

A New Revolution in Economics Education

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Preliminary, Comments Welcome

Abstract

New trends are emerging in education of economics following rapid development in economic theories for static, dynamic and strategic analysis, increasing applications of general equilibrium modelling for evaluation of economic policies at national, regional and global level and overwhelming advancement in econometric techniques developed to test those theories. A concise knowledge of these theories and techniques is essential for understanding micro and macro economic processes and to influence policy making for achieving greater efficiency and satisfaction of mankind. How careful design of curriculum and thoughtful implementations could be instrumental in achieving higher standard of teaching and research is analysed using the practical experience over the years in the University of Hull.

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1 Introduction

Analytical techniques in economics have gone through profound transformation in the last half century. The distinction between good economic schools and bad ones at national and global level is mainly based on how well these institutions have been able to incorporate those trends in teaching learning practices and research in economics. Institutions more open to ideas and new thinking are in the front line as indicated in league tables and research assessment exercises. Teaching of economics lags behind in institutions where the dissemination of mainstream knowledge is clouded by attention to old and defunct concepts. Most often these institutions are in need of sufficient insight or understanding

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of new development and emerging trends. An economics programme cannot be successful unless it provides strong background in core knowledge of economics to its graduates. It is hard to raise standard of education without originality of thinking, research oriented teaching practices, more open mind to take challenges on new techniques and a clear focus on the core knowledge of economics. The major objective of this paper is to illustrate these problems and suggest solutions that can be helpful in solving them. It is about bringing a new revolution in teaching and learning practices in economics.

Every economist should possess analytical perspective for a comprehensive understanding of the resource allocation mechanism in modern economies and know how consumers and producer maximise their objectives constrained by resources and the way they interact with the public sector as well as the global economy. They should be aware of the ideas that have descended from the classical economists including Smith (1776), Ricardo (1817), Say (1817), Malthus (1790), Mill (1844), Marshall (1922), Pigou (1918), Hicks (1936) and Keynes (1936) on one hand and be familiar to contributions of economists of recent generations including the Nobel Laureates in economics. They must have some idea on contributions of professional journals. The Royal Economic Society's Economic Journal has been there for more than 118 years. Publications and deliberations of various professional organizations including the American Economic Association, Econometric Society, European Economic Association, and many other field level organizations are found in more than 200 refereed journals in economics now covering all kinds of economic applications and theoretical derivations. Objective of education in economics is to expose new generation of students to this accumulated knowledge and inculcate wisdom relating to efficiency, equity and continuous improvement in welfare. Comprehending these big ideas need a firm background in techniques of economic analysis which should be the main objective of economics teaching. Design of curriculum and programs, assessment and examination processes, benchmarking of degree structures should be suitable to this professional requirement.

Current learning and teaching practices have not provided enough confidence among graduates. This in most cases is due to a ill-structured learning and teaching strategies and taking education as a ritual rather than problem solving mechanism. Positive attitude and active participation in teaching sessions by students than at the current level can improve teaching and learning practices. Profound changes are required now in curriculum to capture advancement in theoretical construction and technical improvement in testing those theories. Duplication and repetition need to be avoided, old ideas need to be reviewed and new ideas need to be developed. System should have inductive and deductive reasoning process of its own and should incorporate in-built mechanism to update itself. New mathematical, econometric, statistical techniques need to come in the education from the beginning. Problem solving, programing, inferences, calibrating and benchmarking and scenario analyses should be emphasised. An ideal economics graduate should possess sound skills in formulating partial or general equilibrium models as well as the linear and non-linear programs, know a bit of dynamics of stochastic general equilibrium and econometric models

and be confident in scientific and more powerful algorithms that can mimic the stochastic factors of real life with the help of parametric, non-parametric or non-linear models. These sets of skills should enable them to find scientific explanations behind the strategic decisions taken by individuals, firms, governments at regional, national and global level. From the analysis economists should be able to explain the emerging trends and predict and forecast future events with reasonable accuracy. Using more realistic models they should be able to simulate economies and produce scenarios that would result from taking alternative sets of decisions, negotiations, bargaining or other choices by individually and collectively by above economic agents and test various potential hypotheses. This all requires a firm understanding of the core of economics and associated inductive and deductive reasoning skills and quantitative or qualitative methods which many of the current economics education institutions are struggling to provide both for the undergraduate and post graduate levels.

Earlier studies in the education of economics have noticed significant amount of product differentiation in teaching of economics among institutions. As economics forms core contents in finance, business, commerce, administrations, marketing, manpower management and communication and many other sectors (Kolmer (1965), Sigfried (1985), Awh (1986)) model teacher teaching programmes had been suggested to make economics a sexy social science by balancing talk and chalk methods with modelling and applications (Salemi (2003), Becker (2003)). Connection between the economics education and professional standards and undergraduate and post graduate education had been looked quite rigorously in Bowen (1953) and McKinzie (1977), the Commission on Graduate Education in Economics (Krueger (1991), (1999)). Despite this economists have less dominant public influence now than they had in the nineteenth century (Price (1901)) and applications of economic ideas in various industrial activities have declined than reported in Manchester (1933) or in (Owen (1958)). Economic education needs a new revolution so that it could again focus on solving the problems of mankind as Marshall (1933) or Keynes (1933) suggested in the last century.

