

Macroeconomic Analysis of Investment in Fire Protection Using Social Accounting Matrixes: Application to the Navarre Region¹

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Summary

This work carries out an analysis which evaluates the effects of investments in fire protection on the regional economy from a macroeconomic point of view. The new feature of the methodology used is that it has integrate the sum of these investments within a general economic circulation model which consists of a Social Accounts Matrix (SAM) for the Navarre region (Comunidad Foral de Navarra), drafted from its Input-Output Tables (IOT) . The objective was to thus identify the direct, indirect and induced effects of these investments by applying the theory of Leontief multipliers. The analysis justifies the economic and financial backing of this type of forestry management policy, not only from the environmental angle, the protection of the ecological functions of the forestland, but also from a macroeconomic point of view by highlighting that these investments stimulate the regional economy by obtaining an increase in the regional GDP which exceeds the sum of investments made and which is accompanied by job creation.

Introduction

Fire is the main threat to the survival of the woodland and the rest of the forest areas on the Iberian Peninsula. In contrast to other parts of the world, where the majority of fires are due to natural causes (lightning), on the Iberian Peninsula there is a prevalence of forest fires due to anthropic causes. Paradoxically, the main cause of these forest fires is linked to the economic and social progress its population has undergone.

This improvement in living conditions is responsible for the migration of the rural population towards urban areas, the drop in the rate of demographic growth, the abandonment of cultivated land, and the growing lack of interest in the use of forestry resources as a source of energy.

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As a direct consequence of the above, there has been a growth in forestry surface area, abandonment of the rural environment, and what is more important, an accumulation of fuel due to the excess of biomass, contributing significantly to an increase in fire risk and also giving rise to a new type of forest fire characterized by its voracity and speed of propagation and which affects increasingly large surface areas.

Investment in forest fire protection is currently the only way of reducing economic, environmental and personal damage produced by these fires. This study calculates the macroeconomic effects of forestry management policies in the Navarre region from the total of economic programmes directed at forest fire prevention during 1996.

In order to link up investment in fire protection with the regional economy, it is necessary to bear in mind the interrelationship between the different sectors of production. The quantification of this impact is tackled using Input–Output (I-O) analysis, specifically using the Social Accounting Matrixes by means of the multipliers obtained from these.

Unfortunately the information contained in a conventional I-O table may be incomplete for the purposes of evaluating regional macroeconomic impacts, when the relationships which define the use of the resources are not exclusively industrial. The I-O models do not include information on the external effects of the economy's production processes, i.e. on the distribution and circulation of income between economic partners (Thorbecke 1985). For this reason the approach of authors such as Pyatt and Round (1985) or Atkinson (1996) has been used. These authors began to develop a more complete approach based on the SAMs. From this, Khan et al (1990) or Martínez de Anguita (1999), amongst others, have begun to use SAM multipliers which broaden the impact of a change in the use of resources, including direct, indirect and induced effects on the income resulting from this change, and which at the same time bring the environment within the economy – a necessary integration process.

In order to determine the global impact of this forestry management policy, the analysis is extended using SAM, thus fully including the entire cyclical process of the economy (Field 1997), (Pearce y Turner 1989) and enabling us to estimate more precisely not only the direct and indirect effects but also effects induced or caused by the measures taken - stimuli and knock-on effects produced on the regional economy.

Methodology

The Social Accounting Matrixes

The SAMs are very useful analysis tools which, from a quantitative viewpoint, study the economic structure of a specific organisation, regardless of its size. The SAM also enables us to evaluate the effects on this structure of several different exogenous changes, such as those related to reforms in economic policy.

Based on the logic of the Input-Output analysis, the SAMs attempt to correct and overcome some of the most obvious limitations of conventional data bases used for economic analysis: to include all the economic transactions which occur between all the parties in a specific economy and, more specifically, to show the interrelationship between the production structure and the distribution of income and

consumption patterns. It also models the effect of a change in exogenous variables on the production structure and the different economic institutions.

A SAM is the accounting record of all flows in an economic system during a specific period (generally one year). This is equivalent to a snapshot of the links existing between the production sectors of a country, a region, a community or a group of these. The SAM is an extension of Leontief's (1996) Input-Output Table (IOT) and also includes the production structure, data on the distribution of income and institutions' demand structure.

Multiplier Effect of Investment in Fire Protection. Application to the Navarre Region.

The economic impact on the regional economy may be estimated using the multipliers and analysing the Input-Output tables, or the SAM models. The latter are more complete. Multipliers are analysed to estimate the regional economic impact resulting from changes in the final demand for a good or service, or a group of these (Alward et al. 1993). They may also be used to estimate the economic reduction resulting from a tax or rate, applying the multipliers theory inversely (Miller and Blair. 1985).

