Socio-Economic Planning Sciences 43 (2009) 192–200

Contents lists available at ScienceDirect

Socio-Economic Planning Sciences

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

Defining efficient policies in a general equilibrium model: a multi-objective approach

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ARTICLE INFO

Article history:
Available online 21 November 2008

JEL classification:
C61
C68
D78

Keywords:
Public policy
Multicriteria decision making
Computable general equilibrium model
Efficient frontier

ABSTRACT

Macroeconomic policy makers are typically concerned with several indicators of economic performance. We thus propose to tackle the design of macroeconomic policy using Multicriteria Decision Making (MCDM) techniques. More specifically, we employ Multi-objective Programming (MP) to seek so-called efficient policies. The MP approach is combined with a computable general equilibrium (CGE) model. We chose use of a CGE model since it has the dual advantage of being consistent with standard economic theory while allowing one to measure the effect(s) of a specific policy with real data. Applying the proposed methodology to Spain (via the 1995 Social Accounting Matrix) we first quantified the trade-offs between two specific policy objectives: growth and inflation, when designing fiscal policy. We then constructed a frontier of efficient policies involving real growth and inflation. In doing so, we found that policy in 1995 Spain displayed some degree of inefficiency with respect to these two policy objectives. We then offer two sets of policy recommendations that, ostensibly, could have helped Spain at the time. The first deals with efficiency independent of the importance given to both growth and inflation by policy makers (we label this set: general policy recommendations). A second set depends on which policy objective is seen as more important by policy makers: increasing growth or controlling inflation (we label this one: objective-specific recommendations).

1. Introduction

Macroeconomic policy makers are typically concerned with several indicators such as growth, inflation and unemployment rates, and the level of public deficit. In this sense, policy making can be viewed as a problem with several objectives, some of which may conflict with one another. For example, an active anti-unemployment policy could increase inflation; a greater domestic growth rate could be harmful to the balance of trade, and so on. (See refs. [28,30] and [36] for selected discussions and analyses of the multi-objective nature of policy making.)

The well-known area of Multi-criteria Decision Making (MCDM) offers techniques designed to deal with problems in which there are multiple conflicting goals.[1] It thus appears reasonable to tackle the design of macroeconomic policies using MCDM techniques. More specifically, we explore the use of Multi-objective Programming (MP),[2] which specifically seeks so-called (*Pareto*) *efficient solutions*.

For current purposes, we say that a policy is "efficient" if it is not possible to find an alternative that allows improvement in the value of some objectives without harming the value of others. Importantly, knowledge about

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doi:10.1016/j.seps.2008.11.001

[1] See ref. [8] for an introduction to MCDM techniques, and their applications to economic problems, and ref. [15] for a state-of-the-art review of the field.

[2] For recent developments and applications of MP, see, for example, [7,11,14,16,17,19,23].

which policies are efficient or inefficient is of real practical value since, if a given policy is known to be inefficient, guidance can be provided for improvement going forward.

In order to operationalize our MCDM approach, an analytic representation of the economy under study is needed. In the current case, we use a computable general equilibrium (CGE) model. Such structures have been used extensively since the 1980s in the evaluation of public policies and other simulation exercises, both in developed and developing countries. (See refs. [4,18,24,26, 31], and [32] for selected recent applications of CGE models, and [22] for a discussion of the current state-of-the-art.)

CGE modelling is especially attractive for policy makers since, being consistent with standard economic theory, it allows one to 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 principal contribution of the current paper is a methodological proposal for policy making that is both operational/practical and consistent with economic theory. Moreover, it combines two analytical tools that, to the best of our knowledge, have not previously been employed together: CGE modelling and MP. The approach can thus be used to design efficient policies and/or determine if any given (real or potential) policy is efficient or not. A second contribution of the current research is its application to a real economy.

In Section 2, we present an application using the Spanish national Social Accounting Matrix (from 1995) in which growth and inflation are chosen as policy objectives. In Section 3, key results are presented: The trade-off between growth and inflation is assessed, an efficient policy frontier constructed, and the observed policy compared to this frontier. Selected recommendations are offered to improve the observed policy in terms of efficiency. In Section 4, some additional extensions and applications of our methodological proposal are presented. Section 5 concludes the paper, offering some guidelines for future research.

2. The proposed methodology and an application to the Spanish economy

2.1. General setting

We assume that a given policy maker has a vector x of policy instruments (which may include, for example, taxes, public expenditures, subsidies, interest rates, etc.). At the same time, s/he also has a vector of policy objectives, say Z. Typically, these objectives include key macroeconomic indicators such as the rate of economic growth, the rate of inflation, the unemployment rate, the level of foreign deficit, and so on. If s/he also has information about how economic agents behave and interact with one another (i.e., an *economic model*), s/he could estimate the equilibrium of the economy. This would allow calculation of relevant macroeconomic indicators as a function of the policy instruments, x. This formulation gives rise to a multicriteria decision problem to be solved by the policy maker.

In this paper, we propose to model this decision problem using MP in seeking efficient policies. A *feasible* policy (i.e., a feasible value of x) is (Pareto) efficient if it provides some values of the objective variables, Z, such that there is no other feasible policy able to achieve the same or better performance for all objectives, while being strictly better for at least one objective. In order to implement this approach, it is first necessary to identify the policy objectives of interest, and their feasible ranges, as well as appropriate policy instruments. Moreover, as suggested above, a model is needed to represent the policy objectives as a function of the chosen instruments. The remainder of the paper offers a proposed approach to this problem as well as a "real-world" application.

2.2. The economic model

As noted above, here we use a CGE model, following the basic principles of Walrasian equilibrium (as in [22]) including the public and foreign sectors. Taxes and public expenditure are taken as exogenous by consumers and firms, but are considered decision variables for the government. An equilibrium of the economy is given by a price vector for all goods and inputs, a vector of activity levels, and a value for public income that satisfies the following conditions:

1. Consumers maximize their utility
2. Firms maximize their profits
3. Public income equals the payments of all economic agents; and, finally
4. Supply equals demand in all markets.

In the interest of brevity, we present only the basic features of the model. For a more detailed description, see ref. [4] or [9].

The proposed model has nine productive sectors. In each sector, there is a single representative firm producing some sort of output. There is also a single representative consumer, one public sector, and one foreign sector. The production technology is described by a nested production function: The domestic output of sector j, measured in euros and denoted by Xd_j, is obtained by combining, through a Leontief technology, outputs from the remaining sectors, and the value added, VA_j. The latter is generated from primary inputs (labour, L, and capital, K), combined by a Cobb–Douglas technology. Overall output of sector j, Q_j, is obtained from a Cobb–Douglas combination of domestic output and imports, $Xrow_j$, according to the Armington hypothesis.[3]

[3] Nested production functions are commonly used in CGE modelling in order to describe the structure of different stages of production (see ref. [27] for a general discussion). Our model uses a Leontief or fixed-coefficient production function to reflect the fact that, in the short term, productive sectors typically use materials and generate value added (VA) in constant proportions. A Cobb–Douglas technology is used for VA to account for substitution between labour and capital. Finally, domestic and foreign outputs are combined through a Cobb–Douglas production function following the Armington hypothesis, according to which domestic and foreign goods are imperfect substitutes (see ref. [6]). For more details about the production structure of the model, see ref. [4] or [9].