THE SYSTEM DYNAMICS NATIONAL MODEL-- OBJECTIVES, PHILOSOPHY, AND STATUS

Jay W. Forrester
System Dynamics Group
Sloan School of Management
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

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The System Dynamics National Model represents a typical, modern, industrial economy. Although parameters have been chosen for the United States, the behavior modes exhibited by the model are those being experienced in most economies in Western developed countries. The National Model incorporates a wide range of dynamic structures that allow its behavior to span from the short-term business cycle of 3-to-7-year periodicity to the much longer-term behaviors represented by growth and by major depressions that recur at intervals of some fifty years.

The System Dynamics National Model has been under development for about twelve years. An evolutionary process has been followed during which we have extended the scope of the model, added sectors, identified and corrected misbehavior, and simplified unnecessarily complex structures. There have been

more than a thousand modifications and extensions of the Model. The National Model is now close to meeting our primary objectives, and we have started writing four books describing the Model and its implications for economic behavior.

1. OBJECTIVES

The System Dynamics National Model is intended primarily to show how the policies followed at decision-making points in business and government create the behavior of an economy. When typical behavior is achieved in the Model, one can then proceed to determine how a change of policies would affect the economy. One can identify the multitude of low-leverage policies that have little effect and are not worthy of managerial and political attention. At the same time, the Model becomes a tool for locating the few high-leverage policies and determining the direction in which each should be changed.

To be useful for determining the effects of alternative policies, the Model must capture the internal causal processes that create interesting and troublesome behavior of an economy. This means that the Model should, by itself and without exogenous variables, generate the same modes of historical behavior that one is trying to understand in the real system. It should do so

as a consequence of successfully identifying the underlying structure and policies that have been producing puzzling economic behavior.

The System Dynamics National Model has been designed to advance the understanding of business cycles, depressions, inflation, and stagflation. In doing so, it should help explain economic conditions that have caused mounting concern in the last decade--rising unemployment, excess production capacity, inflation, oppressive debt, and faltering productivity.

By being able to generate the major modes of economic behavior and their resulting symptoms, the National Model should clarify how fiscal and monetary policy are related to unemployment, when government policies can alleviate business-cycle fluctuation, why controversies have arisen about the nature and policy relevance of the Phillips curve, and what alternatives are open to a country with high government deficits and a rising national debt.

2. THE SYSTEM DYNAMICS APPROACH TO ECONOMIC BEHAVIOR

The System Dynamics National Model follows the system dynamics methodology that has been progressively developed over the last 25 years. The system dynamics philosophy embodies an

array of characteristics related to feedback-loop structures in systems, internally-generated behavior, tests of confidence in a model, purpose of a model, and sources of information for model building. (1)

Although, individually, the practices embodied in system dynamics are found to varying degrees in other approaches to modeling, the uniqueness of system dynamics comes from the particular mix of characteristics and the extent to which the characteristics are followed in practice.

We believe that the approach brought to economics in the System Dynamics National Model permits progress in several previously troublesome areas. Through the National Model, additional insight should be gained into controversies about the causes of dynamic behavior--such as, what structures are involved in business-cycle behavior, where lie causes of the economic long wave, what accounts for the shifting patterns of the Phillips curve, how does stagflation with simultaneously rising inflation and unemployment develop, and how do fiscal and monetary policy affect business cycles and longer modes of economic change? Within the comprehensive structure of the National Model, policy

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(1) For background on system dynamics see Forrester 1961, and 1968; Pugh 1983; Goodman 1974; Richandson and Pugh 1981; N. Roberts et al 1983; and Randers 1980.

analysis should become more realistic than in other models that less adequately represent the underlying microstructure from which macrobehavior arises.

2.1 Structure.

Because the National Model is constructed from the structural relationships and policies at the operating level of corporations, banking, governmental decisions, and households, the Model bridges from microstructure to macrobehavior. [Forrester 1979] It shows how the overall behavior of the economy arises from the theory of the firm and the theories of consumption and government that are embodied in the Model.

The National Model focuses on the feedback-loop structure of the economy that generates dynamic behavior. The Model is expected to produce the behavior of business cycles, inflation, stagflation, and the economic long wave from within its own equations without the intervention of exogenously supplied time series. Because of the internal generation of the many modes of behavior, the Model is itself a statement of a theory that explains how those behavior modes are created.

