

# Developments in Business Simulation & Experiential Exercises, Volume 15, 1988

## MULTIPLE OBJECTIVES IN THE DEVELOPMENT OF THE GORDON MACRO GAME

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### ABSTRACT

The GORDON MACRO GAME is an interactive graphics tutorial and simulation model for use in Intermediate Macroeconomics classes. The software was carefully designed to meet specified objectives and criteria as they related to students, instructors, author/programmers, and publishers. A review of the literature on computer aided instruction pointed to the need to insure that the interests and viewpoints of many clientele groups guide the development of the software to insure its successful use and implementation. Throughout the development stages the authors constantly measured the product against design criteria in the hope that careful attention to these sometimes tedious details would pay off in the form of successful learning and teaching experiences (not to mention insure widespread adoption of the text book with which it was associated).

### INTRODUCTION<sup>1</sup>

Intermediate macroeconomics has long been a staple of the business school curriculum. Equally as long, the course has proven to be a difficult one for students to fully comprehend, given the tendency of professors to emphasize the ongoing (and often acrimonious) debates that characterize modern macroeconomic theory. It is difficult enough for students to grapple with the debates between the Keynesians, the Monetarists, the Classicals, the New-Keynesians, PostKeynesians, New-Classicals, Supply-siders, and Rational Expectationists. But they also have to learn to cope with what must at times appear to be an entirely new (at not foreign) vocabulary (e.g., the term "investment" as used by economists is entirely different than the same term used throughout the rest of the business school curriculum). To make matters worse, the student is constantly put under the barrage of conflicting theories about the determinants of and role played by key macroeconomic variables e.g., consumption, investment, savings, transfers, taxes, labor supply, money supply, money demand, exports, imports, interest rate, foreign exchange rate, etc.)

Equally frustrating for students is the growing tendency to immediately immerse them in macroeconomic simulation models containing as many as 334 equations [5] or "smaller" versions with only 128 equations and 238 variables [7; 12], each intricately linked to each other to a system of simultaneous equations where everything depends on everything else and requiring sophisticated familiarity with Lotus 1-2-3 or Symphony to review the outputs.

This paper shares our experiences as both users and developers of macroeconomic simulation models and discusses the objectives that guided the development of an interactive graphics simulation model designed to overcome the most common complaints surrounding "canned" software.

### SIMULATION MODELS IN THE CLASSROOM

Economics - despite its reputation for emphasizing quantitative methods and analysis, seems to have lagged behind other disciplines in the development, implementation, and use of CAI and macroeconomic simulation models for classroom use [3]. Early studies and test of measurable learning outcomes suggested the costs of developing and using CAI modules outweighed the benefits [8; 9; 18; 19]. Subsequent studies, however, found that carefully designed CAI packages seemed to enhance learning. Improvements in the design of survey instruments and tests of significance confirmed these results [2].

Many of the early options in CAI were not well thought out and proved to be little more than computerized study guides and workbooks e.g., IS, 17]. Interactive computer games that focused on making macroeconomics interesting and fun for students without explaining what was happening inside the "black box" economy [e.g., 6] were of limited value and received mixed reviews [4; 11]. Attempts to take advantage of the massive but proprietary computer models used by private firms such as Data Resources Inc. (DRI) resulted in little more than fancy graphics and statistical analysis, much of which detracted from the point of the course. The cost of obtaining the larger models (ranging from \$500 to \$25110 for a single non-transferable diskette, with additional charges for data updates, also discouraged widespread use.

Claims were made that the CAI models would revolutionize the way macroeconomics is taught. The prophecy (in economics, at least) proved correct only in the sense that professors found themselves spending valuable classroom time teaching statistical analysis, data input methods, and (with the exception of a few of the most sophisticated undergraduates) spending considerable time discussing the technicalities of running the models and interpreting the results with individual students. Professors who attempted to use massive simulation models discovered that while they were extremely useful in research and perhaps in advanced graduate courses they achieved little in helping students "learn" macroeconomic principles [11].