The aim of this paper is to present coherently the new trends in education of core element of economics and the weaknesses of the current system with illustrations drawn from various aspects of economics teaching including micro theory of markets and stability analysis in section two, glimpse of general equilibrium and growth models in section three, macroeconomic analysis and related time series in sections four, strategic modelling in section five, econometric theories and tests in section six followed by conclusions and references (yet to be refined) at the end.

2 Education of Economic Theory

Economic theory teaches us how to analyse complex functioning of the economy. It provides unifying concepts that improve understanding on how millions of households determine their consumption and labour supply, savings and accumulation of assets. It explains how hundreds of thousands of firms combine inputs in production and how these are brought to the ultimate consumers at home and abroad. Further it explains the market structure and degree of competition, efficiency and welfare achieved through the system. Micro level decisions are aggregated to find the evolution of the economic system in terms of growth, utilisation or employment and unemployment of scarce economic resources to ensure sustainability of the system over the long run. In general it explains the coordination mechanism how decisions of apparently isolated economic agents forms a coherent set of well functioning relations in channelling resources to their best possible uses. Uncertainties inherent in economic system are captured by adding stochastic dimensions and uncertainties in core economic models.

Current system of education aims to introduce students to the key concepts like demand and supply functions and equilibrium prices and quantities, revenues and profits and consumer surplus and welfare in microeconomics, determinants of national income, consumption, investment, exports, imports, money supply and interest rates, exchange rates, unemployment, inflation, issues of revenue and public expenditure in macro economics and issues of public finance, trade, industrial and regulation of various economic sectors. However, it is very disappointing to note the lack of sufficient background and confidence among graduates in explaining current economic problems scientifically and systematically. Current teaching system is based mostly in cookbook approach with less weight put on imagination, exploration, research and theoretical deduction.

For instance the undergraduate students are exposed to demand and supply from the first year

$$D = \alpha - \beta P \quad (1)$$

$$S = -\gamma + \delta P \quad (2)$$

Despite this very few students can solve the following two goods market problem (which can easily be extended to N goods) even in their third year.

Market 1:

$$X_1^d = 10 - 2p_1 + p_2 \quad (3)$$

$$X_1^S = -2 + 3p_1 + p_2 \quad (4)$$

Market 2:

$$X_2^d = 15 + p_1 - p_2 \quad (5)$$

$$X_2^S = -1 + 2p_2 \quad (6)$$

Problem remains partly in the unsystematic design of curriculum and partly on the level of interest among students. For instance the current undergraduate

syllabus does not teach matrix though basics of it could be taught even in a half hour session. Solving this problem requires three steps.

First equate supply and demand: $X_1^d = X_1^S$ implies $10 - 2p_1 + 2p_2 = -2 + 3p_1 + p_2$ in the first market and $X_2^d = X_2^S$ implies $15 + p_1 - p_2 = -1 + 2p_2$ in the second market. Step two putting information together in a matrix form as:

$$\begin{bmatrix} 5 & -1 \\ -1 & 3 \end{bmatrix} \begin{bmatrix} p_1 \\ p_2 \end{bmatrix} = \begin{bmatrix} 12 \\ 16 \end{bmatrix} \quad (7)$$

$$\begin{bmatrix} p_1 \\ p_2 \end{bmatrix} = \begin{bmatrix} 5 & -1 \\ -1 & 3 \end{bmatrix}^{-1} \begin{bmatrix} 12 \\ 16 \end{bmatrix} \quad (8)$$

Step three use Cramer's rule to find the solution as:

$$p_1 = \frac{\begin{vmatrix} 12 & -1 \\ 16 & 3 \end{vmatrix}}{\begin{vmatrix} 5 & -1 \\ -1 & 3 \end{vmatrix}} = \frac{36 + 16}{15 - 1} = \frac{26}{7}; \quad p_2 = \frac{\begin{vmatrix} 5 & 12 \\ -1 & 16 \end{vmatrix}}{\begin{vmatrix} 5 & -1 \\ -1 & 3 \end{vmatrix}} = \frac{80 + 12}{15 - 1} = \frac{46}{7} \quad (9)$$

Finally check the whether solutions satisfy equations:

Market 1:

$$LHS = 10 - 2p_1 + p_2 = 10 - 2\left(\frac{26}{7}\right) + 2\left(\frac{46}{7}\right) = \frac{110}{7} = -2 + 3p_1 + p_2 = \frac{110}{7} = RHS \quad (10)$$

Market 2:

$$LHS = 15 + p_1 - p_2 = 15 + \frac{26}{7} - \frac{46}{7} = \frac{85}{7} = -1 + 2p_2 = \frac{85}{7} = RHS \quad (11)$$

QED.

