

Interactive Model of Business Cycles

A Poster Presentation

International System Dynamics Conference

Palermo, Italy

July 28 – August 1, 2002

David Wheat

President, Wheat Resources Inc.

Adjunct Professor, Virginia Western Community College

P.O. Box 19234

Roanoke, Virginia 24019

<http://www.wheatresources.com>

888-667-8850 (toll-free)

540-966-5167 (fax)

dwheat@wheatresources.com

keywords: business cycles, circular flow, consumption, economy, economic policy, fiscal policy, experiment, fluctuations, forecasting, instruction, interactive, investment, labor, macroeconomics, microworlds, monetary policy, production, sales, scenarios, STELLA, teaching

Interactive Model of Business Cycles

A Poster Presentation

International System Dynamics Conference, 2002

David Wheat
President, Wheat Resources Inc.
Adjunct Professor, Virginia Western Community College

Abstract

This presentation previews a research project for evaluating whether system dynamics business cycle models, when used as instructional tools in undergraduate macroeconomics courses, can enhance student understanding of business fluctuations. First, we will demonstrate a system dynamics model of the standard economics textbook diagram of the circular flow of national income and national product. A working model of the circular flow is useful for revealing patterns of multiplier effects of injections and leakages of spending and income. Yet, even a *dynamic* circular flow model is still fundamentally an accounting tool when standing alone. As we progressively add links with behavioral models of business cycle subsystems, however, the circular flow model behaves more like a real economic system.

Conference participants can interact with a microworld version of the model during the poster sessions, examine changes as behavioral models are successively linked to the accounting model, and test alternative assumptions and policy scenarios.¹ Later, in the experimental design phase of the project, we will test whether this approach—when compared to traditional comparative statics instruction—can improve student understanding of fluctuations in economic activity. Suggestions for improving the model would be appreciated, as would thoughts on the design of tests to measure its effectiveness as an instructional tool.

The Problem. It appears that the predominant methods and tools of macroeconomic instruction in undergraduate courses—graphical analysis of comparative statics in a lecture format—may not be providing students with a sustainable understanding of the dynamic processes at work in a market economy, and may even be dampening interest in learning economics. A possible solution is to introduce advanced quantitative methods at the undergraduate level in order to demonstrate market dynamics. However, that is not feasible due to the lack of requisite mathematical skills among most undergraduates and, moreover, the associated rise in student frustration would likely aggravate some of the attitudinal problems that have been observed. An alternative solution is to transform the circular flow diagram of national income and national product into a functional computer model. Such a model should demonstrate the dynamic,

¹ Diagrams of the circular flow model, the behavioral models, and their links will be available at the poster table during the conference. In addition, copies can be obtained by contacting the author by email (dwxheat@wheatresources.com), toll-free telephone (888-667-8850), or fax (540-966-5167).

cyclical behavior of economic markets, be accessible to undergraduates, and enable more active engagement of students in constructing essential macroeconomic understandings.

This presentation previews a research project designed to evaluate the latter alternative. Using the methodology and tools of system dynamics, the plan is to transform the circular flow diagram into a computer model for use by instructors and students in undergraduate macroeconomics courses.

Generally, a model of the process implicit in the circular flow diagram alone would not be capable of endogenous generation of the recurring forces that drive business cycles. The proposed solution is to link the circular flow model to other system dynamics models that simulate an economy's realistic tendencies to diverge from equilibrium. In short, we seek an answer to this question:

Can a system dynamics model of the national income accounting circular flow diagram, fashioned in modular links with system dynamics behavioral models of key economic subsystems, contribute to improved understanding of business cycles on the part of undergraduates in introductory macroeconomics courses; and, if so, under what conditions?