Oscillatory behavior in the National Model, as in the business cycle and long wave modes, represents behavior that is

inherent in the structure of the economic system. The behavior modes arise because of the amplification and delays that are introduced by such processes as acquiring factors of production, setting wages and prices, determining labor participation, responding to growth expectations, reacting to inflation, and borrowing and saving.

By allowing for full disequilibrium behavior, the National Model is released from limitations that would be imposed by assumptions about equilibrium behavior. The Model can manifest damped cycles that tend to die out in the absence of continuing randomness in the system; we believe that business cycles are such a damped oscillatory mode. But the Model can also generate unstable (that is, tending to grow) oscillations that are limited in amplitude by nonlinearities in the system; we believe that the economic long wave, or Kondratieff cycle, is such an unstable mode.

2.2 Level Variables.

A system dynamics model emphasizes the level variables (otherwise referred to as accumulations, stocks, states, or integrations) in a system. Each level variable decouples inflow rates from outflow rates at its point in a system. Levels are essential to the creation of dynamic behavior. Without level

variables, a system of equations can describe only an equilibrium solution without time-varying behavior. But equilibrium analysis does not shed adequate light on inherent nonequilibrium behavior such as business cycles, inflation, and recurring major depressions. For a model to portray such important nonequilibrium modes of behavior, it must incorporate the appropriate level (or stock) variables in its physical flows and in its information channels.

In the National Model level variables occur not only in physical stocks such as goods and capital, but also in human factors such as labor, and especially in information channels. All memories and information about the past are levels in the information network of a system and are so represented in the National Model.

Level variables are the only directly observable variables in a system; instantaneous rates of flow are not observable (in the process of measurement, rates must be averaged, which involves integration and the creation of a level variable). Levels, being the only observable variables, are the only permissible inputs to decision points in a model, a restriction that reflects the restraint that nature likewise imposes on the real system.

Level variables, serving as the system's memory of the past, govern action in the present to create change in the future. Levels are surrounded by the feedback loops that generate dynamic behavior. Levels provide the information inputs to decision points that control rates of flow that in turn change the system levels.

Because of the fundamental importance of level variables in dynamic behavior, the System Dynamics National Model defines some 200 level (or stock) variables. Mathematically, each represents an integration or accumulation in either a physical or an information channel. Stocks having a wide range of lifetimes are included, from the short duration of unfilled job vacancies, through longer memory of growth trends and the lifetimes of physical capital. The National Model is thus able to generate not only the short-term business cycle but also the much longer dynamics involved in stagflation, growth, and the economic long wave.

2.3 Satisficing or Bounded Rationality.

The National Model represents decision making in accordance with what we believe are the real-life processes. Decisions at each point in the Model are based on only the limited information inputs that are customarily available and used at that point in

the real economy. Decisions are aimed at adjusting to locally-defined goals. Generally, those goals tend to have a short-term focus, as we believe they do in actual situations.

Uncertainty and lack of full understanding of the consequences of decisions tend to dominate individual actions whether at the corporate or national levels. Much of the puzzling behavior in real life arises because local decision-making objectives do not lead either to the locally intended consequences or to best results for the total system.

Decision making in the Model is directed toward "satisficing," that is, attempting to adjust toward local objectives at each point in the system. We do not rely on optimum decision making, which is seldom possible in real-life settings. Even the definition of an optimum lies beyond the reach of most decision makers. An optimum defined in the short run would differ from one for the long run. An optimum defined at a local decision point would differ from one for the system as a whole. In the National Model we have chosen to represent decision-making policies as we believe they occur in actual corporate and political systems--based on "bounded rationality" in which decisions are locally rational over a limited time span when understood and interpreted from the objectives of those in control at the local point.

2.4 Information Sources

The National Model draws on a wide range of available information--information from the mental data bases of people knowledgeable about business and national operations, from the descriptive written data base of books and journals and the business press, and from numerical data measurements of economic activity. Too often, economic models have in the past been based primarily on numerical time-series information, which is only a minor fraction of the total information that is available.