Not having a little knowledge of matrix prevents students from attempting this question and the problem of not knowing them remains haunting them through out their career. This can be corrected.

Cost of not knowing matrix are far greater than one can imagine. Economics is about interdependency among variables and most of the relations are expressed in a set of equations which need to be solved simultaneously. Not having background in matrix puts students off from the solving first order conditions using optimizations. For instance consider an utility function in terms of three goods as given by following equation.

$$y = -5x_1^2 + 10x_1 + x_1x_3 - 2x_2^2 + 4x_2 + 2x_1x_3 - 4x_3^2 \quad (12)$$

Finding optimal values of x_1 , x_2 and x_3 by unconstrained optimization involves solving three first order conditions:

$$\frac{\partial y}{\partial x_1} = -10x_1 + 10 + x_3 = 0 \quad (13)$$

$$\frac{\partial y}{\partial x_2} = -4x_2 + 4 + 2x_3 = 0 \quad (14)$$

$$\frac{\partial y}{\partial x_3} = x_1 + 2x_2 - 8x_3 = 0 \quad (15)$$

$$\begin{bmatrix} -10 & 0 & 1 \\ 0 & -4 & 2 \\ 1 & 2 & -8 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} -10 \\ -4 \\ 0 \end{bmatrix} \quad (16)$$

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} -10 & 0 & 1 \\ 0 & -4 & 2 \\ 1 & 2 & -8 \end{bmatrix}^{-1} \begin{bmatrix} -10 \\ -4 \\ 0 \end{bmatrix} = \begin{bmatrix} 1.043478261 \\ 1.217391304 \\ 0.434782609 \end{bmatrix} \quad (17)$$

Further little knowledge of matrix and eigen values can bring one a lot further in stability analysis of dynamic systems as illustrated in the following two equation system.

$$y_t = a_{10} + a_{12}y_{t-1} + a_{12}z_{t-1} + e_{1t} \quad (18)$$

$$z_t = a_{20} + a_{21}y_{t-1} + a_{22}z_{t-1} + e_{2t} \quad (19)$$

Using lag operators

$$y_t = a_{10} + a_{12}Ly_t + a_{12}Lz_t + e_{1t} \quad (20)$$

$$z_t = a_{20} + a_{21}Ly_t + a_{22}Lz_t + e_{2t} \quad (21)$$

Collecting terms:

$$(1 - a_{12}L)y_t = a_{10} + a_{12}Lz_t + e_{1t} \quad (22)$$

$$(1 - a_{22}L)z_t = a_{20} + a_{21}Ly_t + e_{2t} \quad (23)$$

solve the second equation for z_t and substitute into y_t equation

$$z_t = \frac{a_{20} + a_{21}Ly_t + e_{2t}}{(1 - a_{22}L)} \quad (24)$$

Putting z_t into y_t equation

$$(1 - a_{12}L)y_t = a_{10} + a_{12}L \left[\frac{a_{20} + a_{21}Ly_t + e_{2t}}{(1 - a_{22}L)} \right] + e_{1t} \quad (25)$$

Collecting terms:

$$(1 - a_{12}L)(1 - a_{22}L)y_t = a_{10}(1 - a_{22}L) + a_{12}a_{20} + [a_{12}a_{21}L^2y_t + a_{12}Le_{2t}] + (1 - a_{22}L)e_{1t} \quad (26)$$

$$(1 - a_{12}L)(1 - a_{22}L)y_t - a_{12}a_{21}L^2y_t = a_{10}(1 - a_{22}L) + a_{12}a_{20} + a_{12}Le_{2t} + (1 - a_{22}L)e_{1t} \quad (27)$$

$$y_t = \frac{a_{10}(1 - a_{22}) + a_{12}a_{20} + a_{12}e_{2t} + (1 - a_{22}L)e_{1t}}{(1 - a_{12}L)(1 - a_{22}L) - a_{12}a_{21}L^2} \quad (28)$$

$$z_t = \frac{a_{10}(1 - a_{11}) + a_{21}a_{10} + a_{21}e_{2t-1} + (1 - a_{11}L)e_{2t}}{(1 - a_{12}L)(1 - a_{22}L) - a_{12}a_{21}L^2} \quad (29)$$

Convergence requires the roots of the polynomial (inverse characteristic equation), $(1 - a_{12}L)(1 - a_{22}L) - a_{12}a_{21}L^2$, lie outside the unit circle (or equivalently roots of the characteristic equation lie inside the unit circle. Since both y_t and z_t equations have same polynomial $(1 - a_{12}L)(1 - a_{22}L) - a_{12}a_{21}L^2 = 0$ time series of both variable are similar. By defining $\lambda = \frac{1}{L}$ and $\lambda^2 - (a_{11} + a_{22})\lambda + (a_{11}a_{22} + a_{22}a_{21}) = 0$ these depend on whether the roots $\lambda_1, \lambda_2 = \frac{(a_{11} + a_{22}) \pm \sqrt{(a_{11} + a_{22})^2 - 4(a_{11}a_{22} + a_{22}a_{21})}}{2}$, are real, distinct or complex. This analysis does not require additional technical knowledge from students who have learnt a quadratic equation in the first year. What it requires is the application of technique learnt in the first year in subsequent years to open up more doors for economic analysis. Same applies to the post graduate students; though they come with heterogenous background it is not impossible to build on required background before they can start real lessons in economics. Glossy textbooks often omit these basics.