Preliminary Literature Review. The mathematical complexity of economics explication has become a hallmark of the economics profession.² However, the quantitative aptitude and/or training necessary for working with modern economists' models are rarely found among the attributes and experience of undergraduate students. Thus, most economics students—including those bound for graduate school—continue to be relegated to classes where reliance is on graphical analysis and the teaching of comparative statics.³

² Critics would be unlikely to use such a positive metaphor as "hallmark." One does not have to agree with the following comment by economist Basil Moore (1988) to admit that his allegation is colorfully conveyed: "Macroeconomics is in a state of chronic disarray. □As its mathematical sophistication has intensified, its contribution to our understanding of the real world has diminished. □Increasing rigor has been accompanied by increasing mortis."

³ Advanced instruction relies on calculus to demonstrate dynamic economic behavior. However, while succinct, efficient, and rigorous, the abstract calculus formulations alone may deaden some students' sensitivity to real-world economic behavior. Therefore, if this project supports the hypothesis that system dynamics models can enhance undergraduate instruction, then consideration should be given to similar experiments in higher level courses.

Kennedy (2000) provides a clear summary of the tools used in economics courses:

Students learn to analyze economic phenomena through economic models, formalized with graphs and, at advanced levels, algebra and calculus. Much time is devoted to learning how to manipulate various graphical and algebraic models that have come to serve as an intellectual framework for economists.... At the undergraduate textbook level, the technical dimension is predominantly in the form of graphical analysis.... At advanced levels the technical dimension is dominated by algebraic formulas in which Greek letters play prominent roles.

A critical question is *how much* “students learn to analyze economic phenomena” by using those tools and, more importantly, how such learning transfers to an understanding of the way an economic system works. One recent article suggests that the graphical approach in undergraduate courses may be no more effective than mere verbal explication. In 1997, Cohn et al. (2001) found that during instruction on a Keynesian concept, there was no significant difference in learning gain by students who received graphics instruction compared to those who received only verbal instruction. In a similar experiment in 1995, when a monetary policy topic was presented, students receiving graphical instruction actually scored significantly *lower* than students receiving verbal instruction alone.⁴ If a well prepared, articulate lecturer who does not use graphs may do as well or better than one who uses graphs, perhaps that says something about the graphical mode of instruction. In this connection, Boucher (1995) notes that

... comparative statics has a long and honourable history, ...[but] there is a possibility that by over-concentration on comparative statics, the profession may be omitting or playing down the key importance of the dynamic aspects of most economic problems and issues.

In addition, many students may find it difficult to see how the proliferating textbook graphs relate to one another, and how they interact to influence economic system performance. Indeed, interaction—inherently *multiplicative*—is de-emphasized by the graphical aggregate demand and supply approach, with its emphasis on *adding up* consumption, investment, government spending, and net export curves. Moreover, the

⁴ The learning was measured in terms of gain in pre- and post-test test scores. The Cohn research team established various controls on the two test groups in each experiment, and concluded that the difference in performance in the 1995 experiment was statistically significant at the one percent level.

pseudo-dynamic, stair-step movement over the consumption function curve (when searching for a new equilibrium point) conveys a mechanical sense of inevitability that just does not prevail in a real economy. The elusive dynamics of interaction is almost certainly missed by students struggling just to keep track of the applicable *ceteris paribus* assumptions behind each new graph.

Yet, the Cohn experiments measured just short-term retention of information learned. What about long-term?

Nearly forty years ago, Stigler (1963) asserted that, five years out of college, students with and without a “conventional” one-year economics course would display little difference in economics knowledge and understanding. The results of two tests of the Stigler hypothesis—one involving students seven years beyond university graduation and the other involving university seniors—led Walstad and Allgood (1999) to conclude that “...the economics instruction that students receive at the university level seems to have little effect on what they know about basic economics when they graduate from a university or afterward... [The] test score difference [in favor of those having taken an economics course] is minimal, even if it is statistically significant, and the final level of achievement is low.... [The Stigler] hypothesis and its implied criticism of principles instruction cannot be dismissed.⁵

Comparative statics is the dominant theoretical method in undergraduate courses, and graphical analysis is the instructional tool of choice. The third leg on the instructional stool—the content delivery technique of academic economists—is predominantly lecture style. In 1995 and again in 1996, Becker and Watts (1998) found that about 80 percent of economics classroom contact time was spent lecturing—“chalk and talk”—whether the courses were introductory or advanced. In contrast, the use of techniques to get the students actively engaged in constructing knowledge was minimal. Even in statistics and econometrics courses, just 22 percent of the available time was spent in computer labs.