Of the three data bases--mental, written, and numerical--the mental store is the richest in providing information about policies governing decisions and the information inputs to those policies [Forrester 1980]. In the National Model, we have relied heavily on direct observation of and discussions with those who operate corporations, banks, and government agencies. In doing so, we have followed the suggestion of many who have pointed to under-utilized inputs that could be made available to economic analysis, for example, E. H. Phelps Brown, former president of the Royal Economic Society:

> "...the economist's studies should be field-determined, not discipline-determined....Let the scope of our inquiries be determined not by the customary blinkering of our field of view but by

> what the subject matter presents....We are more likely to do this if we enter personally into a clinical commitment...It also obliges the consultant to see and treat the situation before him as a whole,...we ought to value powers of observation more highly than powers of abstraction, and the insight of the historian more than the rigour of the mathematician." [Brown 1972]

Human affairs are conducted primarily from the mental data base. Anyone who doubts the dominant scope of remembered information should try to imagine what would happen to an industrial society if it were deprived of all knowledge in people's heads, and if action could be guided only from written policies and numerical information. There is no written description adequate for building an automobile, or managing a family, or governing a country.

The mental data base is far more extensive than the written and numerical stores of information. The mental data base is especially stressed here because the significance of that information is not adequately utilized in economic model building. If the mental data base is so important to the conduct of human systems, then a model of such systems should reflect knowledge of policies and structures that resides only in the mental data.

Much of the structure of the National Model, especially that related to production sectors, is drawn from twenty years of system dynamics modeling of corporate behavior aimed at a better understanding of how corporate policies determine such major behavior characteristics as growth and the stability of employment. [Forrester 1961 and 1975, Roberts 1978]

2.5 Establishing Confidence in the National Model.

The National Model is subject to the wide range of confidence-determining tests that can be a applied to system dynamics models [Forrester and Senge 1980]. We believe that "confidence" rather than "validity" is the correct concept to apply in relating a model to the real world.

There can be no proof of the absolute correctness with which a model represents reality. Confidence in a model should be evaluated in terms of the specific uses for which the model is intended. Confidence increases as the model satisfies tests that compare the model with the real system being represented. Failure to pass a test leads either to revision of the model or a narrower definition of the scope within which the model can be used.

Confidence in a model's usefulness is inherently a relative concept. One must always choose between competing models, even if that choice is between a formal model and the intuitive mental model that would otherwise be used.

There is no single test that serves to establish confidence in a system dynamics model. Rather, confidence accumulates gradually as the model passes more tests and as additional points of correspondence are identified between the model and empirical reality. The nature of system dynamics models permits many tests of model structure and behavior that are not possible with other types of models.

In system dynamics models, model structure can be compared directly to descriptive knowledge of real-system structure; and model behavior may be compared to observed real-system behavior. As changes have been made in the National Model, structure of the Model has been continuously compared with the structure of corporations and the other institutions being represented.

A variety of tests are available for comparing the National Model with information about the real economy. Some of the more important have been:

a. Extreme-condition tests reveal much about inadequacies in policy statements in the Model; many proposed formulations look plausible until examined for their behavior under extreme operating conditions.

b. The symptom-generation test asks if the Model recreates the symptoms of economic difficulty that motivated construction of the model. As the Model creates from within its own internal dynamics the stagflation, rising real interest rates, falling return on investment, and faltering productivity that have been so puzzling in recent years, one's confidence is increased that the Model reflects the major economic forces at work in the world's industrial economies.

c. The frequency-generation and also the relative-phasing tests relate to oscillatory modes of behavior and compare periodicities, damping, and phasing as generated in the Model with time-series data from the real economy. Confidence in the Model is increased when it generates not only the same modes of behavior but also the same leading and lagging indicator patterns that are observed in the real data, even with similar uncertainties appearing in cycle-to-cycle variations.

d. The multiple-mode test on the Model is answered when the model can simultaneously generate business cycles, Kuznets cycles, and the economic long wave along with some of their interactive symptoms such as stagflation.

3. THE SYSTEM DYNAMICS NATIONAL MODEL--STATUS AND RESULTS

In reaction to unfavorable economic symptoms, governments change regulations, increase expenditures, and alter tax laws. In doing so, governments are running experiments on the actual full-scale economy. Because the complexity of economic systems obscures the relationships between policies and their consequences, such experiments fail far too often.

Unfortunately, those responsible for managing countries have not in the past been able to test policy changes in the laboratory before trying them full-scale on the entire population. Now, however, the System Dynamics National Model provides a laboratory representation of a real economy. The Model permits controlled experiments in which a policy in the model can be changed to determine how real behavior would be affected. The National Model is sufficiently comprehensive in its structure that it internally generates realistic economic behavior. It does not use the external, exogenous inputs that must be assumed for important economic variables in the usual econometric models.