3 General Equilibrium Modelling

General equilibrium analysis is the most beautiful development in the entire 200 years of evolution of economics. Demand functions for goods and services are derived from the utility maximization of households constrained to their budget constraints in each instant and over periods. Preference for goods and services and endowments vary across households which induces them to gain from exchange. Supply functions are derived from the profit maximizing behaviors of small, medium and large firms. Dynamics of competition in the market place guarantees that firms keep updating the best available technique in production in order to survive in their markets. Prices are determined by the interactions of demand and supply and adjust till the excess demand or supply is eliminated in the market. Households react to changes in prices through a complex process of income and substitution effect depending on the nature of goods. Micro

level measures influencing allocations have their macro counterparts and consequences. More efficient allocations bring higher rates of economic growth and closer to full employment level of capital and labour. Comparative advantage at the international markets require efficiency and proper pricing of all negative and positive externalities. Economic links are so well connected that a shock in one part sets a series of knock on effects that circulates to the entire system.

Most students are found to struggle even with the simplest pure exchange model underlying the Ricardian Model of comparative advantage with two goods and two countries and fail to establish why autarky solution is inefficient than a trade equilibrium and appreciate the fact that the exchange rate is determined by endowments (supply) and preferences (demand) in the global market. For instance take a two country model with:

Preferences in consumption:

$$\max U^1 = (C_1^1)^{\alpha^1} (C_2^1)^{1-\alpha^1} \quad (30)$$

Income

$$I^1 = w_1 L_1^1 + w_2 L_2^1 + TR^1 \quad (31)$$

Technology constraints in sector 1 in country 1

$$X_1^1 = a_1^1 \cdot L_1^1 \quad (32)$$

Technology constraints in sector 2 in the country 1

$$X_2^1 = a_2^1 \cdot L_2^1 \quad (33)$$

Resource constraint in the country 1

$$L^1 = L_1^1 + L_2^1 \quad (34)$$

Production possibility of the country 1

$$Y^1 = \frac{1}{a_1^1} \cdot X_1^1 + \frac{1}{a_2^1} \cdot X_2^1 \quad (35)$$

Consumers problem in country 2

$$\max U^2 = (C_1^2)^{\alpha^2} (C_2^2)^{1-\alpha^2} \quad (36)$$

Subject to budget constraint

$$I^2 = w_1 L_1^2 + w_2 L_2^2 + TR^2 \quad (37)$$

Technology constraints in sector 1 in the country 2

$$X_1^2 = a_1^2 \cdot L_1^2 \quad (38)$$

Technology constraints in sector 2 in the country 2

$$X_2^2 = a_2^2 \cdot L_2^2 \quad (39)$$

Resource constraint in country 2

$$L^2 = L_1^2 + L_2^2 \quad (40)$$

Income of the country 2

$$I^2 = P_1 L_1^2 + P_1 L_2^2 + TR^2 \quad (41)$$

Demand for good 1 in the country 1

$$C_1^1 = \frac{\alpha^1 \cdot I^1}{P_1} \quad (42)$$

Demand for good 2 in the country 1

$$C_2^1 = \frac{(1 - \alpha^1) \cdot I^1}{P_2} \quad (43)$$

Demand for good 1 in country 2

$$C_1^2 = \frac{\alpha^2 \cdot I^2}{P_1} \quad (44)$$

Demand for good 2 in country 2

$$C_2^2 = \frac{(1 - \alpha^2) \cdot I^2}{P_2} \quad (45)$$

Global market clearing for good 1

$$C_1^1 + C_1^2 = X_1^1 + X_1^2 \quad (46)$$

Global market clearing for good 2

$$C_2^1 + C_2^2 = X_2^1 + X_2^2 \quad (47)$$

	α	a_1	a_2	L
Country 1	0.4	2	5	365
Country 2	0.6	5	2	1200

Analytical solution

Choose good 1 as numeraire, then $P_1 = 1$. Under complete specialization country 1 produces services X_2 and country 2 produces manufacturing goods. Complete specialisation solution $I^1 = P_1 L_1^1 = 1 \times 365 = 365$; $I^2 = P_2 L_2^2 = P_2 \times 1200$

$$\frac{\alpha^1.I^1}{P_1} + \frac{\alpha^2.I^2}{P_1} = 1825 = 365 \times 5 \quad (48)$$