⁵ The first test group of students had been out of college for seven years, and on a 33-item multiple choice test, the alumni who had taken an introductory economics course scored just 3.2 points higher than the other group when other factors were statistically controlled. On a 33-item test, that is equivalent to answering correctly just one more question. Similar results were found when comparing university seniors: those who had taken an economics course barely outscored those who had not (less than 5 points in one test and 2 points in another).

Of course, heavy reliance on the lecture style is not *prima facie* evidence of ineffective instruction. Yet, coupled with the other staples of undergraduate instruction methods—graphical analysis of comparative statics—excessive reliance on lectures may cause additional problems even if learning were not impaired. In their research on innovative teaching methods, Becker and Watts found that

*...in most of the articles we reviewed on innovative and active-learning approaches, there was at least anecdotal evidence, and in many cases data from student course and instructor evaluations, indicating that students preferred these [non-lecture] approaches.... Student preferences certainly aren't the only measure of instructional effectiveness and value, but they do count for something, **ceteris paribus**, and together with student grades, it seems plausible that they are related to future enrollments in upper-division economics courses.⁶*

When Boucher (1995) reached a similar conclusion, he offered an admonition:

This ought to persuade the profession to seek to identify the reasons for this decline, and attempt to establish policies and strategies to reverse or attenuate the rate of change in this process.

Rationale for a System Dynamics Solution. Beginning with J. Forrester (1961), four decades of system dynamics research has demonstrated the inherent cyclical behavior resulting from the endogenous interaction of an economy's key components, each represented explicitly by either stocks or flows of goods, services, materials, capital, labor, information, income, and expenditures.⁷ This project is designed to test the general hypothesis that using system dynamics business cycle models can improve a macroeconomics educational process that relies largely on graphical comparative statics and underutilizes the instructional potential of the circular flow concept. Specifically, we want to know if a system dynamics model of the national income accounting circular flow diagram, fashioned in modular links with system dynamics behavioral models of key economic subsystems, can contribute to improved understanding of business cycles on the part of undergraduates in introductory macroeconomics courses.

⁶ *Teaching Economics to Undergraduates* (Becker and Watts, 1998) contains a number of examples of innovative instructional methods. In addition, Barreto (2001) maintains a web site devoted to a non-lecture method of teaching comparative statics, using Excel spreadsheets.

⁷ Economists' dynamic business cycle models have an even longer history but, as Kennedy (2000) said, "Greek letters play prominent roles" in their formulas, and the models' quantitative complexity has been a barrier to student access in undergraduate courses.

The early characterization of business cycles is attributed to Burns and Mitchell (1946).⁸ Others, of course, had long been studying particular features of business fluctuations. Wicksell (1898), for example, studied the impact of interest rates on real economic activity; while Hawtry (1913) and Hayek (1933) focused on the swings in availability of bank credit and its alternating impact on both prices and real output. The study of fluctuations, of course, would seem to posit the existence of some norm from which deviations occur. Decades earlier, that norm had been established by Walras (1874), with his development of general equilibrium theory, a mathematical solution to the problem of how interrelated markets could achieve simultaneous equilibrium.⁹