The National Model contains internal structures covering a range of time behaviors. In the short term are inventory-management and hiring policies; in the medium term are wage and price setting and responses to growth trends; and in the long term are policies governing capital investment and management of

debt and saving. By encompassing a diversity of short-term through long-term forces, the National Model can deal with long-range issues of economic growth, resources, energy, and capital investment, as well as with shorter-term dynamics of business cycles and economic stabilization policies. The ability to combine long-term and short-term behavior is necessary for comprehensive policy analysis, because different modes of economic behavior can affect one another, and symptoms of different simultaneous modes can be confused with one another.

By spanning from national monetary and fiscal policy down to ordering and accounting details within individual production sectors, the National Model bridges between microeconomic structure and macroeconomic behavior. Just as major behavior modes in an economy develop from deep within its structure, the Model generates the same modes from interactions between elements of the microstructure represented within production, consumption, finance, and government.

Few people suspect the degree to which the puzzling complexities of business cycles, unemployment, depressions, and inflation arise from interactions between well-known and well-understood parts of an economic system. The System Dynamics National Model is constructed from policies, organizational structure, and physical processes that would be familiar to

businessmen and those in government, and the model produces the same troubling modes of behavior experienced in real life. Actual economic behavior is puzzling, not because of insufficient information about the parts of an economic system, but because, until recently, it has not been possible to show how well-understood parts interact to produce the baffling behavior of the whole system.

The National Model does generate many of the patterns of change that have been observed in real economic systems. The Model exhibits business cycles of 3 to 7 years duration. It shows Kuznets or construction cycles of 15 to 25 years in length. [Mass 1975] The National Model produces an economic long wave, or Kondratieff cycle. [Forrester 1977] It manifests stagflation at times with simultaneous unemployment and inflation.

3.1 Business Cycles

There have been many theories about how business cycles arise; and the diverse opinions have not been resolved in the economics literature. Probably the most commonly held belief attributes business cycles to interaction of capital investment, interest rates, and consumer income; from such a theory follows a belief that fiscal and monetary policies directly affect business cycles and real economic activity. But from our work on the

System Dynamics National Model we find that the only tenable theory for business cycles is the one that is second most popular in the economics literature--that business cycles arise primarily from interactions involving employment, inventories, production, and backlogs. (2)

Business cycles are caused by activity within the private sector. Put briefly, assume consumer demand were to rise, intially inventories would fall while at the same time there would would develop a need for larger inventories. After an adjustment time, employment and production rise both to supply demand and to build up inventories. For a time, while inventories are being increased, production exceeds sales. Conversely, on a decline in sales, production falls further than sales to liquidate inventories. The larger changes in production and employment relative to sales produces an instability that appears as business-cycle fluctuation. The instability arises mostly from physical processes and competitive pressures.

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(2) For the inventory theory of business cycles, see Metzler 1941, pp. 113-129; Klein and Popkin 1961, pp. 71-86; and Abramovitz 1950.

3.2 Kuznets Cycles

The National Model generates a 15-to-25-year, rather heavily damped, oscillation that we interpret as the Kuznets cycle that has been discussed in the economic literature. This oscillation involves a varying mix of labor and capital in the goods sector, with varying employment and production in the capital sector. It seems to be a weak mode that is less important than business cycles and the economic long wave.

3.3 Economic Long Wave

The long wave, or Kondratieff cycle, which runs its course over some 50 years, is important in understanding today's economic difficulties. The long wave causes a rise and fall in capital investment, employment, and prices. (3)

In Western industrial economies, capital investment has been concentrated in periods of economic excitement lasting about three decades. Such periods of active new construction have been interrupted by major depressions. Three such major capital-

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(3) For early descriptions of the long wave in the National Model see Forrester 1976 and 1977. More recently, Graham and Senge 1980.

investment cycles have occurred since 1800. Vigorous economic activity has been terminated by Great Depressions in the 1830s, 1890s, and 1930s.

Literature on the Kondratieff cycle is filled with debate and conflicting assertions. Economic evidence has been interpreted differently by different observers. Because no theory of the long wave existed to show how the many aspects of reality could fit into a unified pattern, controversy was unavoidable.

Until the National Model showed a mechanism for generating the long wave, there had been no cohesive theory to explain how an economic pattern spanning a half century could be systematically and internally created. We believe the National Model now provides a theory of how the economic long wave is generated.