$$\frac{(1 - \alpha^1).I^1}{P_2} + \frac{(1 - \alpha^2).I^2}{P_2} = \frac{0.6 \times 365}{P_2} + \frac{0.4 \times P_2 \times 1200}{P_2} = 1200 \times 2 = 6000 \quad (49)$$

$$\frac{219}{P_2} = 5520; P_2 = \frac{219}{5520} = 0.0397 \quad (50)$$

$$I^2 = P_2 \times 1200 = 0.0397 \times 1200 = 47.64 \quad (51)$$

Similar examples can be made for economy with production or the Neoclassical growth model. Let us look at an economic growth growth model with human capital in which the physical capital is not subject to diminishing returns and shows how one gets features of endogenous growth model when the human capital is added in the neoclassical model. This application of the dynamic general equilibrium models in analysing growth is appealing considering the impact of human capital in raising the productivity and growth. It justifies more allocation of resources by the public and the private sector on manpower training and education under the university system and research activities carried on science laboratories. The simplest way of illustrating this is following:

$$Max U_c = \frac{C^{1-\theta}}{1-\theta} \quad (52)$$

$$Y = AK^\alpha H^{1-\alpha} \quad (53)$$

Physical and human capital accumulation process

$$\dot{K} = I_k - \delta K \quad (54)$$

$$\dot{H} = I_H - \delta H \quad (55)$$

Market clearing

$$Y = C + I_k + I_H \quad (56)$$

Current value Hamiltonian

$$J = \frac{C^{1-\theta}}{1-\theta} e^{-\rho t} + v [I_k - \delta K] + \mu [I_H - \delta H] + \omega [AK^\alpha H^{1-\alpha} - C - I_k - I_H] \quad (57)$$

$$\frac{\partial J}{\partial C} = C^{-\theta} e^{-\rho t} - \omega = 0 \quad (58)$$

$$\frac{\partial J}{\partial I_k} = v - \omega = 0 \quad (59)$$

$$\frac{\partial J}{\partial I_H} = \mu - \omega = 0 \quad (60)$$

$$\dot{v} = -\frac{\partial J}{\partial K} \quad (61)$$

$$\dot{\mu} = -\frac{\partial J}{\partial H} \quad (62)$$

These five equations can be used to solve the values of K, H, Y, C , and shown how such economy can grow at a constant growth rate over time.

$$\dot{v} = -\frac{\partial J}{\partial K} = v\delta - \omega\alpha AK^{\alpha-1} H^{1-\alpha} \quad (63)$$

$$\dot{\mu} = -\frac{\partial J}{\partial H} = \mu\delta - \omega(1-\alpha) AK^\alpha H^{-\alpha} \quad (64)$$

From the first order condition of consumption and investment

$$C^{-\theta} e^{-\rho t} = \nu \quad (65)$$

Taking log both sides

$$-\theta \ln C - \rho t = \ln \nu \quad (66)$$

$$-\theta \frac{\dot{C}}{C} - \rho = \frac{\dot{\nu}}{\nu} \quad (67)$$

$$g_c = \frac{\dot{C}}{C} = \frac{1}{\theta} \left(\frac{\dot{\nu}}{\nu} + \rho \right) = \frac{1}{\theta} \left(\frac{v\delta - \omega\alpha AK^{\alpha-1} H^{1-\alpha}}{\nu} + \rho \right) = \frac{1}{\theta} (\omega\alpha AK^{\alpha-1} H^{1-\alpha} - \delta - \rho) \quad (68)$$

$$\frac{\dot{\nu}}{\nu} = \frac{v\delta - \omega\alpha AK^{\alpha-1} H^{1-\alpha}}{\nu} = \delta - \alpha AK^{\alpha-1} H^{1-\alpha} \quad (69)$$

$\frac{\dot{\nu}}{\nu} = \frac{\dot{\mu}}{\mu}$ implies

$$\delta - \alpha AK^{\alpha-1} H^{1-\alpha} = \delta - (1-\alpha) AK^\alpha H^{-\alpha} \quad (70)$$

$$\frac{K^\alpha H^{-\alpha}}{K^{\alpha-1} H^{1-\alpha}} = \frac{\alpha}{(1-\alpha)} \quad (71)$$

$$\frac{K}{H} = \frac{\alpha}{(1-\alpha)} \quad (72)$$

Thus the ratio of physical to human capital is constant. Putting this value in the production function:

$$Y = AK^\alpha H^{1-\alpha} = AK \frac{K^\alpha H^{1-\alpha}}{K} = AK \frac{H^{1-\alpha}}{K^{1-\alpha}} = AK \left(\frac{1-\alpha}{\alpha} \right) \quad (73)$$

Thus this model becomes a form of the AK model. The steady state solutions imply $\frac{\dot{Y}}{Y} = \frac{\dot{C}}{C} = \frac{\dot{K}}{K} = \frac{\dot{H}}{H} = \frac{\dot{\mu}}{\mu} = \frac{\dot{\nu}}{\nu}$. Steady state and the transitional dynamics are solved in terms of $\alpha, \beta, \delta, \sigma, \nu, \mu, \lambda$ and ω . For educational planners this little model has much insights to offer that can justify further resources in education.