In his review of the work of the early business cycle theorists, Zarnowitz (1996) concludes that

the dominant tone is one of awareness that what matters most is the interaction of changes in money and credit with changes in economic activity...[Also,] the theories are mainly endogenous. That is, they purposely concentrate on internal dynamics of the system....They viewed the role of exogenous forces as secondary “disturbers of endogenous processes, with power to accelerate, retard, interrupt, or reverse the endogenous movement of the economic system.” [quoting Haberler (1937, 1964)]

The system dynamics paradigm is consistent with the Zarnowitz description of what might be called the classic business cycle theoretical perspective. According to Sterman (2000), system dynamics research suggests that

the business cycle is a damped oscillation originating from the interaction of inventory management with the labor supply chain [and] this damped oscillation is kept alive in the real world by continuous, random disturbances originating from the environment.

However, a difference exists with respect to the concept of equilibrium. The Walrasian equilibrium is achieved when all markets clear, whereas the system dynamics equilibrium makes no assumption that all markets will clear simultaneously. Indeed, equilibrium in a system dynamics economic model is achieved when stocks are

⁸ Burns and Mitchell emphasized that business cycles are “recurrent but not periodic,” and Zarnowitz attributes the persistent use of the term *business cycle* (even though it is a misnomer) to “the recognition of important regularities of long standing.” He also emphasizes that the fluctuations in economic activity that we call business cycles differ greatly in “amplitude and scope, as well as duration.”

⁹ The historical discussion in this section relies on Zarnowitz (1996) and Pressman (1999). Spanning half a millennium, Pressman provides fifty colorful accounts of major economists such as Walras and Wicksell.

unchanging, meaning that inflows and outflows are equal. In discussing the system dynamics National Model developed at MIT, J. Forrester (1980) states unequivocally that it is a “disequilibrium model” that makes “no theoretical assumptions that markets always clear or that they function in an optimal manner.” He elaborates:

One important way in which disequilibrium behavior is captured in the National Model is through the representation of level variables, or accumulations, that decouple rates of flow. For example, in the model, as in real life, the differences between production and sales of a business accumulate in a level of inventory. In the model, therefore, production and consumption (sales) need not be equal at each point in time. If, for example, production is below sales, inventory will fall, thereby signaling a need to expand production by acquiring additional labor, capital, materials, and other factors of production. By incorporating conserved levels of inventories, money balances, and other tangible items, the National Model will contain the processes of accumulation (integration) that give real systems their dynamic behavior.

Forrester’s concept of “decoupling rates of flow” is central to the structure of system dynamics models of the economy.¹⁰ Moreover, for purposes of this project, it is the prospect of unequal flows (e.g., production and sales) in and out of a stock (e.g., product inventories) that provides the potential for turning the steady-state circular flow model into one that displays the “dynamic behavior” of “real systems.”

Thus, system dynamics conceptualizes an economy as a collection of market systems in which more or less continuous inflows of resources, or factors of production, are transformed into more or less continuous outflows of real goods and services. Market systems are sets of interrelated entities and activities that determine the prices and quantities of inflowing resources and outflowing goods and services. Payments for items sold in markets constitute a second basic set of flows—money—to suppliers of goods, services, and resources.

The flows accumulate for different lengths of time at various points in the system as stocks of physical inventories (e.g., raw materials awaiting processing, laborers working or not, capital equipment in-use or idle, finished products awaiting distribution and sale) or money stocks (e.g., currency in the hands of the public, checkable accounts, savings accounts, retained earnings). Changes in money stocks reflect changes in the

¹⁰ See, for example, Maas (1975 and 1980), N. Forrester (1973), Low (1980), Sterman (2000), and Saleh and Davidsen (2001).

value of loans and checkable banking accounts, often due to central bank monetary policy initiatives in the government securities market. Money stock changes can have multiple impacts on consumption and investment, as can changes in government spending and net taxation. Such changes in monetary and fiscal policies are, in turn, triggered by fluctuations in the circular flow of goods, services, resources, and money in the overall economic system.

