	A	FRACTIONAL INCREASE IN PRIVATE SECTOR EMPLOYEES (1/YEAR)	IPSE, R, 109
FOAPS	158.1	C	FRACTION OF OUTPUT AVAILABLE FOR PURCHASE OF SECURITIES (DIM)	FAPS, A, 158
FRGE	35	A	FACTOR PAYMENTS PER GOVT EMPLOYEE (\$/PERSON/YEAR)	PFGP, A, 34
FRGOLG	154.3	C	FRACTION OF REFERENCE GOVT OUTPUT BY LEVEL OF GOVT (DIM)	RFPGE, N, 154.2
FUELG	44	A	FRACTION OF UNEMPLOYED ELIGIBLE BY LEVEL OF GOVT (DIM)	EU, A, 43
GE	3	L	GOVERNMENT EMPLOYEES (PEOPLE)	IGE, R, 4/DGE, R, 8/EAGE, A, 14/GEPS, A, 18/GEPT, A, 26/PFGP, A, 34/U, N, 106.1/EGE, N, 147.1/TGE, A, 148/RFPGE, N, 154.2/PTEGP, A, 166/PTEFG, A, 183/GEPLF, A, 193
GE	151.3	N		GE, N, 151.3
GEF	151.4	C	GOVT EMPLOYMENT FRACTION (DIM)	
GEPLF	193	A	GOVERNMENT EMPLOYEES AS A % OF LABOR FORCE (DIM)	

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GEPS	18	A	GOVERNMENT EMPLOYEES PRODUCING SERVICES (PEOPLE)	OCS, A, 17
GEPT	26	A	GOVT EMPLOYEES PRODUCING TRANSFERS (PEOPLE)	OGT, A, 25
GMA	48	A	GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)	EMAFI, A, 6/FDMA, A, 13/EMAFPE, A, 36/EMATEPC, A, 41/EMAPEU, A, 45 EMADP, A, 52/EMADS, A, 60/EMADF, A, 74/GMAT, A, 92/CGMA, A, 119/GMB N, 153.9/GMARG, A, 160/PGMA, N, 162.6
154.1	N			
GMARG	160	A	GOVT MONEY ADEQUACY PERCEIVED BY GOVT (DIM)	FCIMA, A, 79
GMAT	92	A	GOVT MONEY ADEQUACY BY TAX (DIM)	PGMA, L, 91
GMB	31	L	GOVT MONEY BALANCE (DOLLARS)	GMA, A, 48/EDGMB, A, 169
153.9	N			
GNP	139	A	GROSS NATIONAL PRODUCT (\$/YEAR)	TB, A, 97/AGNP, L, 140/AGNP, N, 140.1/TBF, N, 163.2/GS G, S, 192 GPPGNP, S, 197
139.1	N			
GPGS	144	A	GOVT PRODUCTION OF GOODS & SERVICES (\$/YEAR)	DI, A, 138/GNP, A, 139/TBF, N, 163.2/GPPGNP, S, 197/GPGSP, A, 201
GRGSP	201	A	GOVT PRODUCTION OF GOODS & SERVICES PER CAPITA (\$/PERSON/YEAR)	
GPPGNP	197	S	GOVERNMENT PRODUCTION AS A PERCENT OF GNP (DIM)	
GS	198	A	GOVERNMENT SURPLUS (\$/YEAR)	
GSPG	192	S	GOVERNMENT SPENDING AS A % OF GNP (DIM)	
IEPLGF	151.5	C	INITIAL EMPLOYEES PER LEVEL OF GOVT FRACTION (OUTPUT UNITS/PERSON/YEAR)	GE, N, 151.3
IGE	4	R	INCREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)	GE, L, 3/U, L, 106
ICSO	75	A	INTEREST ON GOVT SECURITIES OUTSTANDING (\$/YEAR)	DMB, R, 33/DS, A, 59/ADMB, N, 155.5
IMB	32	R	INCREASE IN MONEY BALANCE (\$/YEAR)	GMB, L, 31/RSSPTR, A, 195/TRPTR, S, 196
IPSE	109	R	INCREASE IN PRIVATE SECTOR EMPLOYEES (PEOPLE/YEAR)	U, L, 106/PSE, L, 108
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TOTLG	119.1	C	TOTAL LEVELS OF GOVT (DIM)	CGMA, A, 119
TP	37	A	TRANSFER PAYMENTS (\$/YEAR)	DMB, R, 33/DI, A, 138/ADMB, N, 155.5/TBP, N, 163.2/GS, A, 198/TRSR, A, 200
TRGMA	162.7	C	TIME TO PERCEIVE GOVT MONEY ADEQUACY (YEARS)	PGMA, L, 91
TR	76	L	TAX RATE (DIM)	CTR, , 77/PTR, A, 82/PCTR, A, 88/TTR, L, 89/TRBT, A, 96/TTR, N, 162.4
TRBT	96	A	TAX REVENUE BY TAX (\$/YEAR)	TBF, N, 163.2/EMTR, A, 175
TRPTR	196	S	TAX REVENUE AS A % OF TOTAL REVENUE (DIM)	TAXREV, A, 95
TRSR	200	A	TAX REVENUE SPENDING RATIO (DIM)	
