

Francisco J. André
M. Alejandro Cardenete
Carlos Romero

Designing Public Policies

An Approach Based on Multi-Criteria Analysis
and Computable General Equilibrium Modeling

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Dr. Francisco J. André
Universidad Pablo de Olavide
Department of Economics
Carretera de Utrera km. 1
41013 Sevilla
Spain
andre@upo.es

Dr. M. Alejandro Cardenete
Universidad Pablo de Olavide
Department of Economics
Carretera de Utrera km. 1
41013 Sevilla
Spain
macardenete@upo.es

Prof. Carlos Romero
Technical University of Madrid
Research Group:
Economics for a Sustainable
Environment
Ciudad Universitaria s/n
28040 Madrid
Spain
carlos.romero@upm.es

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Para mis padres y para Sara
F.J.A.

To my father, Manuel
M.A.C.F.

To my dear flat-mates Carlos, Javier and Puelcio
C.R.

Foreword

This monograph provides a novel approach to the evaluation of economic policy by combining two different analytical strategies. On the one hand, the computable general equilibrium (CGE) analysis, a standard tool mostly used to quantify the impact of economic measures or changes in the structural data of the economy. On the other hand, the multiple criteria decision-making (MCDM) approach, an optimisation technique that deals with problems with more than one objective. Typically, CGE is well suited for the analysis of the interactions of multiple agents from the point of view of a planner single objective. Combining this technique with the MCDM approach allows developing models in which we find many interacting agents and a decision maker with several objectives.

The contribution of this work is partly methodological and partly applied. It provides a framework for the analysis of this type of problems, as well as a series of applications in which the strength of the approach is made clear. The consideration of environmental problems, as a specific field in which this technique of analysis can be used, is particularly well chosen. The environmental concern keeps growing steadily and has already become an issue in most of the standard economic decisions. It is therefore extremely important to find systematic ways to introduce such a concern in the models with which we evaluate the impact of policy measures. This work is a relevant addition to the stock of knowledge from that perspective and will become a standard reference for the field. The authors have already proven their skills on those topics in a number of internationally renowned contributions. So the reader is in good hands to travel along these matters.

Antonio Villar
Professor of Economics
Universidad Pablo de Olavide

Preface

Almost eighty years ago the British economist Lord Robbins proposed what is now his famous and universally accepted definition of economics in his classic book *Nature and Significance of Economic Science*¹:

“Economics is the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses”.

Robbins’ definition was not, however, readily accepted at first and raised many controversies. In fact, several epistemological issues underlying this definition have been discussed since its conception. Backhouse and Medema² offer a recent and lucid discussion about the controversies, as well as the slow acceptance of Robbins’ definition.

Two main issues derive from this definition. The first is that scarcity is the primitive concept underlying any type of economic problem. The second is that, to some extent as a consequence of the scarcity issue, economics aims to deal with scarcity in the best possible way. Technically speaking, economics attempts to “optimize” the existing scarcity. In short, as Intriligator³ states, “economic problems” can be expressed as particular cases of “mathematical optimization problems”. The underlying optimization problem can be undertaken within an environment devoid of institutions (a “Robinson Crusoe economy”) or within an environment with very dense institutions (the “current global economy”). But at the two opposite poles or in any intermediate state, the “economic act” is analytically speaking “an optimization act”.

According to the above ideas, it is reasonable to accept that economics strongly depends on the state-of-the-art of current mathematical optimization theory. In this

¹Robbins LC (1932) *An essay on the nature and significance of economic science*. Macmillan, London.

²Backhouse RE, Medema SG (2009) Defining economics: the long road to acceptance of the Robbins definition. *Economica* 76: 805–820.

³Intriligator MD (1971) *Mathematical optimisation and economic theory*. Prentice-Hall, Englewood Cliffs, New Jersey.

sense, we should stress that economics is today generally underpinned by a classic optimization theory. This type of theory postulates the optimization (maximization or minimization) of an objective function that is assumed to represent the preferences of the economic agents (e.g., utility for a consumer, profits for a producer, etc). On the other hand, the optimization process is subject to a set of constraints being met. This can be understood as a representation of the economics side of scarcity (i.e. budget restraint, technology of a production process, etc).