Even this skeletal description of an economy-at-work suggests that it is the behavior of the stocks and flows in the markets that determines the behavior of the overall economic system. Of course, recognition of the difference between stocks and flows is not limited to practitioners in the field of system dynamics. The distinction is commonly found in economics textbooks, and some economists organize their analysis around that difference. When Godley (1983) described his theoretical framework, for instance, he compared it to making “a monetarist financial system (based on the behavior of stocks of money, financial assets, and debt) drive a Keynesian flow system based on the response of expenditure to income.”

What may be distinctive about the system dynamics handling of stocks and flows is the ready incorporation of non-linear feedback—both physical and informational flows—and the recognition that people observing even a simple system (or operating within it) often misjudge the behavior of stocks and flows. There is a growing literature on the “misperception of feedback” and the implications for those responsible for interpreting the likely behavior of a system. The implications in a public policy setting are obvious. Less obvious, but more germane to this project is that, in economics classes, merely telling students that there are stocks and delayed feedbacks is not sufficient to ensure that students draw correct conclusions about the likely behavior of that system.¹¹

A subtle yet additionally useful characteristic of SD models is that they divert attention from their underlying mathematics and focus the learner’s mind on the visible structure of a model and its representation of a real-world economic system. As is true of all models, that representation is vastly simplified. Nevertheless, as Richmond (2000) emphasizes, visualizing the “physics” of the system is a big step towards understanding the interactive forces at work. Relative-absence-from-view, of course, does not mean

¹¹ See Moxnes (2000) and Sterman (2000), for example, on the issue of misperception of feedback.

relative insignificance. Clearly, in both the system dynamicists' models and those of the economists, it is the equations that generate the models' dynamic behavior. In that regard, Sterman (2000) provides a simple yet vivid illustration of the equivalence of stock-flow diagrams and the corresponding integral and differential equations.¹²

Preview of the Instructional Model. A premise of this research effort is that the well known circular flow diagram that illustrates the national income accounting identity is underutilized as a tool for teaching dynamic economics. An initial task of the project will be to demonstrate the value of the circular flow diagram after it has been converted to a system dynamics computer model. On the next page, Figure 1 displays a preview of such a model: a highly simplified schematic of the national income circular flow process from a system dynamics perspective.

Among the simplifications of the diagram in Figure 1 are these assumptions: no international trade, no financial intermediaries (loans and debt service are shown flowing directly from one sector to another), and no central bank to exert influence over the money supply. In addition to excluding flows of services and products, the diagram also omits relatively minor financial flows (e.g., business transfer payments) and some very important ones (e.g., business investment). All of the major constraints will be removed at appropriate stages in the instructional process.

J. Forrester's principle of decoupling flows provides guidance to the central task. Within each sector ("box") at any given time, there is a stock of unspent money that is the current difference between income and expenses in that sector. The cumulative total of those stocks, again at any given time, represents "national savings." For purposes of simplicity in this high-level diagram, the total flow of funds from one sector to the other is represented by a thick "bundled" arrow, whereas in the computerized version of the model, each separate flow is represented by a separate arrow. Here, and in the computerized version, the stocks represent "inventories" of money. Only when the inventory levels are constant (i.e., when inflows and outflows are equal) will equilibrium prevail. Only then will national product equal national income.

¹² Exposition of advanced economic concepts would appear to be enhanced by the visual representations such as Sterman provides.