TTESGO	153.5	T	TABLE OF TIME TO ESTABLISH TRADITIONAL STANDARD OF GOVT OUTPUT PER CAPITA	TESOGS, A, 21/T OGT, A, 28
TNS	159.1	T		TNS, A, 159
TTR	89	L	TRADITIONAL TAX RATE (DIM)	PCTR, A, 88
	162.4	N		
TTX			TOTAL TYPES OF TAX	TAX, F, 2
U	106	L	UNEMPLOYED (PEOPLE)	EAEFIG, A, 7/EUCFD, A, 12/EU, A, 43/EUCFI, A, 113/EURDGT, A, 131/UPLF, A, 199
	106.1	N		

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UCFPP	155.1	C	UNEMPLOMENT COMPENSATION AS A FRACTION OF PRIVATE PRODUCTION (DIM)	BCU, A, 47
UPLF	199	A	UNEMPLOYMENT AS A PERCENT OF THE LABOR FORCE (DIM)	

VARIABLE DEFINITION FILE

00010 TLG TOTAL LEVEL OF GOVTS
00020 LG LEVEL OF GOVT
00030 TTX TOTAL TYPES OF TAX
00040 TAX TYPES OF TAX
00050 GE GOVERNMENT EMPLOYEE (PEOPLE)
00060 DT SOLUTION INTERVAL (YEARS)
00070 IGE INCREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)
00080 DGE DECREASE IN GOVT EMPLOYEES (PEOPLE/YEAR)
00090 FIGE FRACTIONAL INCREASE IN GOVT EMPLOYEES (1/YEAR)
00100 ETEPG EXOGENOUS TRANSFER OF EMPLOYEES FROM
00110 PRIVATE TO GOVT SECTOR (PEOPLE/YEAR)
00120 NFIGE NORMAL FRACTIONAL INCREASE IN GOVT EMPLOYEES (1/YEAR)
00130 EMAFI EFFECT OF MONEY ADEQUACY ON FRACTIONAL INCREASE (DIM)
00140 EAFIG EFFECT OF AVAILABILITY OF EMPLOYEES ON FRACTIONAL INCREASE
00150 IN GOVT EMPLOYEES (DIM)
00160 EWFI EFFECT OF WAR ON FRACTIONAL INCREASE (DIM)
00170 EECFI EFFECT OF EXOGENOUS CHANGE ON FRACTIONAL INCREASE (DIM)
00180 TABLE TABLE LOOK-UP FUNCTION
00190 TABHL TABLE LOOK-UP FUNCTION
00200 TEMAFI TABLE OF EFFECT OF MONEY ADEQUACY ON FRACTIONAL INCREASE
00210 GMA GOVERNMENT MONEY ADEQUACY (DIMENSIONLESS)
00220 TEAEFG TABLE OF EFFECT OF AVAILABILITY OF EMPLOYEES ON FRACTIONAL
00230 INCREASE IN GOVT EMPLOYEES
00240 U UNEMPLOYED (PEOPLE)
00250 MU MINIMUM UNEMPLOYED (PEOPLE)
00260 FDFP FRACTIONAL DECREASE IN GOVERNMENT EMPLOYEES (1/YEAR)
00270 EDGS EXOGENOUS DECREASE IN GOVT SECURITIES (\$/YEAR)
00280 ETEGP EXOGENOUS TRANSFER OF EMPLOYEES FROM GOVT TO PRIVATE
00290 SECTOR (PEOPLE/YEAR)
00300 FDPSP FRACTIONAL DECREASE FROM PRIVATE SECTOR DEMAND (1/YEAR)
00310 FDMA FRACTIONAL DECREASE FROM MONEY ADEQUACY (1/YEAR)
00320 EAGE EFFECT OF AVAILABILITY OF GOVT EMPLOYEES (DIMENSIONLESS)
00330 FLPSD FRACTIONAL DECREASE FROM PRIVATE SECTOR EMPLOYMENT DISCREPANCY
00340 (1/YEAR)
00350 EUCFD EFFECT OF UNEMPLOYMENT CONDITIONS ON FRACTIONAL DECREASE (DIM)
00360 TFDPSD TABLE OF FRACTIONAL DECREASE FROM PRIVATE SECTOR DEMAND
00370 TEUCFD TABLE OF EFFECT OF UNEMPLOYMENT CONDITIONS ON FRACTIONAL DECREASE
00380 TFDPSD TABLE OF FRACTIONAL DECREASE FROM PRIVATE SECTOR DEMAND
00390 PSE PRIVATE SECTOR EMPLOYEES (PEOPLE)
00400 DESPSE DESIRED PRIVATE SECTOR EMPLOYEES (PEOPLE)
00410 TFDMA TABLE OF FRACTIONAL DECREASE FROM MONEY ADEQUACY
00420 TEAGE TABLE OF EFFECT OF AVAILABILITY OF GOVT EMPLOYEES
00430 RLGE REQUIRED LEVEL OF GOVT EMPLOYEES (PEOPLE)
00440 DEGS DEMAND FOR GOVT SERVICES (OUTPUT UNITS/YEAR)