Further applications of above fundamentals appear in the form of dynamic general equilibrium (DGE) models. More decentralised dynamic general equilibrium models are benchmarked to the input-output tables of an economy which give a consistent set of account of demand and supply, income and expenditure, exports and imports, and revenue and public spending. It details the sectoral and household dimensions and environmental factors that can be taken into account. DGE models have wide ranging applications of analysis of economic policies which include analysis of impacts of taxes on income, consumption, production and exports; tariffs on imports, subsidies and fines in goods with positive and negative externalities. They also show how growth, investment and accumulation of physical and human capital are affected by various economic policies and are used for constructing scenarios over a model horizon.

4 Macroeconomic Analysis

Students are exposed to static closed or open economy IS-LM models but have little knowledge of dynamics despite the fact that most of the macroeconomic questions are of dynamic nature. It is important that they can find the time path of the variables involved which can be given by even simple first order difference equations as can be illustrated from a popular Keynesian model as following:

Consumption function :

$$C = a + bY - nR \quad (74)$$

Let investment and government spending be as given at $I = \bar{I}$ and $G = \bar{G}$

Goods markets does not balance automatically, it takes time for adjustment as given by the following equation ($\alpha < 1$):

$$\frac{\partial y}{\partial t} = \alpha (a + by - nR + I + G - y) \quad (75)$$

Money market is assumed to balance instantaneously

$$L = ky - hR \quad (76)$$

$$M = \bar{M} \quad (77)$$

Money market equilibrium implies

$$R = \frac{k}{h}y - \frac{\bar{M}}{M} \quad (78)$$

Putting the money market equilibrium in the goods market gives the economy wide equilibrium process as:

$$\frac{\partial y}{\partial t} = \alpha \left(a + by - \left(\frac{nk}{h}y - \frac{n\bar{M}}{M} \right) + I + G - y \right) \quad (79)$$

By rearrangement

$$\frac{\partial y}{\partial t} + \alpha \left(1 - b + \frac{nk}{h} \right) y = \alpha \left(a + by + \frac{n\bar{M}}{M} + I + G \right) \quad (80)$$

$$\frac{\partial y}{\partial t} + Ay = B \quad (81)$$

where $A = \alpha \left(1 - b + \frac{nk}{h} \right)$ and $B = \alpha \left(a + \frac{n\bar{M}}{M} + I + G \right)$

The steady state equilibrium is given by $y_p = \frac{B}{A} = \frac{\alpha \left(a + \frac{n\bar{M}}{M} + I + G \right)}{\alpha \left(1 - b + \frac{nk}{h} \right)}$ and the complementary path is given by $y_c = Ce^{-At} = Ce^{-\alpha \left(1 - b + \frac{nk}{h} \right) t}$

Complete income path from solving the difference equation is given by combinations of these two:

$$y_t = Ce^{-At} + \frac{B}{A} \quad (82)$$

Definite solution requires getting value of C using the initial conditions $y_{t=0} = y_0$ as $C = y_0 - \frac{B}{A}$

$$y_t = \left[y_0 - \frac{B}{A} \right] e^{-At} + \frac{B}{A} = \left[y_0 - \frac{\alpha \left(a + \frac{n\bar{M}}{M} + I + G \right)}{\alpha \left(1 - b + \frac{nk}{h} \right)} \right] e^{-\alpha \left(1 - b + \frac{nk}{h} \right) t} + \frac{\alpha \left(a + \frac{n\bar{M}}{M} + I + G \right)}{\alpha \left(1 - b + \frac{nk}{h} \right)} \quad (83)$$

Convergence to the steady state requires that $A > 0$. This implies $1 - b + \frac{nk}{h} > 0$ or $\frac{k}{h} > -\frac{1-b}{n}$. The slope of the LM curve $\left(\frac{k}{h}\right)$ should be greater than the slope of the IS curve $\left(-\frac{1-b}{n}\right)$.

In putting the knowledge in practice it is very worrying that most students are not familiar to the time series properties of variables involved and not able to decompose trends, cyclical, seasonal and irregular components though these are essential for making sense of macro economic series. Decomposing series in components could help one to distinguish between temporary and secular factors underlying these macro variables. For instance:

$$Y = T \times C \times S \times I \quad (84)$$

In a simple method the moving average gives $T \times C$ components and is used to isolate the $S \times I$ components. For instance for a 12 monthly moving average

$$\bar{Y}_i = \frac{1}{12} (Y_1 + Y_2 + \dots + Y_{12}) \quad (85)$$

$$S \times I = \frac{T \times C \times S \times I}{T \times C} = \frac{Y_i}{\bar{Y}_i} = z_t \quad (86)$$