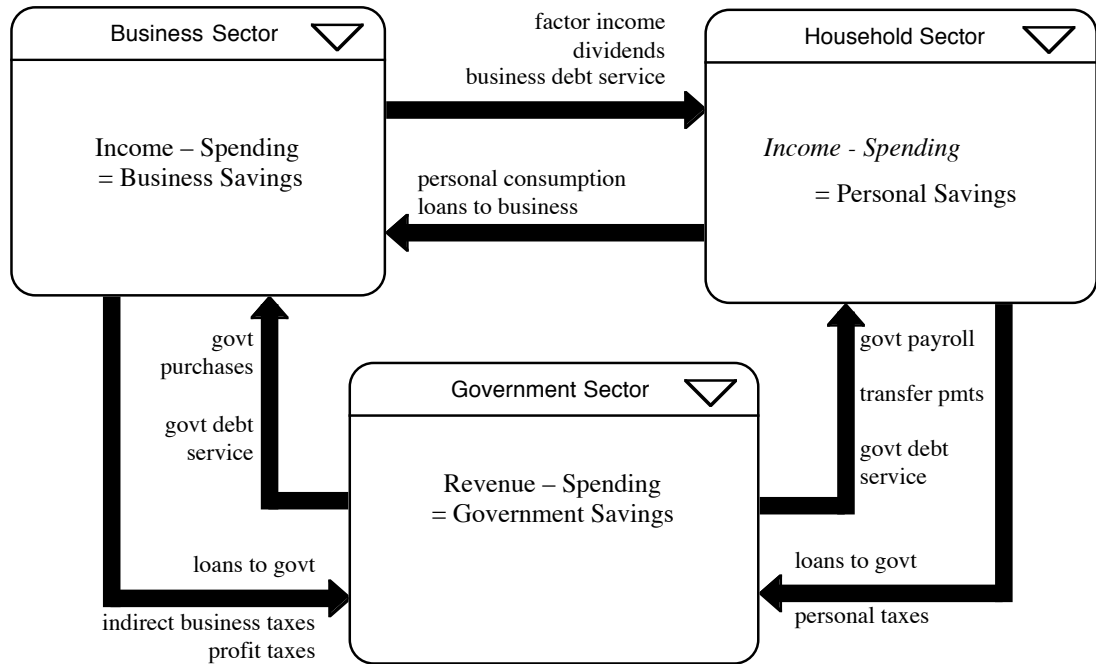


Figure 1. Simplified System Dynamics Schematic of the National Income Circular Flow Process in a Closed Economy.

In the learning unit series that will be developed in this project, behavioral subsystem models will be linked to their normal access points on the circular flow model. A fiscal policy subsystem, for example, will link with the flows going into and out of the government sector, and tax revenue and government spending rates will feed into the circular flow, replacing the default settings in the initial version.

Likewise, a production and sales subsystem will be linked to the income and spending flows on the circular flow model. In addition, the derived demand for labor in that subsystem will, when coupled with a subsystem reflecting the supply of labor, determine an unemployment rate. That unemployment rate will then be linked to the fiscal policy subsystem in ways that generate an appropriate response from the so-called automatic stabilizers (e.g., progressive tax rates and unemployment compensation), and the subsequent changes in government spending and revenue rates will eventually be channeled into the circular flow model. Enhancements to the fiscal policy subsystem would enable inclusion of political variables drawn from theories of *political* business

cycles. (See Tufte 1975, Nordhaus 1975, Keech 1995, Stimson 1999, and Alesina and Roubini 1999.)

As additional subsystems are linked to the circular flow, the feedback effects of the various subsystems will create temporary discrepancies between flows entering and leaving the savings inventory stocks in the circular flow model. As balancing feedback forces in the various subsystems seek steady states, the measurable rates in the circular flow model (e.g., personal consumption, investment, government spending) will reflect the net effect of those forces. Thus, the circular flow model, although strictly an accounting identity model in its purest form, can become a model that reflects the expansionary and contractionary forces associated with changes in private investment and consumption and fiscal and monetary policies.

Instructional Units. It will be necessary to test whether the system dynamics approach to macroeconomics instruction, when compared to traditional comparative statics, can improve student understanding of fluctuations in economic activity. That will be accomplished by developing instructional units based on development of the model, followed by a series of experiments designed to measure the relative effectiveness of the two instructional methods.¹³ The series of instructional units will consist of a system dynamics model of the national income circular flow process found in standard macroeconomics textbooks, plus system dynamics models of behavioral subsystems of a market economy.

