Dynamic Programming

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November, 2021

Dynamic Programming

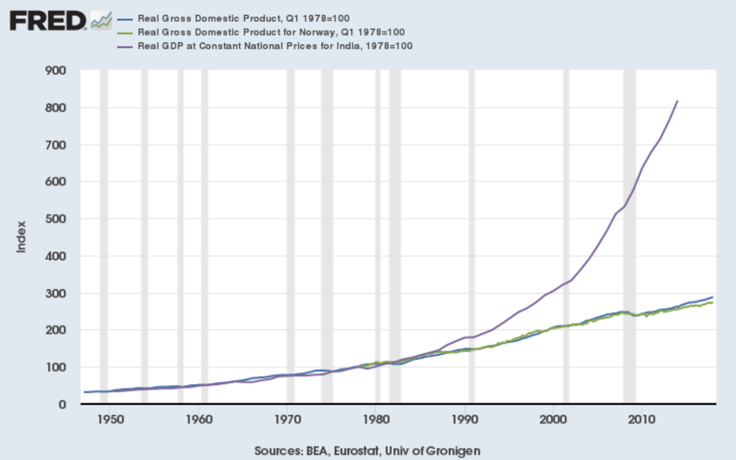
- Dynamic programming is a mathematical method to solving problems using recursive methods
- This is **key** tool to studying economic dynamics!
- Dynamics (i.e., intertemporal considerations) **are** macroeconomics – and are important in most (all?) areas of economics.

What is dynamic?

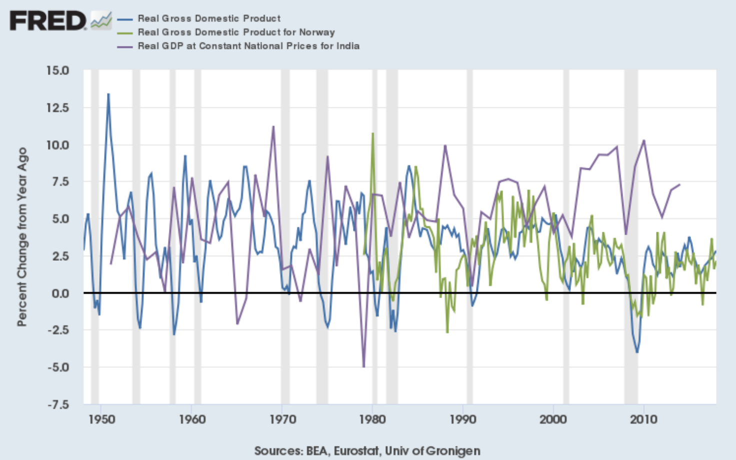
Some (general) examples of dynamic problems in economics:

- Patterns of household consumption and savings
- Portfolio choice problems
- Expenditures on durables (e.g., demand for cars)
- Human capital accumulation
- Health capital/investment
- Employment and unemployment flows
- Natural resource extraction

Economic Growth



Economic Fluctuations



Corporate Finance

THE JOURNAL OF FINANCE • VOL. LX, NO. 3 • JUNE 2005

Debt Dynamics

CHRISTOPHER A. HENNESSY and TONI M. WHITED*

ABSTRACT

We develop a dynamic trade-off model with endogenous choice of leverage, distributions, and real investment in the presence of a graduated corporate income tax, individual taxes on interest and corporate distributions, financial distress costs, and equity flotation costs. We explain several empirical findings inconsistent with the static trade-off theory. We show there is no target leverage ratio, firms can be savers or heavily levered, leverage is path dependent, leverage is decreasing in lagged liquidity, and leverage varies negatively with an external finance weighted average Q. Using estimates of structural parameters, we find that simulated model moments match data moments.