Now to isolate the Irregular component I from $S \times I$ take out the seasonal elements from z_t assuming monthly data for 5 years (60 observations) compute the seasonal indices as following:

$$\text{Month1} : \bar{z}_1 = \frac{1}{5} (z_1 + z_{13} + z_{25} + z_{39} + z_{48}) \quad (87)$$

$$\text{Month2} : \bar{z}_2 = \frac{1}{5} (z_2 + z_{14} + z_{26} + z_{40} + z_{49}) \quad (88)$$

$$\text{Month3} : \bar{z}_3 = \frac{1}{5} (z_3 + z_{15} + z_{27} + z_{41} + z_{50}) \quad (89)$$

.....

$$\text{Month11} : \bar{z}_{11} = \frac{1}{5} (z_{11} + z_{23} + z_{35} + z_{47} + z_{59}) \quad (90)$$

$$\text{Month12} : \bar{z}_{12} = \frac{1}{5} (z_{12} + z_{24} + z_{36} + z_{46} + z_{60}) \quad (91)$$

Deseasonalisation of data $Y_i^d = \frac{Y_i}{\bar{z}_i}$ and irregular component should be

$$i = \frac{z_t}{\bar{z}_i} \tag{92}$$

There are many macro and micro applications of these techniques that can help one to process information that is expanding rapidly.

5 Strategic Analyses

Economic decisions of one sets of agents affect the decision of others. Cooperative solutions Pareto dominate non-cooperative solutions. In general students may be able to identify Nash equilibrium in games like:

$$A = \begin{bmatrix} (2, 4) & (3, 1) \\ (5, 3) & (5, 5) \end{bmatrix} \tag{93}$$

or be able to solve the duopoly game and its consequence in product and prices in a model with demand and cost functions given by

$$P = 130 - (q_1 + q_2) \tag{94}$$

$$C_i = 10q_i \tag{95}$$

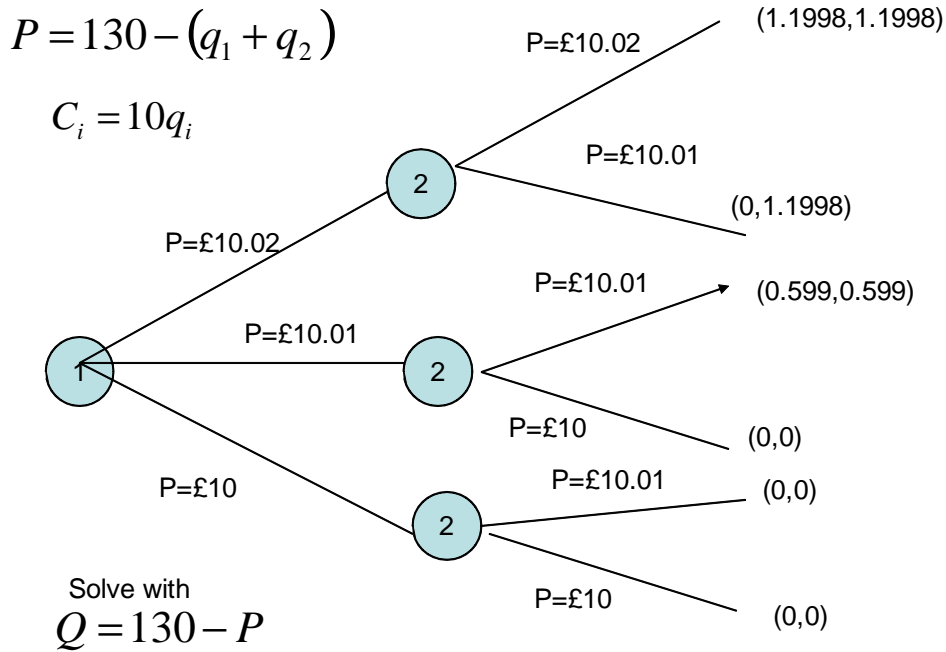
Most of them face difficulty in putting scenarios for the structures of these markets as:

Table 1: Solutions under Cartel, Cournot and Cheating

	Price	Total Output	Output	Output 1	Output 2	profit 1	Profit 2
<i>Cartel</i>	70	60	3600	30	30	1800	1800
<i>Cournot</i>	50	80	3200	40	40	1600	1600
<i>Cheating</i>	55	85	3625	45	40	2025	1600

Very few could appreciate the nature of the cut-throat competition in the Bertrand game though it only requires just one concept and one calculation.

Bertrand-Stackelberg Cut-Throat Competition



9

Solutions of bargaining, signaling, asymmetric information, core in games and Shapley value, design of incentive compatible mechanisms can be dealt with similar models.