The first unit will be devoted exclusively to the circular flow model. That model will be presented in a series of successively more complex stages, ranging from familiar textbook-style diagrams to system dynamics models. The first stage will be a simple two-sector model of exchange between the household sector and the business sector. The final stage will include the household and business sectors plus a government sector (including a central bank), a sector that includes financial intermediaries, and an import/export sector. Each sector will have an “on/off” switch so that, even after all sectors have been added to the model, it will be possible to simulate activity within subsets of the total.

¹³ Discussion of the experimental design for measuring the model’s effectiveness as an instructional tool is beyond the scope of this paper. Nevertheless, the author would also appreciate hearing from readers and/or poster visitors who have thoughts or suggestions regarding the assessment phase of the project.

Beginning with the second instructional unit and continuing with each succeeding unit, the *accounting identity* model of the circular flow of income will be linked with one or more *behavioral* models of market subsystems that contribute to the business cycle phenomenon. Each behavioral model will be presented as a stand-alone model first, so that its systemic behavior can be analyzed and understood apart from the circular flow process. Then, one or more of its flows will be linked to appropriate flows in the circular flow model. In addition, some of the subsystems will be linked together. The list of subsystem models includes:

- (1) a production and sales subsystem that relies on inventory levels to signal the need for production and/or pricing adjustments to balance supply and demand;
- (2) a private labor subsystem (i.e., not including government workers) that combines endogenous labor force participation rates with an exogenous population growth rate to determine labor supply, and then links with the production and sales subsystem to determine the intersection of labor supply and demand;
- (3) a governmental subsystem that determines both fiscal policy and monetary policy under various political decision making rules, and also includes a public labor component (i.e., government workers) that is a function of government spending levels and overall labor supply;
- (4) a financial subsystem that links commercial banks to the central bank in the governmental subsystem, and is linked to savers and borrowers in the production and sales subsystem and also on the fiscal side of the governmental subsystem.

The instructional units will focus on fluctuations in economic activity associated with recurring (but not periodic) business cycles. In the U.S., the average duration of the “cycle” is about four years, measured trough to trough. Given that relatively short time span, our preliminary inclination is not to include a separate subsystem to account for productive capacity growth stemming from capital investment or technological innovation. Instead, the investment spending flow (for both new and replacement capacity) would be derived within the production and sales subsystem. That inclination is not firm, however.

The process of validating the realism of the model will include comparison of its behavior with reference mode data drawn from actual economic systems. Comparing the *relative* realism of the system dynamics model and the comparative statics model will also be done, using the same hypothetical textbook data for both.

The Vision. Imagine undergraduate students manipulating the parameters of the dynamically enhanced model of the circular flow process, turning subsystems on and off individually or in combinations, and generally “test driving” their own mental models of the economy. In such classes, it would be unlikely that lectures occupied 80 percent of contact time.

In Palermo, conference participants will be among the first to test-drive a preliminary microworld version of this model. They will examine changes that occur as behavioral models are successively linked with the accounting model, and test alternative assumptions and policy scenarios. Hopefully, the informal give-and-take that is characteristic of poster sessions will generate suggestions that improve the model and help confirm the “vision.”