Given this close connection between economics and optimization theory, it is worthwhile investigating what effects a change in the underlying mathematical optimization paradigm might have on economic science. Such a shift in the optimization paradigm has occurred in the last 40 years or so, with the slowly evolving of the Multiple Criteria Decision Making (MCDM) paradigm. The main purpose of this book is to analyse some potential effects of this shift of paradigm on an important branch of the economic analysis: the design and assessment of public policies. We will show throughout the book how this branch of economics can be considerably revitalized by formulating and solving the basic problems of this discipline within the MCDM paradigm. Thus, the acceptance of this new paradigm as a framework for economic policy implies new challenges, but also more realistic formulations, as well as more pragmatic solutions to the design of public policies especially when environmental and traditional economic criteria are considered together.

The MCDM paradigm has been developed mainly within the field of operational research/management science (OR/MS). Although it has been used to address many economic problems, it has not been fully incorporated yet into the core of economic thinking, and it remains unknown to many economists. Therefore, we would like to stress that our effort could be useful for re-building bridges between economics and operational research/management science (OR/MS). This connection takes place, first, through the extensive application of MCDM to a classical economic problem, such as the design and evaluation of economic policies. And second, our work establishes another connection between OR/MS and economics in the sense that we address policy design problems by combining MCDM techniques with structural economic models.

From the economics side, we need some analytical representation of the main economic mechanisms, such as production and consumption decisions, as well as markets for goods and inputs, to properly specify our policy design problems. Computable general equilibrium (CGE) models are useful for this representation of the economy. Such structures have been used extensively since the 1980s in the evaluation of public policies and other simulation exercises in both developed and developing countries. CGE modelling is especially attractive for policy-makers since, being consistent with standard economic theory, it can measure the effects of a specific change (e.g., a given policy) on the most significant economic variables such as prices, production levels, tax revenues, and income distribution.

The importance of the connection between economics and OR/MS was quite clear in the 1950s and 1960s, with important contributions by leading figures in economics like Arrow, Baumol, Dorfman, Hicks, Leontief, Samuelson, Solow,

among others. However, this important tradition of linking economic problems with OR/MS almost vanished as of the early 1980s, which, in our view, is an important loss to both disciplines. We insist that our book can help to fill this gap. Thus, it is intended for postgraduate students and researchers of economic policy with an OR/MS orientation or of OR/MS with an economic policy orientation. In short, economic policy can be revitalized with new formulations and analytical procedures borrowed from the MCDM paradigm, whereas OR/MS can also be stimulated with the appearance of new interesting areas of application.

We are aware of the limits of our analysis. In fact, we only present initial and tentative procedures and solutions, but hopefully in a new and promising direction.

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Francisco J André and M Alejandro Cardenete
Carlos Romero

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The work reported in this book has evolved gradually over five years of collaboration among the three authors. In this respect, there are a lot of beneficial intellectual influences that must be cited.

Francisco J. André came up with the idea of addressing macroeconomic policy making as a multicriteria problem after taking an extremely inspiring PhD course taught by Professor Carlos Romero at the Technical University of Madrid. The embryo of this idea was born when he was following the PhD program on economic analysis at the Complutense University of Madrid. He is indebted to many professors for helping him to develop an analytical vision of the economy. Of these, Professors Emilio Cerdá and Alfonso Novales deserve a special mention. This idea came to light after meeting Dr. Manuel Alejandro Cardenete at the Department of Economics of the Pablo de Olavide University of Seville, which provided a fruitful research environment.

Manuel Alejandro Cardenete thanks Professor Ferran Sancho from the Autonomous University of Barcelona for his patience and effort. Almost fifteen years ago he thought that helping this young graduate student to learn applied general equilibrium models might be of some use. Even today he still assists him with his research, although the relationship is now more than just professional. He would also like to thank Professor Jose Maria O’Kean from the Pablo de Olavide University of Seville and Professor Geoffrey J.D. Hewings from the University of Illinois at Urbana-Champaign for highlighting important points throughout his academic career.