The long-wave process involves an overbuilding of capital sectors during which they grow beyond the capital-output rate needed for long-term equilibrium. Capital plant is expanded until it exceeds the level justified by the marginal productivity of capital. Finally, the overexpansion is ended by a depression during which excess capital plant is physically worn out and is

financially depreciated on the account books until the economic stage has been cleared for a new era of rebuilding.

Long-wave behavior, as revealed in the National Model, seems to explain many things now happening around the world. Current economic conditions are much like those that the National Model exhibits at a peak of the long wave. At such a peak one should expect business cycles to become more severe, excess capacity to appear in many industries, productivity to no longer rise as it had before, return on investment to be declining, prices to rise, debt to increase, and unemployment to worsen. Also, at a peak in the long wave, interest rates would be high, the pace of capital investment would slacken, and technical innovation would diminish. Such conditions fit today's situation. Similar conditions last occurred in the 1920s and 1930s around the previous long-wave peak.

3.4 Inflation

The worldwide debate regarding inflation reveals confusion about causes of inflation and disagreements about policy recommendations. From different viewpoints, inflation presents quite different appearances. Inflation has been attributed to a variety of causes including labor unions, insufficient capital

investment, government deficits, monetary policy, and the oil shortage. Faced with such conflicting opinion, neither governments nor the public have known what to do.

The System Dynamics National Model is beginning to offer a new perspective for understanding inflation. Many anti-inflation policies in recent years have been ineffective because they treated immediate symptoms, rather than underlying causes of inflation. We believe that much of the confusion about inflation arises from failing to distinguish six different processes we see in the National Model that can cause prices to vary:

1. business-cycles
2. the economic long wave
3. economic stresses
4. inflationary expectations
5. changing velocity of money
6. changing money supply.

These six processes that vary prices can exist independently, but their consequences are superimposed in the economic data. The effects of all six appear in prices, wages, production, unemployment, liquidity, and interest rates. With the consequences of several sources of price movement intermingled in the data, it has been impossible for statistical

analysis to separate important from unimportant processes, or to distinguish causes from symptoms.

Business-cycles contribute rising and falling components to total price change. Due to the business cycle alone, prices would decline during recessions by as much as they rise during upturns. The compensating rise and fall of prices from business cycles is of little consequence to inflation. But even so, business-cycle price movement dominates much of the political and professional debate about inflation.

Prices also rise and fall over the economic long wave. The amplitude of price movement from the long wave is far larger than from business cycles. Heavy debt loads are created during expansion of the long wave, and new money is created when debt is extended by commercial banks. At the long-wave peak, the added money encourages speculation that pushes up the prices of land and commodities. Fluctuating capital investment, debt, prices, and interest rates help drive the long wave. Price change from the long wave can easily be confused with true continuing inflation caused by excessive creation of money by the government.

Economic stresses can cause a one-time increase in prices, but not a sustained rise in prices, unless the money

supply is increased. The stress processes include many of the alleged causes of inflation except for governmental increase in the money supply. In a stress process, something pushes up one or more prices in an economy. Such a stress can be created by a shortage of some commodity, reduced productivity, declining innovation, union bargaining pressure for higher wages, or resistance to downward movement of prices and wages. A rise in price created by stress is self-limiting. The stress induces counterbalancing forces that reduce other prices. The counterbalancing forces appear as higher unemployment, lower liquidity, less production, larger unsold inventories, and higher interest rates. In time, the counterbalancing forces cause price readjustments that relieve the stress.

Once prices are rising, strong forces become established to sustain the rise. Inflation creates the expectation of further inflation. Suppliers raise prices and unions bargain for higher wages, all in anticipation of continuing inflation. Once established, the circular process of prices rising because wages increase, and wages rising because prices increase, will continue until counterpressures dispell the inflationary expectations. The counteracting forces appear as falling demand for goods, which will put a downward pressure on prices, and rising unemployment, which will put a downward pressure on wages.

Velocity of money is intimately related to prices and to the ability of a monetary authority to control the price level. Other things being equal, if the velocity of money doubles, so will the price level. An increase in the velocity of money is just as powerful in raising prices as would be a corresponding increase in the amount of money. Many legal, technical, banking, and managerial changes are reducing the size of necessary bank deposits. Electronic banking, computers for corporate data processing, money market funds, credit cards, automatic loans for overdrafts, and relaxation of banking regulations all contribute to increased velocity of money and a rise in prices.