References Cited

- Alesina, A. and N. Roubini. (1999). *Political Cycles and the Macroeconomy*. Cambridge, MA: MIT Press.
- Barreto, H. (2002). "Teaching Comparative Statics with Microsoft Excel." (<http://www.wabash.edu/econexcel/compstatics>)
- Boucher, A. (1995). "Systems Modelling in Economics: Use of Object-Oriented Software." *Computers in Higher Education Economics Review*, 9:2 (virtual edition) http://www.economics.ltsn.ac.uk/cheer/ch9_2/ch9_2p03.htm).
- Becker, W. and M. Watts (1998). *Teaching Economics to Undergraduates: An Alternative to Chalk and Talk*. Northampton, MA: Edward Elgar.
- Burns, A. and W.C. Mitchell (1946). *Measuring Business Cycles*. New York: NBER
- Cohn, E., S. Cohn, D. Balch, and J. Bradley (2001). "Do Graphs Promote Learning in Principles of Economics?" *Journal of Economic Education* (Fall), 299-310.
- Forrester, J. (1961). *Industrial Dynamics*. Waltham, MA: Pegasus Communications.
- Forrester, J. (1968). *Principles of Systems*. Waltham, MA: Pegasus Communications.
- Forrester, J., N. Maas, and C. Ryan (1980). "The System Dynamics National Model: Understanding Socio-Economic Behavior and Policy Alternatives." *Technology Forecasting and Social Change* 9: 51-68.
- Forrester, N. (1973). *The Life Cycle of Economic Development*. Cambridge: Wright Allen Press, Inc.
- Godley, W. (1983). *Macroeconomics*. New York: Oxford University Press.
- Haberler, G. (1937, 1964). *Prosperity and Depression*. League of Nations. Reprint. Cambridge, MA: Harvard University Press.
- Hawtry, R.G. (1913). *Good and Bad Trade: An Inquiry into the Causes of Trade Fluctuations*. London: Constable.
- Hayek, F.A. von (1933). *Monetary Theory and the Trade Cycle*. New York: Harcourt, Brace.
- Keech, W. (1995). *Economic Politics: The Costs of Democracy*. Cambridge University Press.
- Kennedy, P. (2000). *Macroeconomic Essentials: Understanding Economics in the News*. Cambridge: The MIT Press.

- Low, G. (1980). "The Multiplier-Accelerator Model of Business Cycles Interpreted from a System Dynamics Perspective" in Randers (1980).
- Maas, N. (1975). *Economic Cycles: An Analysis of Underlying Causes*. Cambridge, MA: Wright-Allen Press, Inc.
- Maas, N. (1980). "Stock and Flow Variables and the Dynamics of Supply and Demand" in Randers (1980).
- Moore, B.J. (1988). *Horizontalists and Verticalists: The Macroeconomics of Credit Money*. Cambridge: Cambridge University Press.
- Moxnes, E. (2000). "Not only the tragedy of the commons: misperceptions of feedback and policies for sustainable development." *System Dynamics Review* 16:4
- Nordhaus, W. (1975). "The Political Business Cycle." *Review of Economic Studies*. 42:169-90.
- Pressman, S. (1999). *Fifty Major Economists*. New York: Routledge.
- Randers, J. (1980). *Elements of the System Dynamics Method*. Cambridge, MA: MIT Press.
- Richmond, B. (2000). *An Introduction to Systems Thinking*. Hanover, NH: High Performance Systems.
- Saleh, M. and P. Davidsen (2001). "The Origins of Business Cycles." Paper presented at the International System Dynamics Conference, July 2001, Atlanta, GA.
- Sterman, J. (2000). *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Boston, MA: McGraw-Hill Companies.
- Stigler, G. (1963). Elementary economic education. *American Economic Review*. 53:2. 653-59.
- Stimson, J. (1999). *Public Opinion in America: Moods, Cycles, and Swings*. Boulder, CO: Westview Press.
- Tufte, E. (1978). *Political Control of the Economy*. Princeton, N.J.: Princeton University Press.
- Walras, L. (1874). *Elements of Pure Economics*. Homewood, IL: Irwin. 1954.
- Walstad, W. B., and S. Allgood. (1999). What do college seniors know about economics? *American Economic Review*. 89:2. 350-354.

Wicksell, K. (1898). *Interest and Prices: A Study of the Causes Regulating the Value of Money*. London: Macmillan.

Zarnowitz, V. (1996). *Business Cycles: Theory, History, Indicators, and Forecasting*. Chicago: University of Chicago Press.