6 Econometrics for Testing Economic Theories

Theoretical predictions need to be tested by real world data to generate insights useful for making economic decisions. Data bases on economic variables recorded on daily, weekly, monthly, quarterly and annual basis have much improved after the revolution on information technology in recent years. There are parallel advancements in computing technology that allow processing large scale data set in order to test economic theories. Panel data on households provide information on economic choices of millions of households, time series of financial variables such as the exchange rates or stock prices are recorded daily, macro indicators such as inflation and unemployment are recorded monthly, GDP and its components are recorded quarterly. Similarly millions of production firms keep their economic records on appropriate time scale. Linear, non-linear, parametric and non-parametric, single or multiple equation models are estimated to test economic theories and to make predictions and forecasts based on all

available information. Major focus of econometric analyses is in finding the best fit for the data using functions of dependent and independent variables, testing the significance of the models using t , F , R -square, χ -Square, Durbin Watson, RMSE, ADF, cointegration tests and many other specific tests or doing ANOVA, correlations, regressions, interdependent and dependent analysis for decomposition of variances. Econometrics theories build on mathematical functions derived from economic theories on one side and standard statistical analyses including the central tendency and dispersions as reflected in means, variances, other higher moments and other measures of normality and multivariate techniques.

Students may be comfortable with the simple linear regression model of the form:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + e_t \quad (96)$$

However, true knowledge of these parameters is not possible without proper knowledge of matrix that underlie derivations of true estimators of mean and variance of parameters such as $\beta_0, \beta_1, \beta_2, \beta_3$ and σ^2 .

Students should be aware of general principles underlying the estimation techniques such as the maximum likelihood

$$\ln L(\theta/y) = \ln \left\{ \prod_{i=1}^T \frac{1}{\sqrt{2\pi\sigma^2}} \exp \left[-\frac{1}{2} \frac{(y_i - \alpha - \beta x)^2}{\sigma^2} \right] \right\} \quad (97)$$

or the GMM estimators:

$$0 = g(\theta, Y_t) = \frac{1}{T} \sum_t (X_t (Y_t - X_t' \beta)) \quad (98)$$

$$\sum_t X_t Y_t = \left\{ \sum_t X_t X_t' \right\} \hat{\beta}_T \quad (99)$$

$$\hat{\beta}_T = \left\{ \sum_t X_t X_t' \right\}^{-1} \sum_t X_t Y_t \quad (100)$$

Similarly for the maximum likelihood function implies

$$L(\theta) = \sum_t \log f(Y_t/Y_{t-1}; \theta) \quad (101)$$

First order conditions

$$\sum_t \frac{\partial \log f(Y_t/Y_{t-1}; \theta)}{\partial \theta} = 0 \quad (102)$$

$$0 = \frac{1}{T} \sum_t^T h(\theta, y_t) \quad (103)$$

Thus the orthogonality condition to estimate θ are same in both GMM and MLE.

Importance of the error correction and cointegrations models

$$Y_t = \varphi_2 X_t + \epsilon_t \quad (104)$$

$$Y_t = X_t + \epsilon_t ; \quad \varphi_2 = 1 \quad (105)$$

$$\epsilon_t = Y_t - X_t \quad (106)$$

$$\Delta \epsilon_t = \gamma \epsilon_{t-1} + u_t \quad (107)$$

$$\Delta(Y_t - X_t) = \gamma(Y_{t-1} - X_{t-1}) + u_t \quad (108)$$

$$\Delta Y_t = \Delta X_t + \gamma(Y_{t-1} - X_{t-1}) + u_t \quad (109)$$

Or generalisation of a VAR model

$$Y_t = \Pi_1 Y_{t-1} + \Pi_2 Y_{t-2} + \dots + \Pi_p Y_{t-p} + \epsilon_t \quad (110)$$

its ECM form

$$\Delta Y_t = \Pi Y_{t-1} + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \dots + \Gamma_p \Delta Y_{t-p} + \epsilon_t \quad (111)$$

$\Pi = \Pi_1 + \Pi_2 + \dots + \Pi_p - I$; $\Gamma_i = -(\Pi_{i+1} + \Pi_{i+2} + \dots + \Pi_p)$ for $i = 1, \dots, p-1$.

deserve attention given their importance in time series analysis.

7 Areas of Policy Analyses

The course of economy can be changed using policy instruments that influence the first order conditions of optimisation or the budget or market clearing conditions. The impact of policies on economic variables can be studied qualitatively using theoretical derivations for static, comparative static or dynamic analyses. Then equilibrium can be computed for scenarios of such changes in order to conduct before after the policy changes. Econometric models estimate such relations and test them using the most appropriate data but more decentralised dynamic general equilibrium models are required for meaningful policy analysis. Decisions taken on the basis of such analysis can have profound impacts in the lives of millions of people like those of the expansionary policies taken by governments around the world to mitigate the impacts of current crises.

8 Conclusion

New trends are emerging in education of economics following rapid development in economic theories for static, dynamic and strategic analysis, increasing applications of general equilibrium modelling for evaluation of economic policies at national, regional and global level and overwhelming advancement in theoretical and econometric techniques developed to test those theories. A concise knowledge of these theories and techniques is essential for understanding economic process and to influence policy making for achieving greater efficiency and satisfaction of mankind. Careful design of curriculum and thoughtful implementation are essential for maintaining higher standard of education in economics.

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