An excess of new money created by the government is the only cause of indefinitely continuing inflation. New money is created when the monetary authority buys government bonds. The bonds represent either past or current government deficits. By such monetizing of government deficit, both the underlying money supply and bank reserves are increased. The additional bank reserves allow commercial banks to create still more money by expanding their loans. In the United States, debt extended by commercial banks is the source of about three-fourths of the total money supply. Except for public political reaction against inflation, there seems to be no counterforce internal to the financial system that will stop continuous money creation by government.

3.5 Phillips Curve

The so-called Phillips curve has dominated much of the debate about inflation. The Phillips curve refers to an assumption that there is a tradeoff between inflation and unemployment. [Phillips 1958] According to the Phillips curve viewpoint, if action is taken to reduce inflation, the result will be increased unemployment and vice versa. The Phillips curve concept is woven through much of the inflation debate. Most politicians, much of the press, and many economists believe that government action to alter money supply has a major and immediate effect on unemployment. But our work with the National Model suggests that the belief in a close coupling between an increase in money and more employment has been substantially exaggerated.

We find from our work with the National Model that the classical Phillips curve is generated within the business-cycle mode in the economy. During a business cycle, employment fluctuates as a consequence of the way inventory and employment policies interact in the presence of decision-making uncertainty. Wages and overtime payments change in response to changing demands for labor. Prices change over the business cycle as a consequence of wage change and supply-demand imbalances.

Part of the inflation debate deals with the significance of shifts in the Phillips curve. Real data show that the Phillips curve has moved up and down. It has moved right and left. It has rotated. One wonders how a curve that can lie almost anywhere on the plot could have captured so much political attention.

Because the economy can generate a Phillips curve, one should expect that the National Model would generate a similar relationship between wage change and unemployment. The National Model does not contain a Phillips curve assumption as such. The Model does contain policies governing prices, wages, and employment. For example, wages are caused to change by availability of labor, that is, the average time to fill job openings. Wages are also affected by inflation expectations, wage controls, and return on investment and liquidity of the employer. The National Model generates time-series data for wage change and for unemployment as does a real economy. When only the business-cycle mode is active, the relationship that is produced between wage change and unemployment is that of the simple Phillips curve. Like historical data, they show substantial scatter but define a downward-sloping curve.

Both vertical and horizontal shifts of the Phillips curve occur during the economic long wave. In the expansion stage of

the long wave when capital construction is active, unemployment is low and the Phillips curve is moved to the left. Then, when the rate of new construction slows and money is released from capital-construction transactions, the excess money leads to bidding up prices and the Phillips curve rises into a region of higher inflation. At the end of the construction phase, when unemployment increases, the curve moves to the right. During the depression period, prices fall and deflation causes the Phillips curve to move down. These long-wave movements occur over a 45-to-60-year time span and cause shifts in the Phillips curve as the long wave moves from one stage to the next.

B.4 Stagflation

Economists and political leaders have been surprised by stagflation. Stagflation is the appearance at the same time of unemployment and inflation. A few years ago it was believed on the basis of the Phillips curve relationship that a country could have either unemployment or inflation but not both simultaneously. The misunderstanding arose from failing to recognize the many different economic mechanisms that can cause unemployment and can change prices.

Recognizing the several different causes of price change helps to explain stagflation. Stagflation occurs because the

unemployment arises from behavior within the real, private-business side of an economy, while the inflation comes from government increase in money.

Rising unemployment is being caused by both the economic long wave and by the economic stress processes. But in the last three decades, governments have tried to actively intervene to control economic behavior. In response to rising unemployment, high interest rates, and reduced liquidity, governments have used monetary and fiscal policies to increase the money supply. However, increased money is very weak in combatting unemployment arising from real physical causes within an economy. Instead, increased money leads primarily to bidding up prices of goods and services.

In stagflation, unemployment results from government social policies and from changes occurring in the business and consumer sectors of an economy. The accompanying inflation is a consequence of the price rise from the economic long wave and from futile governmental efforts to stimulate economic activity by increasing the money supply.

4. - SUMMARY

The System Dynamics National Model has existed in many versions. Some versions have represented evolutionary improvement, other versions have been created especially to study one or another of the major modes of economic behavior. We have not yet had a single, trouble-free model that simultaneously exhibited all of the behavior characteristics that I have discussed.

We are now making a final assembly of the National Model that should be robust and represent the full range of economic behavior that we want to see for the initial publication of the Model and its implications. Four books are under way to report a detailed description of the Model and the lessons learned from working with it.

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