Those early experiences have led to several different responses. The need to encourage computer literacy and the ensuing establishment of microcomputer student labs encouraged further experimentation with CAI in spite of the lack of professionally related incentives. Those professors who attempted to overcome the obstacles found it necessary to prove away from canned programs that were little more than marketing gimmicks by the publishing houses and which denied the experience of actually learning about the modeling elements that are integral to economic analysis. Recently, emphasis in user specific class-created simulation models has become common-place [10; 16].

In response to these challenges and the increasing demand for pedagogically useful simulation software textbook publishers (if they were to remain competitive) found it necessary to spend considerable time, effort, and money in the development of interactive graphics tutorials that could meet the market test. For both marketing and pedagogical

<sup>1</sup> Alston and Chi are the authors of the IBM-PC and Macintosh versions of *The Gordon Macro Game: Interactive Graphics Tutorial and Simulation Model to Accompany Robert J. Gordon, Macroeconomics*, 4th ed. 1987. (Glenview, IL: Scott, Foresman and Co., Little, Brown College Division; they are also the authors of the IBM-PC and Macintosh versions of *Interactive Graphics Tutorial to Accompany Milton Spencer's Contemporary Economics* 1988. N.Y.: Worth Publishers.

<sup>2</sup> "Faculty members who write computer software for teaching often find that their chances of getting credit for it during promotion and tenure reviews are discouragingly slim....We give good guy credit for writing software. It's like doing a good job teaching a course" [20]. Recent reports suggest that at a limited number of universities the incentive structure is changing [e.g., 14].

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reasons,<sup>3</sup> the professionally created simulation models are closely tied to a specific textbook [e.g.,]: [3]. The remainder of the paper discusses the pedagogical advantages of this approach and focuses on THE GORDON MACRO GAME III.

### BRIEF OVERVIEW OF THE GORDON MACRO GAME

Intermediate macroeconomics courses invariably combine both a theoretical and policy orientation. Computer simulations, we feel, should complement this dual purpose. Student's often wonder what it would be like to be the President's economic advisor. They recognize that, although not always able to control events, the President is ultimately responsible for the administration's overall fiscal (spending and taxation) policies. And, they recognize as well, that, the President has an agenda (e.g., the President may propose a particular monetary policy to support other macroeconomic goals of the administration). If the student could be put into the role of the economic advisor it would become quickly apparent that they must know how any particular policy change will impact various sectors of the economy, whether interest rates will rise or fall, and what will happen to employment levels, investment activity, and economic growth - and what relationship exists between the government deficit and the foreign trade balance.

THE GORDON MACRO GAME can be used strictly as a supplemental learning aide, but it also allows students to figuratively take on the role of the economic advisor, under somewhat less hectic and demanding conditions than face their real world counterparts who are often required to give responses overnight (or in some cases within hours). The student is allowed to work at his or her own pace to fully "flesh out" a particular program proposal. As they progress through the chapter modules they find continuously more realistic models on the economy, each designed to provide more insight into the fascinating, but confusing, internal workings of the economy.

Students quickly recognize that as an economic advisor certain aspects of the economy are beyond their control (i.e., built into the core program). But, given the flexibility built into the software, the student is allowed to break out of the restrictions built into the "current economic situation." They can take charge of the GAME. With a little practice he or she can confidently build their own model of the economy. In this way they can learn directly about how the economy works and trace through the impact of changes on relevant variables.

Exercise problems make the relationships described in the text easy to understand. Suggested exercises clarify difficult points and the ease of experimentation encourages the

student to delve deeply into the complexities and interrelationships among identified variables in the modern economy. When a change is made the impacts show up almost instantly both in the form of tabular reports and graphical displays. Hard copy printouts of every aspect of the GAME make it possible to continue study away from the computer terminal.

