

Title: Interactive Models for Pluralist Intermediate Microeconomics

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We plan to provide a resource -- online simulations of diverse topics -- to facilitate the teaching of instructors wanting either a) to include more pluralistic and diverse topics in their intermediate microeconomics courses, such as those listed above, or b) to provide a comprehensive coverage of topics that would form the core for an instructor who wishes to teach an entirely different course to that which is typical in intermediate microeconomics.

We wish to obtain funding to create modules hosted online, the core of which would be **interactive graphs**. The interactive graphs would be coded in the free and open-source language R and all code would be hosted and provided in the background of each simulation. Each module would be accompanied by a set of **interactive online questions** and wider **discussion questions**. Each graph would also have a **screencast walkthrough** and additional screencast and slide content to provide a **background for instructors and students**. The modules would also contain suggestions for instructors wishing to include the analysis in their classes and example exam and discussion questions for someone who wishes to use the interactive graphs as part of their assessment.

To indicate the power of R as a language with its interactive system, we have provided a draft interactive graph based on the credit market model from Bowles (2008), *Microeconomics: Behavior, Institutions and Evolution* with additional insights drawn from conversations with Prof. Duncan Foley of the New School for Social Research (Prof. Foley has used interactive graphs done in Mathematica in his intermediate microeconomics course).

Each simulation can serve several purposes.

- A simulation makes **explicit** the **parameters** affecting the model
- By playing with the parameters, students can engage **intuitively** with ideas that would otherwise be mathematically complex (and might therefore exclude some students).
- By using a simulation, students can examine **multiple scenarios** easily (low cost of effort) rather than calculating by hand each different scenario (high cost of effort).
- Students can also examine parameters that provide the **equilibrium** while also observing outcomes **out of equilibrium**.
- By assessing the model explicitly, engaging intuitively and easily observing multiple scenarios, students can see a variety of **principles** in action in a variety of ways
- The simulations can, depending on an instructor's preferences, serve either as **substitutes for** or **complements to** mathematics. They could serve as a substitute for an instructor who wishes to keep some of the math 'behind the scenes' or they could serve as a complement to an instructor who wishes their students to do mathematical derivations or comparative statics and then to see what they mean in practice

In the credit market model with equity and quality of projects (see a draft example here: <https://shalliday.shinyapps.io/creditmarket/>), we can do the following:

- See explicitly the roles of the **parameters** -- equity (k) and project quality (μ) -- on the best response function and therefore on the equilibrium values of the failure rate (f) and the interest factor (δ).
- Develop an **intuition** about the tradeoffs between project quality (μ) and equity (k) in **equilibrium**, from seeing how the best response function changes with these variables.
- See that **in equilibrium** some borrowers will be **involuntarily** excluded from the market for credit when they have low equity (low k).
- The simulation can show mathematically complex results easily, e.g., someone with more equity can obtain finance for a lower quality project than someone with less equity, which is mathematically complex to show, but can be demonstrated easily in the simulation because the student can pick different combinations of project quality and equity and see how they affect the equilibrium values of f and δ .

Background: The Intermediate Microeconomics Curriculum

Subsequent to the financial crisis, there has been a great deal of discussion about how to reform undergraduate economics education. Much of that discussion has focused on how to reform the introductory economics sequence. That concern is justified, but it is also true that we ought to be concerned with students who complete economics majors and who take courses where introductory economics is cemented and formalized at the intermediate level.

Many standard intermediate microeconomics textbooks focus on content that does not reflect advances in either the mainstream of economics or of the diversity in economics over the past generation. Most intermediate microeconomics textbooks have a core of topics with chapters added in to reflect changes in the discipline over the past twenty years, but without integrating those ideas into the subject's core. Topics such as behavioral economics, externalities, information asymmetry, and public goods are included in additional chapters, many of which seldom are taught because of their being relegated to the end of the book. For example, in Hal Varian's text, these topics are covered in chapters 31, 35, 37 and 38. They are considered peripheral, rather than crucial to the endeavor of economics. Institutions, history, generalized increasing returns and instability do not get a look-in. A cursory discussion of the role of network externalities in monopoly power may be the exception that proves the rule.