00450 PGEPS PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING SERVICES
00460 (OUTPUT UNITS/PERSON/YEAR)
00470 DGT DEMAND FOR GOVT TRANSFERS (OUTPUT UNITS/YEAR)
00480 PGEPT PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING TRANSFERS
00490 (OUTPUT UNITS/PERSON/YEAR)
00500 OGSP OUTPUT OF GOVT SERVICES PER CAPITA (OUTPUT UNITS/PERSON/YEAR)
00510 OGS OUTPUT OF GOVT SERVICES (OUTPUT UNITS/YEAR)
00520 POP POPULATION (PEOPLE)
00530 GEPS GOVERNMENT EMPLOYEES PRODUCING SERVICES (PEOPLE)
00540 FGEASP FRACTION OF GOVT EMPLOYEES ALLOCATED TO SERVICE PRODUCTION (DIM)
00550 SOGSP STANDARD OUTPUT OF GOVT SERVICES PER PERSON (OUTPUT UNITS/
00560 PERSON/YEAR)
00570 SOGTP STANDARD OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT UNITS/
00580 PERSON/YEAR)
00590 RPGEPS REFERENCE PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING SERVICES
00600 (OUTPUT UNITS/PERSON/YEAR)
00610 ETPGES EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF GOVT EMPLOYEES
00620 IN SERVICES (DIM)
00630 TETPGS TABLE OF EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF GOVT
00640

0263J APPGSP AVERAGE PRIVATE PRODN OF GOODS & SERVICES PER CAPITA
02690 (\$/PERSON/YEAR)
02700 RPPPE REFERENCE PRODUCTIVITY OF PRIVATE EMPLOYEES (\$/PERSON/YEAR)
02710 EGRP EFFECT OF GOVT REGULATION ON PRODUCTIVITY (DIM)
02720 ETP EFFECT OF TECHNOLOGY ON PRODUCTIVITY (DIM)
02730 EWP EFFECT OF WAR ON PRODUCTIVITY (DIM)
02740 TASGS TOTAL AVERAGE SALE OF GOVT SECURITIES (\$/YEAR)
02750 TEGRP TABLE OF EFFECT OF GOVT REGULATION ON PRODUCTIVITY
02760 EGE EFFECTIVE GOVT EMPLOYEES (PEOPLE)
02770 TCEO TIME FOR GOVT EMPLOYEES TO ORGANIZE (YEARS)
02780 TGE TOTAL GOVT EMPLOYEES (PEOPLE)
02790 TETP TABLE OF EFFECT OF TECHNOLOGY ON PRODUCTIVITY
02800 ALT ALTERED LEVEL OF TECHNOLOGY (FIM)
02810 RLT REFERENCE LEVEL OF TECHNOLOGY (DIM)
02820 TAF TECHNOLOGY ALTERATION FRACTION (DIM)
02830 GEF GOVT EMPLOYMENT FRACTION (DIM)
02840 FRGOLG FRACTION OF REFERENCE GOVT OUTPUT BY LEVEL OF GOVT (DIM)
02850 SWF SERVICE RATIO WEIGHTING FACTOR (DIM)
02860 PULSE DYNAMO FUNCTION USED TO SWITCH IN EXOGENOUS RATES FOR
02870 TESTING PURPOSES
02880 EI EXPERIMENTAL INTERVAL (YEARS)
02890 TIE1 TIME TO IMPLEMENT EXPERIMENT 1 (YEAR)
02900 TIE2 TIME TO IMPLEMENT EXPERIMENT 2 (YEAR)
02910 TIE3 TIME TO IMPLEMENT EXPERIMENT 3 (YEAR)
02920 TIE6 TIME TO IMPLEMENT EXPERIMENT 6 (YEAR)
02930 TIE7 TIME TO IMPLEMENT EXPERIMENT 7 (YEAR)
02940 TIE8 TIME TO IMPLEMENT EXPERIMENT 8 (YEAR)
02950 EFD EXOGENOUS FRACTIONAL DECREASE (DIM)
02960 EDGMB EXOGENOUS DECREASE IN GOVT MONEY BALANCE (\$/YEAR)
02970 EFDMB EXOGENOUS FRACTIONAL DECREASE IN GOVT MONEY BALANCE (DIM)
02980 EMTR EXOGENOUS MODIFICATION OF TAX RATE (1/YEAR)
02990 ERDMB EXOGENOUS REDUCTION IN DECREASE IN MONEY BALANCE (\$/YEAR)
03000 EDDMB EXOGENOUS DECREASE IN DECREASE IN MONEY BALANCE (\$/YEAR)