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Chapter 1

General Framework: Policy Making as a Problem with Multiple Criteria

Abstract This chapter underlines some limitations of the traditional approach to public policy making. First, it is troublesome to find an expression for a social welfare function because of information requirements and the technical difficulties associated with the aggregation of preferences. Second, observed policy practice does not appear to be consistent with the existence of a well-defined social welfare function. On the contrary, policy design seems to be targeted to the improvement of economic performance as measured by a number of conflicting indicators. Based on this evidence, we set out to provide an alternative, more pragmatic approach to policy making. In this chapter we introduce a recent line of research that we have developed in which policy design is modelled as a decision problem with several objectives using multiple criteria techniques. This approach requires a structural model of the economy, such as a computable general equilibrium model, some multicriteria techniques to address the policy design problem and to identify the key set of policy instruments and policy objectives. All these elements are analysed and developed throughout the rest of the book.

1.1 Introduction

Traditional economic analysis builds on the principle that agents are considered to be rational. This idea is typically rendered as the assumption that they set out to optimize some objective function subject to some constraints. In this way, most economic problems can be expressed as particular cases of mathematical optimization (see for example Intriligator 1971). Thus, consumers are assumed to maximize their utility subject to their budget constraints, and firms are assumed to maximize their profits subject to technology and market environment constraints. This approach is appealing for at least two reasons. On the one hand, it looks to be a sound and logical way to think about decision making from a conceptual point of view. On the other hand, by resorting to optimization theory, it provides economic theory with a powerful and consistent analytical tool.

Following this trend, the design of public policies has also been traditionally envisioned as an optimization problem. As a matter of fact, finding an optimal policy, in the sense of choosing the value of instruments to optimize some social utility or welfare function, has become a traditional economic problem (see, for example, Ramsey (1927); Kumar (1969); Holbrook (1972) or Chow (1973) for classical references). To apply this approach, it is necessary to specify the policy maker's objective, which is typically assumed to be the maximization of the utility function of a representative consumer.

This conventional approach to economic policy design has also been frequently applied to environmental policy modeling, envisioned as the correction of externalities and other market failures in order to achieve maximum economic welfare (see, for example, Pigou (1920), and Coase (1960), for pioneering works, Baumol and Oates (1988), for a classical comprehensive text or Xepapadeas (1997), for a more recent analysis).

Despite the theoretical and technical interest of this framework for policy design, its applicability is arguable for at least two sets of reasons. The first group has to do with the technical problems associated with the specification of the government's objective function. It is philosophically appealing to assume that the government sets out to maximize a function that aggregates the preferences of society as a whole, but it is very difficult to find such a function in practice. First, it is problematic because of the huge amount of information that would be necessary to summarize the preferences of society as a whole. Second, Arrow (1963) noted that it is very troublesome to aggregate ordinal preferences and preserve all desirable properties. Within a cardinal context, on the other hand, the aggregation of individual preferences into a collective preference is not so complex, but leads to another problem known as "interpersonal comparison of utilities" (see for example Keeney 1976). Arrow's ideas were the embryo of a long line of research called social choice, concerned with aggregating individual into social preferences. This has proven to be a rather tricky problem.

The second set of reasons why the traditional single-optimization approach to policy design is troublesome in practice has to do with its realism. In fact, it is difficult in real life to identify a single policy objective for the government (see, for example, Fair and Howrey 1996). Moreover, direct observation does not seem to support the claim that the government has a single policy target or a well-defined objective function. On the contrary, policy makers are typically concerned about a bundle of economic variables that represent the state and evolution of the economy from a macroeconomic point of view. These variables include indicators related to the real evolution of the economy, such as the growth rate or the unemployment rate, nominal indexes such as the inflation rate, indicators related to public accounts, such as public deficit or public debt, or the evolution of the foreign sector as measured by the foreign deficit. On the other hand, environmental variables, including the emissions of certain polluting substances or the depletion of some natural resources, are increasingly becoming a government concern. In this framework, policy making can be understood as an attempt to improve the performance of the economy as measured by all these indicators.