Marketing

Decision-making Under Uncertainty: Capturing Dynamic Brand Choice Processes in Turbulent Consumer Goods Markets

Tülin Erdem • Michael P. Keane
University of California at Berkeley
University of Minnesota

Abstract

We construct two models of the behavior of consumers in an environment where there is uncertainty about brand attributes. In our models, both usage experience and advertising exposure give consumers noisy signals about brand attributes. Consumers use these signals to update their expectations of brand attributes in a Bayesian manner. The two models are (1) a dynamic model with immediate utility maximization, and (2) a dynamic ''forward-looking'' model in which consumers maximize the expected present value of utility over a planning horizon. Given this theoretical framework, we derive from the Bayesian learning framework how brand choice probabilities depend on past usage experience and advertising exposures. We then form likelihood functions for the models and estimate them on Nielsen scanner data for detergent.

keting mix strategies. Our paper will be of particular interest to those interested in the long run effects of advertising.

Note that our estimation strategy requires us to specify explicit behavioral models of consumer choice behavior, derive the implied relationships among choice probabilities, past purchases and marketing mix variables, and then estimate the behavioral parameters of each model. Such an estimation strategy is referred to as ''structural'' estimation, and econometric models that are based explicitly on the consumer's maximization problem and whose parameters are parameters of the consumers' utility functions or of their constraints are referred to as ''structural'' models.

A key benefit of the structural approach is its potential usefulness for policy evaluation. The parameters of structural models are invariant to policy, that is, they do not change due

Education

Journal of Econometrics 166 (2012) 3–16

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Contents lists available at SciVerse ScienceDirect

Journal of Econometrics

journal homepage: www.elsevier.com/locate/jeconom

Modeling college major choices using elicited measures of expectations and counterfactuals☆

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ARTICLE INFO

Article history:
Available online 24 June 2011

Keywords:
Choice of college major
Subjective expectations

ABSTRACT

The choice of a college major plays a critical role in determining the future earnings of college graduates. Students make their college major decisions in part due to the future earnings streams associated with the different majors. We survey students about what their expected earnings would be both in the major they have chosen *and* in counterfactual majors. We also elicit students' subjective assessments of their abilities in chosen and counterfactual majors. We estimate a model of college major choice that incorporates these subjective expectations and assessments. We show that both expected earnings and students' abilities in the different majors are important determinants of a student's choice of a college major. We also consider how differences in students' forecasts about what the average Duke student would earn in different majors versus what they expect they would earn both influence one's choice of a college major. In particular, our estimates suggest that 7.8% of students would switch majors if they had the same expectations about the average returns to different majors and differed only in their perceived comparative advantages across these majors.

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Bus Engines

Econometrica, Vol. 55, No. 5 (September, 1987), 999-1033

OPTIMAL REPLACEMENT OF GMC BUS ENGINES: AN EMPIRICAL MODEL OF HAROLD ZURCHER

BY JOHN RUST[1]

This paper formulates a simple *regenerative optimal stopping* model of bus engine replacement to describe the behavior of Harold Zurcher, superintendent of maintenance at the Madison (Wisconsin) Metropolitan Bus Company. The null hypothesis is that Zurcher's decisions on bus engine replacement coincide with an optimal stopping rule: a strategy which specifies whether or not to replace the current bus engine each period as a function of observed and unobserved state variables. The optimal stopping rule is the solution to a stochastic dynamic programming problem that formalizes the trade-off between the conflicting objectives of minimizing maintenance costs versus minimizing unexpected engine failures. The model depends on unknown "primitive parameters" which specify Zurcher's expectations of the future values of the state variables, the expected costs of regular bus maintenance, and his perceptions of the customer goodwill costs of unexpected failures. Using ten years of monthly data on bus mileage and engine replacements for a subsample of 104 buses in the company fleet, I estimate these primitive parameters and test whether Zurcher's behavior is consistent with the model. Admittedly, few people are likely to take particular interest in Harold Zurcher and bus engine replacement *per se.* I focus on a specific individual and capital good because it provides a simple, concrete framework to illustrate two ideas: (i) a "bottom-up" approach for modelling replacement investment, and (ii) a "nested fixed point" algorithm for estimating dynamic programming models of discrete choice.

KEYWORDS: Optimal replacement, regenerative optimal stopping models, dynamic programming, controlled stochastic processes, nested fixed point algorithm.

But we will start with cake!