### MULTIPLE OBJECTIVES OF THE GORDON MACRO GAME

As the author's of THE GORDON MACRO GAME we were guided by the following objectives (not necessarily in order of importance):

#### Professor/Pedagogical Objectives:

1. In order to maximize the pedagogical usefulness of the simulation package, the model should unfold sequentially, following the chapter by chapter development in the textbook.
2. Sample problems with pre-entered data should be carefully designed to illustrate model development.
3. Separate applications models with completely blank data entry tables should be provided for independent model development by the student at each stage.
4. Both the sample and applications problems should be designed to allow for changes in all (e.g., from 0 to n) parameters and coefficients in order to allow students to perform sensitivity analysis.
5. The software should introduce each new equation, parameter, coefficient, or relationship in a way that allows for cumulative model development. Too often space limitations require textbook authors to introduce a concept or model limitation in early chapters only to have them aggregated into composite terms (or worse, simply ignored) in later chapters. For example, once the international sector containing exports and imports is introduced, it makes no sense to combine them into an aggregated term called net exports.
6. Similarly, if several behavioral equations have functional relationships with, say, interest rates, they should be carried separately not combined into a composite term.
7. The software package should be completely self-contained with all necessary directions for data entry, output generation, and interpretation provided on the screen rather than in a complex user's guide. The professor should be free to teach economics rather than how to run the software.
8. Only minimal guidance from the professor should be required. All symbols used should correspond as closely as possible with the textbook presentation.
9. All inputs and outputs should be "named" in English, not simply identified by the algebraic symbol used in the model.
10. Copying the program to user supplied diskettes should not be limited beyond legitimate requirements that the source code be inaccessible.
11. Cost to obtain and to use the software by the student should be limited to the price of a diskette. This allows the software to be available for use 24 hours a day and without the need for supervision.
12. The models available in the software should be capable of showing which variables, coefficients, and parameters are most important in the ongoing debates between economists concerning the structure of the economy. The models should allow supply side, demand side, monetarist, rational expectations and other schools of thought to be investigated with

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<sup>3</sup> Much to their chagrin, the publishing houses discovered that, unlike accounting and spreadsheet software which held an attraction for students who envisioned a long-term value after graduation, the demand for economics software would not support stand-alone commercial development. In economics, CAI diskettes (as with gradebooks, testbanks, instructor's manuals, and professionally prepared overlay sets) became a marketing department "freebie" delivered to any college or university which adopted the publisher's textbook, particularly at the Principles level. Some were packaged as special student studyguides [e.g., 13]. The Fairmodel [12] attempts to serve both the academic and private industrial market with one forecasting model. Each Fairmodel subscription contains the econometric model, database and software. Quarterly updates on the database are available for \$3,000 per year's subscription. Monthly updates are also available. Advertising brochures claim that the "versatility of the Fairmodel makes it a perfect tool-satisfying the forecasting needs of the most seasoned economists, while at the same time helping business people in any industry apply economic forecasts to company specific or product-specific concerns." One can with justification question the pedagogical usefulness of such a broadly targeted software package.

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emphasis men ease of comparison.

13. Both comparative static and dynamic simulation capability should be provided at appropriate levels tee correspond to the textbook presentation.

14. The software should facilitate the 'assignment of teem. papers amid written reports which require the student tee explain how changes in particular variables affect, the macroeconomic equilibrium. Emphasis should be on understanding, not mathematical manipulations.

15. The cost of adoption and implementation should be minimal.

16. The software simulation package should complement, facilitate, and reinforce, not compete with or stand apart from classroom presentation, the textbook, and other supplemental workbooks, reading assignments, etc.

17. Students should be encouraged to think about what is happening and what it implies about the working of the economy rather than being passive observers.

18. The software should lead to improved classroom discussion of current events.

19. Examples should be realistic and reflect real world and real time dimensions (e.g., if the nominal GNP is \$4.5 trillion, examples and graphs denominated in the hundreds of dollars make little sense).

### Student Oriented Objectives:

1. Make it user friendly! Students should be provided a user-friendly data input tableau. While students should be encouraged to become familiar with, and thereby less fearful of, the computer – this element of the simulation game should be secondary. User friendliness is, perhaps the single most important objective to be satisfied.

2. Students should be shown the "model" that they have created and should have immediate feedback on all data entered to insure that the model created was the model intended.

3. Students should be able to print every display screen for subsequent study away from the terminal and for in class discussions. Instant feedback on the display monitor rather than a remote terminal printout should be available. All display screens and outputs should be immediately printable on a dot-matrix printer attached to the personal computer.

4. Students should be able to work independently or in groups.

5. Self-contained exercises designed to illustrate the major lessons of the chapter(s) should be built directly into the software. Care must be taken to insure that students learn from, rather than become intimidated by, such exercises.