03010 EDADPY EXOGENOUS DECREASE IN AVERAGE DESIRED PAYMENTS (\$/YEAR)
03020 ERGS EXOGENOUS REDUCTION IN GOVT SECURITIES (\$/YEAR)
03030 (OUTPUT UNITS/PERSON/YEAR)
03040 ERSOGT EXOGENOUS REDUCTION IN STANDARD OUTPUT OF GOVT TRANSFERS
03050 PER CAPITA (OUTPUT UNITS/PERSON/YEAR)
03060 PTEPG PULSE TRANSFER OF EMPLOYEES FROM PRIVATE SECTOR TO GOVT
03070 (PEOPLE/YEAR)
03080 FET FRACTION OF EMPLOYEES TRANSFERRED (DIM)
03090 ECFI EXOGENOUS CHANGE IN FRACTIONAL INCREASE (1/YEAR)
03100 TEWFI TABLE OF EFFECT OF WAR ON FRACTIONAL INCREASE
03110 GSPG GOVERNMENT SPENDING AS A % OF GNP (DIM)
03120 GEPLF GOVERNMENT EMPLOYEES AS A % OF LABOR FORCE (DIM)
03130 PEPLF PRIVATE EMPLOYEES AS A % OF LABOR FORCE (DIM)
03140 RSSPTR REVENUE FROM SALE OF SECURITIES AS % OF TOTAL REVENUE (DIM)
03150 TRPTR TAX REVENUE AS A % OF TOTAL REVENUE (DIM)
03160 GPPGNP GOVERNMENT PRODUCTION AS A PERCENT OF GNP (DIM)
03170 GS GOVERNMENT SURPLUS (\$/YEAR)
03190 UPLF UNEMPLOYMENT AS A PERCENT OF THE LABOR FORCE (DIM)
03190 TRSR TAX REVENUE SPENDING RATIO (DIM)
03200 LENGTH LENGTH OF SIMULATION (YEARS)
03210 PLTPER PLOT PERIOD FOR SIMULATION PLOTTED OUTPUT (YEARS)
03220 PLP PLOT PERIOD (YEARS)
03230 TYPL TIME TO BEGIN PLOTTING (YEAR)
03240 PRTPER PRINT PERIOD FOR PRINTED SIMULATION OUTPUT (YEARS)
03250 PRP PRINT PERIOD (YEARS)
03260 T2PR TIME TO BEGIN PRINTING (YEAR)
03270 DPTR BIAS IN PERCEIVING TAX RATE (DIM)
03280 TECTFA TABLE OF FRACTIONAL CHANGE IN TAX FROM FISCAL ACTION

01970 TBF TAX BASE FRACTION (DIM)
01980 TEMADF TABLE OF EFFECT OF MONEY ADEQUACY ON DEFAULT FRACTION
01990 RPOP REFERENCE POPULATION (PEOPLE)
02000 FE FRACTION OF ELDERLY (DIM)
02010 CLIP DYNAMO FUNCTION USED FOR ALTERING PARAMETERS FOR TESTING PURPOSES
02020 AFE ALTERED FRACTION OF ELDERLY (DIM)
02030 RFE REFERENCE FRACTION OF ELDERLY (DIM)
02040 TIME DYNAMO FUNCTION FOR RECORDING ELAPSED SIMULATION TIME (YEARS)
02050 TIE4 TIME TO IMPLEMENT EXPERIMENT 4 (YEAR)
02060 FC FRACTION OF CHILDREN (DIM)
02070 AFC REFERENCE FRACTION OF CHILDREN (DIM)
02080 AFC ALTERED FRACTION OF CHILDREN (DIM)
02090 TIE5 TIME TO IMPLEMENT EXPERIMENT 5 (YEAR)
02100 FCRA FRACTION OF CHILD-REARING ADULTS (DIM)
02110 RFCRA REFERENCE FRACTION OF CHILD-REARING ADULTS (DIM)
02120 PCRA POPULATION OF CHILD-REARING ADULTS (PEOPLE)
02130 LF LABOR FORCE (PEOPLE)
02140 LFF LABOR FORCE FRACTION (DIM)
02150 RLFF REFERENCE LABOR FORCE FRACTION (DIM)
02160 DPSE DECREASE IN PRIVATE SECTOR EMPLOYEES (PEOPLE/YEAR)
02170 IPSE INCREASE IN PRIVATE SECTOR EMPLOYEES (PEOPLE/YEAR)
02180 SUM DYNAMO FUNCTION FOR SUMMING DIMENSIONS OF AN ARRAY
02190 MUF MINIMUM UNEMPLOYMENT FRACTION (DIM)
02200 PSEF PRIVATE SECTOR EMPLOYMENT FRACTION (DIM)
02210 FIPSE FRACTIONAL INCREASE IN PRIVATE SECTOR EMPLOYEES (1/YEAR)
02220 FIED FRACTIONAL INCREASE FROM EMPLOYMENT DISCREPANCY (1/YEAR)
02230 FIED TABLE OF FRACTIONAL INCREASE FROM EMPLOYMENT DISCREPANCY