An intermediate microeconomics course typically leaves out a variety of important topics:

- 1) Generalized increasing returns -- both in social interactions and in production affecting the existence and uniqueness of equilibria
- 2) Self-interested preferences are one among many kinds of preferences: altruistic, inequality averse, reciprocal, and others requiring social norms & conventions
- 3) Externalities pervade social interactions and production, rather than being exceptional
- 4) Understanding clearly the (global) public goods and (global) commons as being at the heart of many economic challenges for policy-makers and communities

- 5) Multiple equilibria as common, Pareto-efficient equilibria difficult to achieve or involve conflict of interest when choosing one Pareto-efficient equilibrium among many
- 6) Information asymmetry and non-contractuality as common, not exceptional
- 7) Non-contractuality in labor markets & credit markets resulting in markets that do not clear, which is essential for a good understanding of **macroeconomics**
- 8) Exchange and social interactions involving aspects of *common interest*, while almost always also having aspects of *conflict of interest* over the division of economic rents
- 9) Institutions affecting how decisions get made and the division of resources, in particular, attention to power dynamics, the status quo, and the role of property rights
- 10) The pervasive existence of economic rents as the norm with resultant unemployment of workers, people who are excluded from credit markets, and investment in low quality projects in the financial sector
- 11) The roles of communities, markets and the state in moderating or exacerbating existing divisions of wealth
- 12) The role of history in microeconomic decisions, games and social interactions, through the mechanisms of culture and institutions
- 13) The role of endogenous instability in many economic systems (as informed by multiple equilibria and increasing returns)

These topics and many others are neglected in many intermediate microeconomics courses though some have begun to inform the mainstream of economics in graduate education and some undergraduate electives. Many of these ideas have, as an alternative, been included in INET's CORE economics curriculum, though other fruitful alternatives do exist. We plan to create resources for instructors wishing to teach these topics in a variety of contexts and to permit others to add to the resources once they are created through open online content.

Our Project and INET's Goals

Our project builds on several of INET's goals during this grant round for curriculum design and improvement:

- the role of **income** and **wealth inequality** in decision-making and policy design, e.g. in climate policy (a topic for which we have a planned simulation)
- the role of **power** and **institutions** in policy and individual decision making, e.g. in credit markets and policy responses.
- the search for broader accounts of **why people cooperate** and how cooperation is affected by preferences, institutions, politics, norms and culture
- explicitly considering self-interested **preferences** as one (limited) class among many kinds of preferences that people may hold and which affect their behavior
- the role of **property rights** in affecting what people decide in exchange and bargaining, e.g. as applied to land rights, labor markets, and credit markets; also as applied to the policy-responses that could be involved

These are the most salient of the institutes many goals that we believe we can meet. We will also gladly be involved in projects to engage with and satisfy other topics with our pedagogical approach.

Why R?

R is a free and open-source statistical programming language known for its powerful graphics capability. It has a long history of use in academic statistics and in recent years has emerged as a viable alternative to the proprietary software used in other disciplines (SAS, SPSS, Stata, etc.). The base source code of R is developed by a small core of academics but the language has been substantially extended by the contributions of thousands of programmers.

Several advances in the past year have made it much easier to implement beautiful and robust online interactive graphics. First, the R package “shiny” allows for the creation of web apps that have a front-end R script that creates the web page seen by the user, and a back-end R script that does the computation in a server-side R session. Second, the packages “ggvis” and “rCharts” provide an interface between R and JavaScript, where there has been much development of interactive graphics. By leveraging JavaScript, developers can run much of the computation client-side instead of server-side. This is important to consider when building infrastructure that can support wide online usage without a heavy burden on server resources. While we shall host the draft credit market graphic on the free-for-education shinyapps.io, long-term hosting can be done through our home institutions.

While the primary focus of this proposal is to create high quality resources for students, an important ancillary goal is to make the source code behind these tools available to instructors in a transparent and extensible manner. By using only open-source technologies, every aspect of these simulations can be accessed, investigated, and extended by anyone.

Motivation for Requested Funds

Developing high quality teaching materials is enormously time-consuming. Consequently, we request one course buyout for each of the two years of the project for Simon Halliday and summer salary for Andrew Bray for the two years of the project. Dr. Halliday would also pilot the simulations in his intermediate microeconomics classes where he would also pilot questions and screencasts and provide preliminary versions to interested parties.

We also want to involve students in the development of the materials and the simulations, to mentor them as researchers in economics and statistics broadly conceived. We have catered for two research assistants over two years, with the summer of 2015-16 being the more essential period. We hope that by doing this we will nurture female students who hope to undertake graduate degrees in economics, statistics or related fields.

We have requested funds for a consultant from R-Studio to ensure that we use the most cutting edge methods with R and so that we can share the project more widely.

Finally, we have requested funds to support our transport and accommodation at conferences where we could promote the project. We have mentioned the INET conference, the ASSA conference and the Conference on Teaching and Research in Economic Education.