6. Students should be able to easily trace the complex interactions of the variables, including how a change in one affects all of the others.

7. While it is pedagogically useful for students to be able to change any variable or coefficient without unnecessary limitations it is desirable to place restrictions on certain data entries in order to present the creation of mis-specified models or models without feasible solutions. See objective #9 below.

8. If a student created model generates outcomes that fall beyond the "graphic window" built into the program, he or she should still be able to display the equilibrium outputs in order to aid them in reformulation of the model.

9. Error messages written in plain English, not programmers jargon, should be clearly displayed on the screen and guide the student on how to correct the error.

10. Logic checks should inform the student when entered variable values generate solutions that fall outside of the positive quadrant, but they should not be prevented from entering such data if it can be done without "crashing" the program (e.g., entering zero coefficients in the denominator of equations).

11. Students should be allowed to make grievous mistakes (especially when entering data or formulating new models) without crashing the program. Simple instructions on what went wrong and how to get back in track should be provided on screen displays. Ease of experimentation should be emphasized. The student should always be allowed to "start From scratch."

12. The software should be menu-driven in order to allow students flexibility in repeating and reviewing material as well as skipping lever material with which they are already familiar.

13. Tire simulations should allow (and the suggested exercises should encourage) the student to replicate virtually all of the diagrammatics contained in the relevant chapters of the textbook.

14. The software should be designed to allow for meaningful learning sessions to be completed by a student in to more than 10 minutes, but with the flexibility to allow for extended periods of use.

15. The experience should be challenging and fun rather than repetitive, boring, or tedious. The program should allow for the assignment of "outside projects" without taking on the air of busy-work. Students should walk away from each session convinced of its value in fulfilling learning objectives.

### Author/Programmer/Publisher Objectives:

1. The software should be available for use in both Macintosh and IBM and IBM compatible PS's with minimal memory demands (e.g., 256k) in order to facilitate home use by students beyond the campus and in a wide variety of CAI environments.

2. No Mainframe computer facilities should be required.

3. The software should be usable with or without color monitors even though color graphics cards are required to display and print graphics.

4. The program should automatically search and identify the machine being used and adjust mode and graphics commands to reject the configuration. Neither students no faculty should have to know the hardware of all possible machines to be used.

5. Complete specification of the models should be provided, including written solution(s), either directly in the software or as an appendix to the user guide.

6. The user guide should be kept as short and simple as possible, but it should thoroughly explain how to boot the system, how to enter data, how to correct entries, how to exit the system (an option that should be available at all times), how to interpret error messages, how to print outputs, and what to do when all else fails.

7. The program should be efficient.

8. A programming language that minimizes eh need to repeat program lines for repetitive calculations through the use of structured libraries and built-in graphics commands should be utilized. In this case, True Basic was the language of choice.

9. A troubleshooting telephone number should be provided users to facilitate unforeseen (an inevitable) problems.

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## INSTEAD OF A CONCLUSION

All of the above objectives were met in the final version of the GORDON MACRO GAME. It is not perfect and updated versions are already in the planning stage. Use of the GAME identified subtle textbook errors and became the focal point of discussions about whether to allow the software to "correct the errors" prior to the appropriate corrections in revised editions. Decisions to remain consistent with the textbook prevailed.

THE GORDON MACRO GAME has been extensively reviewed by academic economists teaching the intermediate macroeconomics course at a variety of institutions. Those who have responded to review questionnaires have unanimously endorsed the approach. But the "proof of the pudding is in the eating." It is easier to create models that please the appetites of professionals than it is to satisfy the palates of students. Although we have used early versions of the software in our own teaching with encouraging results, it has been available for general adoption and use throughout the country only since the beginning of the 1987-88 academic year. It will be a year or more before a meaningful study along the lines conducted by Millerd and Robertson (1987) can be reported. But if their findings are at all transferable we can reasonably expect that the use of THE GORDON MACRO GAME (or other simulations guide by similar objectives) will fulfill not only our ambitious goals (which, after all we could and did control), but a much wider set of objectives. Among these will be adding to the understanding of the complex relationships involved in the study of the modern macroeconomic, improving student comprehension and retention. Grades. And reducing computer-anxiety.

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