02240 DPO DEMAND FOR PRIVATE OUTPUT (\$/YEAR)
02250 PPE PRODUCTIVITY OF PRIVATE EMPLOYEES (\$/PERSON/YEAR)
02260 FDPSE FRACTIONAL DECREASE IN PRIVATE SECTOR EMPLOYEES (1/YEAR)
02270 EDGD FRACTIONAL DECREASE FROM GOVT DEMAND (1/YEAR)
02280 EAPE EFFECT OF AVAILABILITY OF PRIVATE EMPLOYEES (DIM)
02290 TGE TOTAL GOVT EMPLOYEES (PEOPLE)
02300 RELGE REQUIRED LEVEL OF GOVT EMPLOYEES (PEOPLE)
02310 TEAPE TABLE OF EFFECT OF AVAILABILITY OF PRIVATE SECTOR EMPLOYEES
02320 PCDGS PER CAPITA DEMAND FOR GOVT SERVICES (OUTPUT UNITS/PERSON/YEAR)
02330 EFCDGS EFFECT OF FRACTION OF CHILDREN ON DEMAND FOR GOVT SERVICES (DIM)
02340 EFEDGS EFFECT OF FRACTION OF ELDERLY ON DEMAND FOR GOVT SERVICES (DIM)
02350 TESOGS TIME TO ESTABLISH STANDARD OUTPUT OF GOVT SERVICES (YEARS)
02360 TTESGO TABLE OF TIME TO ESTABLISH TRADITIONAL STANDARD OF GOVT OUTPUT
02370 PER CAPITA
02380 TEFCD TABLE OF EFFECT OF FRACTION OF CHILDREN ON DEMAND FOR GOVT
02390 SERVICES
02400 TEFEDT TABLE OF FRACTION OF ELDERLY ON DEMAND FOR GOVT SERVICES
02410 PCDGT PER CAPITA DEMAND FOR GOVT TRANSFERS (OUTPUT UNITS/PERSON/YEAR)
02420 EFEDGT EFFECT OF FRACTION OF ELDERLY ON DEMAND FOR GOVT TRANSFERS (DIM)
02430 EURDGT EFFECT OF UNEMPLOYMENT RATE ON DEMAND FOR GOVT TRANSFERS (DIM)
02440 TESOGT TIME TO ESTABLISH STANDARD OUTPUT OF GOVT TRANSFERS PER CAPITA
02450 (YEARS)
02460 TTESGO TABLE OF TIME TO ESTABLISH STANDARD OUTPUT OF GOVT TRANSFERS PER
02470 CAPITA
02480 TEFEDT TABLE OF EFFECT OF FRACTION OF ELDERLY ON DEMAND FOR TRANSFERS
02490 TEURDT TABLE OF EFFECT OF UNEMPLOYMENT ON DEMAND FOR GOVT TRANSFERS
02500 PCDPO PER CAPITA DEMAND FOR PRIVATE OUTPUT (\$/PERSON/YEAR)
02510 EPCID EFFECT OF PER CAPITA INCOME ON DEMAND (DIM)
02520 EOD EFFECT OF OUTPUT ON DEMAND (DIM)
02530 TEOD TABLE OF EFFECT OF OUTPUT ON DEMAND
02540 TEPCID TABLE OF EFFECT OF PER CAPITA INCOME ON DEMAND
02550 PCDI PER CAPITA DISPOSABLE INCOME (\$/PERSON/YEAR)
02560 RPPGS REFERENCE PRIVATE PRODUCTION OF GOODS & SERVICES (\$/YEAR)
02570 PPGS PRIVATE PRODUCTION OF GOODS & SERVICES (\$/YEAR)
02580 GPGS GOVT PRODUCTION OF GOODS & SERVICES (\$/YEAR)
02590 RTO REFERENCE TOTAL OUTPUT (\$/YEAR)
02600 AGNP AVERAGE GROSS NATIONAL PRODUCT (\$/YEAR)
02610 TAGNP TIME TO AVERAGE GNP (YEARS)
02620 POFRTO PRIVATE OUTPUT AS A FRACTION OF REFERENCE TOTAL OUTPUT (DIM)

01310 MR MARKET RESPONSE (DIM)
01320 MRDF MARKET RESPONSE TO DEFAULT FRACTION (DIM)
01330 MRFAPS MARKET RESPONSE TO FUNDS AVAILABE TO PURCHASE SECURITIES (DIM)
01340 MRDTP MARKET RESPONSE TO DEPARTURE FROM TARGET DEBT POSITION (DIM)
01350 MRSR MARKET RESPONSE TO SERVICE RATIO (DIM)
01360 MRTNS MARKET RESPONSE TO THREAT TO NATIONAL SECURITY (DIM)
01370 TMRDF TABLE OF MARKET RESPONSE TO DEFAULT FRACTION
01380 DF DEFAULT FRACTION (DIM)
01390 ADF ACCEPTABLE DEFAULT FRACTION (DIM)
01400 TMRFAP TABLE OF MARKET RESPONSE TO FUNDS AVAILABLE FOR THE
01410 PURCHASE OF SECURITIES
01420 TASGS TOTAL AVERAGE SALE OF GOVT SECURITIES (\$/YEAR)
01430 TAVSGS TIME TO AVERAGE SALE OF GOVT SECURITIES (YEARS)
01440 FAPS FUNDS AVAILABLE FOR THE PURCHASE OF SECURITIES (\$/YEAR)
01450 ASGS AVERAGE SALE OF GOVT SECURITIES (\$/YEAR)
01460 TMRDTP TABLE OF MARKET RESPONSE TO DEPARTURE FROM TRADITIONAL DEBT
01470 POSITION
01480 DTDTP DEPARTURE FROM TRADITIONAL DEBT POSITION (DIM)
01490 TMRSR TABLE OF MARKET RESPONSE TO SERVICE RATIO
01500 SR SERVICE RATIO (DIM)
01510 TMRTNS TABLE OF MARKET RESPONSE TO THREAT TO NATIONAL SECURITY
01520 TNS INDEX OF THREAT TO NATIONAL SECURITY (DIM)
01530 ATGS AVERAGE TERM OF GOVT SECURITIES (YEARS)
01540 RDF REFERENCE DEFAULT FRACTION (DIM)
01550 EMADF EFFECT OF MONEY ADEQUACY ON DEFAULT FRACTION (DIM)
01560 IRGS INTEREST RATE ON GOVT SECURITIES (1/YEAR)
01570 TR TAX RATE (DIM)
01580 CTR CHANGE IN TAX RATE (1/YEAR)
01590 FCTR FRACTIONAL CHANGE IN TAX RATE (1/YEAR)
01600 FCTMA FRACTIONAL CHANGE IN TAX FROM MONEY ADEQUACY (1/YEAR)
01610 FCTPS FRACTIONAL CHANGE IN TAX FROM PUBLIC SENTIMENT (1/YEAR)
01620 FCTFA FRACTIONAL CHANGE IN TAX FROM FISCAL ACTION (1/YEAR)
01630 TFCTMA TABLE OF FRACTIONAL CHANGE IN TAX FROM MONEY ADEQUACY
01640 GMAPG GOVT MONEY ADEQUACY PERCEIVED BY GOVT (DIM)
01650 FCLT FRACTIONAL CHANGE FROM LEVEL OF TAX (1/YEAR)
01660 FCCTR FRACTIONAL CHANGE FROM CHANGE IN TAX RATE (1/YEAR)
01670 FCPGMA FRACTIONAL CHANGE FROM PERCEIVED GOVT MONEY ADEQUACY (1/YEAR)
01680 ETNSPS EFFECT OF THREAT TO NATIONAL SECURITY ON PUBLIC SENTIMENT (DIM)
01690 TETNSS TABLE OF EFFECT OF THREAT TO NATIONAL SECURITY ON PUBLIC
01700 SENTIMENT
01710 TFCLT TABLE OF FRACTIONAL CHANGE FROM LEVEL OF TAX
01720 PTR PERCEIVED TAX RATE (DIM)
01730 PROGTP PULSE REDUCTION IN OUTPUT OF GOVT TRANSFERS PER PERSON
01740 (OUTPUT UNITS/PERSON/YEAR)
01750 ATR ACCEPTABLE TAX RATE (DIM)
01760 ATRURC ACCEPTABLE TAX RATE UNDER REFERENCE CONDITIONS (DIM)
01770 ELOATR EFFECT OF LEVEL OF OUTPUT ON ACCEPTABLE TAX RATE (DIM)
01780 ECOATR EFFECT OF CHANGE IN LEVEL OF OUTPUT ON ACCEPTABLE TAX RATE (DIM)
01790 ESRATR EFFECT OF SERVICE RATIO ON ACCEPTABLE TAX RATE (DIM)
01800 TELOAT TABLE OF EFFECT OF LEVEL OF OUTPUT ON ACCEPTABLE TAX RATE
01810 RLPPP REFERENCE LEVEL OF PRIVATE PRODUCTION PER CAPITA (\$/PERSON/YEAR)
01820 TECOAT TABLE OF EFFECT OF CHANGE IN LEVEL OF OUTPUT ON ACCEPTABLE TAX
01830 RATE
01840 TESRAT TABLE OF EFFECT OF SERVICE RATIO ON ACCEPTABLE TAX RATE
01850 SRT SERVICE RATIO BY TAX (DIM)
01860 TFCCTR TABLE OF FRACTIONAL CHANGE IN TAX RATE
01870 PCTR PERCEIVED CHANGE IN TAX RATE (1/YEAR)
01880 TTR TRADITIONAL TAX RATE (DIM)
01890 TETTR TIME TO ESTABLISH TRADITIONAL TAX RATE (YEARS)
01900 TFCPGM TABLE OF FRACTIONAL CHANGE FROM PERCEIVED GOVT MONEY ADEQUACY
01910 PGMA PERCEIVED GOVT MONEY ADEQUACY (DIM)
01920 TPGMA TIME TO PERCEIVE GOVT MONEY ADEQUACY (YEARS)
01930 GMAT GOVT MONEY ADEQUACY BY TAX (DIM)
01940 TRBT TAX REVENUE BY TAX (\$/YEAR)
01950 TB TAX BASE (\$/YEAR)

00650 T INDEX OF TECHNOLOGY (DIMENSIONLESS)
00660 RLT REFERENCE LEVEL OF TECHNOLOGY (DIM)
00670 OGTP OUTPUT OF GOVT TRANSFERS PER PERSON (OUTPUT UNITS/PERSON/YEAR)
00680 OGT OUTPUT OF GOVT TRANSFERS (OUTPUT UNITS/YEAR)
00690 GEPT GOVT EMPLOYEES PRODUCING TRANSFERS (PEOPLE)
00700 RPGEPT REFERENCE PRODUCTIVITY OF GOVT EMPLOYEES PRODUCING TRANSFERS
00710 (OUTPUT UNITS/PERSON/YEAR)
00720 ETPGET EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF GOVT EMPLOYEES
00730 IN TRANSFERS (DIM)
00740 TETPGT TABLE OF EFFECT OF TECHNOLOGY ON PRODUCTIVITY OF GOVT
00750 EMPLOYEES PRODUCING TRANSFERS
00760 GMB GOVT MONEY BALANCE (DOLLARS)
00770 IMB INCREASE IN MONEY BALANCE (\$/YEAR)
00780 DMB DECREASE IN MONEY BALANCE (\$/YEAR)
00790 ERGMB EXOGENOUS REDUCTION IN GOVT MONEY BALANCE (\$/YEAR)
00800 TAXREV TAX REVENUES (\$/YEAR)
00810 SGS SALE OF GOVT SECURITIES (\$/YEAR)
00820 PFGP PAYMENTS TO FACTORS OF GOVT PRODUCTION (\$/YEAR)
00830 TP TRANSFER PAYMENTS (\$/YEAR)
00840 IGSO INTEREST ON GOVT SECURITIES OUTSTANDING (\$/YEAR)
00850 PGR RETIREMENT OF GOVT SECURITIES (\$/YEAR)
00860 FPGF FACTOR PAYMENTS PER GOVT EMPLOYEE (\$/PERSON/YEAR)
00870 RFPGE REFERENCE FACTOR PAYMENT PER GOVT EMPLOYEE (\$/PERSON/YEAR)
00880 EMAFPE EFFECT OF MONEY ADEQUACY ON FACTOR PAYMENTS PER EMPLOYEE (DIM)
00890 TEMAFP TABLE OF EFFECT OF MONEY ADEQUACY ON FACTOR PAYMENTS
00900 POU PAYMENTS FOR OTHER THAN UNEMPLOYMENT (\$/YEAR)
00910 PU PAYMENTS FOR UNEMPLOYMENT (\$/YEAR)
00920 COU COMPENSATION PER OUTPUT UNIT (\$/OUTPUT UNIT)
00930 BCOU BASE COMPENSATION PER OUTPUT UNIT (\$/OUTPUT UNIT)
00940 EMATPC EFFECT OF MONEY ADEQUACY ON TRANSFER PAYMENT COMPENSATION (DIM)
00950 APPGSP AVERAGE PRIVATE PRODUCTION OF GOODS AND SERVICES PER CAPITA
00960 (\$/PERSON/YEAR)
00970 RPOUPU RATIO OF PAYMENTS FOR OTHER THAN UNEMPLOYMENT COMPENSATION
00980 TO PAYMENTS FOR UNEMPLOYMENT COMPENSATION (DIM)
00990 TEMAC TABLE OF EFFECT OF MONEY ADEQUACY ON COMPENSATION
01000 PPGSP PRIVATE PRODUCTION OF GOODS & SERVICES PER CAPITA (\$/PERSON/YEAR)
01010 DPCDPO DESIRED PER CAPITA DEMAND FOR PRIVATE OUTPUT (\$/PERSON/YEAR)
01020 EU ELIGIBLE UNEMPLOYED (PEOPLE)
01030 CU COMPENSATION PER UNEMPLOYED (\$/PERSON/YEAR)
01040 BCU BASE COMPENSATION PER UNEMPLOYED (\$/PERSON/YEAR)
01050 UCFPP UNEMPLOMENT COMPENSATION AS A FRACTION OF PRIVATE PRODUCTION
01060 (DIM)
01070 ADPAY AVERAGE DESIRED PAYMENTS (\$/YEAR)
01080 DMCOV DESIRED MONEY COVERAGE (YEARS)
01090 TADP TIME TO AVERAGE DESIRED PAYMENTS (YEARS)
01100 DPAY DESIRED PAYMENTS (\$/YEAR)
01110 ERADPY EXOGENOUS REDUCTION IN AVERAGE DESIRED PAYMENTS (\$/YEAR)
01120 ADMB AVERAGE DECREASE IN MONEY BALANCE (\$/YEAR)
01130 TADMB TIME TO AVERAGE DECREASE IN MONEY BALANCE (YEARS)
01140 ERDMB EXOGENOUS REDUCTION IN DECREASE IN MONEY BALANCE (\$/YEAR)
01150 EMADP EFFECT OF MONEY ADEQUACY ON DESIRED PAYMENTS (DIM)
01160 TEMADP TABLE OF EFFECT OF MONEY ADEQUACY ON DESIRED PAYMENTS
01170 OGSY OUTSTANDING GOVT SECURITIES (\$)
01180 DGS DEFAULT ON GOVT SECURITIES (\$/YEAR)
01190 DSGS DESIRED SALE OF GOVT SECURITIES (\$/YEAR)
01200 EMRDS EFFECT OF MARKET RESPONSE TO DESIRED SALE (DIM)
01210 ARGS AVERAGE RETIREMENT OF GOVT SECURITIES (\$/YEAR)
01220 EDSTRR EFFECT OF DEBT SERVICE TAX REVENUE RATIO (DIM)
01230 EMADS EFFECT OF MONEY ADEQUACY ON DESIRED SALE (DIM)
01240 TARGS TIME TO AVERAGE RETIREMENT OF GOVT SECURITIES (YEARS)
01250 TEDSTR TABLE OF EFFECT OF DEBT SERVICE TAX REVENUE RATIO

03290 PROSSP PULSE REDUCTION IN OUTPUT OF GOVT SERVICES PER CAPITA
03300 (OUTPUT UNITS/PERSON/YEAR)
03310 IEPLGF INITIAL EMPLOYEES PER LEVEL OF GOVT FRACTION
03320 (OUTPUT UNITS/PERSON/YEAR)
03330 RLPPP REFERENCE LEVEL OF PRIVATE PRODUCTION PER CAPITA (\$/PERSON/YEAR)
03340 GPGSP GOVT PRODUCTION OF GOODS & SERVICES PER CAPITA (\$/PERSON/YEAR)
03350 DI DISPOSABLE INCOME (\$/YEAR)
03360 TADP TIME TO AVERAGE DESIRED PAYMENTS (YEARS)
03370 TOTLG TOTAL LEVELS OF GOVT (DIM)
03380 FDGMA FRACTIONAL DECREASE FROM GOVT MONEY ADEQUACY (1/YEAR)
0 .90 CGMA COMBINED GOVT MONEY ADEQUACY (DIM)
0 .00 TFDGMA TABLE OF FRACTIONAL DECREASE FROM GOVT MONEY ADEQUACY
03410 SOGSP STANDARD OUTPUT OF GOVT SERVICES PER CAPITA
03420 (OUTPUT UNITS/PERSON/YEAR)
03430 SOGTP STANDARD OUTPUT OF GOVT TRANSFERS PER PERSON
03440 (OUTPUT UNITS/PERSON/YEAR)
03450 FIAE FRACTIONAL INCREASE FROM AVAILABLE EMPLOYEES (1/YEAR)
03460 TEUCFI TABLE OF EFFECT OF UNEMPLOYMENT CONDITIONS ON FRACTIONAL
03470 INCREASE
03480 EUCFI EFFECT OF UNEMPLOYMENT CONDITIONS ON FRACTIONAL INCREASE
03490 (DIM)
03500 ELOGSD EFFECT OF LEVEL OF OUTPUT OF GOVT SERVICES ON DEMAND (DIM)
03510 RLGOSP REFERENCE LEVEL OF GOVT OUTPUT OF SERVICES PER
03520 CAPITA (OUTPUT UNITS/PERSON/YEAR)
03530 EPODGO EFFECT OF PRIVATE OUTPUT ON DEMAND FOR GOVT OUTPUT (DIM)
03540 TEODGO TABLE OF EFFECT OF OUTPUT ON DEMAND FOR GOVT OUTPUT
03550 TEPODG TABLE OF EFFECT OF PRIVATE OUTPUT ON DEMAND FOR GOVT
03560 OUTPUT
03570 ELOGTD EFFECT OF LEVEL OF OUTPUT OF GOVT TRANSFERS ON DEMAND (DIM)
03580 TIE9 TIME TO IMPLEMENT EXPERIMENT 9 (YEAR)
03590 EDPSE EXOGENOUS DECREASE IN PRIVATE SECTOR EMPLOYEES (PEOPLE/YR)
03600 PEDPSE PULSE EXOG DECREASE IN PRIVATE SECTOR EMPLOYEES (PEOPLE/YR)
03610 FD FRACTIONAL DECREASE (1/YEAR)
03620 TTESGO TABLE OF TIME TO ESTABLISH STANDARD GOVT OUTPUT
03630 FOAPS FRACTION OF OUTPUT AVAILABLE FOR PURCHASE OF SECURITIES (DIM)
03640 RFUELG REFERENCE FRACTION OF UNEMPLOYED ELIGIBLE BY LEVEL
03650 OF GOVT (DIM)
03660 FUELG FRACTION OF UNEMPLOYED ELIGIBLE BY LEVEL OF GOVT (DIM)
03670 EMAPEU EFFECT OF MONEY ADEQUACY ON POPULATION OF ELIGIBLE
03680 UNEMPLOYED (DIM)
03690 TEMAEP TABLE OF EFFECT OF MONEY ADEQUACY ON ELIGIBLE POPULATION
03700 RCOU REFERENCE COMPENSATION PER OUTPUT UNIT (\$/OUTPUT UNIT)