To find the multiplier effect of investment in forest fire protection. we took the IOTs for the Navarre economy for 1996. In order to facilitate the analysis of these, a modification was made in the sectors making up the original IOTs. More specifically, the 24 sectors of the Navarre IOTs were grouped into 11 as follows: agriculture, livestock, forestry, agrifood industry, chemical-textile, mining, metallurgy, transport elements and spare parts, public administration. services and others. The first three were separated while the remaining areas were grouped together. Once the IOTs had been established with the new sector-based distribution, the Navarre SAM was constructed.

The SAM Backward² multipliers were then calculated. producing the following results (*table 1*).

Table 1— *Backward multipliers for the different production sectors.*

Sectors	Backward Multiplier (type I)	Backward Multiplier (type III)
Agriculture	1.16906	1.20403
Livestock	1.39510	1.44131
Forestry	1.00236	1.00888
Agrifood Indus	1.37107	1.46005
Chemical-Textile	1.11671	1.20137
Mining	1.23193	1.38256
Metallurgy	1.19615	1.29002
Transport Elem.	1.19416	1.26466
Others	1.22416	1.33972
Public Admin	1.32507	1.85286
Services	1.29772	1.50697

¹The Backward multipliers in the Leontief matrix come from the SAM of the technical coefficients for production. The type I multipliers only include the inter-industrial effect, whereas the type III multipliers include the regional effect, including the whole cycle of the economy. i.e. they consider a broader based effect. **Source:** Own develop.

The relevance and suitability of using the SAM Backward multipliers is shown in how the weighting of the rest of the sectors varies with regard to the

distribution obtained in the IOT multipliers. i.e. the SAM analysis estimates more thoroughly the relationships between the production sectors, but taking in the entire economic cycle. Below details this reassigning of weightings between the production sectors for the case of the Backward multiplier for Forestry, the sector which receives investment in forest fire protection. (table 2).

Table 2—*Distribution of weightings by type of multiplier used (as a percentage).*

Sectors	Weighting in the Backward Multiplier (type I)	Weighting in the Backward Multiplier (type III)
Agriculture	0.00 %	0.01 %
Livestock	0.00 %	0.00 %
Forestry	99.77 %	99.12 %
Agri-food Ind.	0.00 %	0.02 %
Chemical–Textile	0.01 %	0.01 %
Mining	0.00 %	0.01 %
Metallurgy	0.01 %	0.02 %
Transport Elem.	0.00 %	0.00 %
Others	0.11 %	0.25 %
Public admin.	0.00 %	0.04 %
Services	0.10 %	0.52 %

Source: Own develop.

In the case of the SAM multiplier it is observed that the weight of the rest of the sectors increases to 0.88 per cent compared with 0.23 obtained by the IOT analysis. This means that the effect identified by the SAM multiplier is 282.61 percent greater than the figure obtained using the IOT multiplier.

Results and Discussion

Given the difficulty of obtaining budget data on fire prevention in the Navarre region in 1996, and as the figure allotted to fire prevention in 1998 which appears in the Navarre Forestry Plan (Navarre Government 1998) is based on real data from previous years, we consider that this is fairly approximate and is taken as valid for 1996.

Using the Backward multiplier of the SAM model, we obtain the overall effect which investment in fire protection has had during 1996 on the Navarre economy. Thus, these funds, amounting to €1.827 million are obtained. This produced an increase in regional GDP of €1.843 million, €0.016 million corresponding to indirect and induced effects caused by Forestry on the regional economy, mainly resulting in repercussions on the service sector: 59.56 per cent and on other areas: 28.15 per cent.

The modest value achieved by the Navarre forestry sector multiplier fits with the value obtained at national level and highlights its scarce development, due mainly to the fact that this sector has not traditionally been considered as a key or strategic one in economic development at regional or national level.

To calculate the effects of these investments on regional employment, the relationship between production and jobs was identified for each economic sector (table 3).

Table 3—*Proportion between production and jobs by sectors (millions of euros/job)*

Sectors	Multiplier	Sectors	Multiplier
Agriculture	0.03278	Metallurgy	0.13550
Livestock	0.03278	Transport Elem.	0.20880
Forestry	0.03278	Others	0.12993
Agrifood Indus.	0.13277	Public admin.	0.04907
Chemical–Textile	0.10980	Services	0.05732
Mining	0.09678		

Source: Own develop.

Thus we obtain the figure of €1.827 million invested, producing 56 direct jobs (in the forestry sector). Similarly, in order to create indirect and induced employment in other sectors, investments of over €10 million would be necessary.

Conclusions

Using the SAM model multipliers we obtained the overall effect of investments in fire protection on the Navarre economy. This analysis unequivocally justifies economic and financial backing for this type of forestry management policy, by highlighting that these investments dynamise the regional economy, increasing the regional GDP beyond the level of the investments made.

Investments directed at fire prevention produced an increase in regional GDP of €1.843 million, €0.016 million corresponding to indirect and induced effects caused by the forestry sector in other areas of the regional economy.

Investments in forest fire protection have been responsible for the creation of approximately 50 percent of direct jobs in the primary forestry sector, with the production of 56 jobs (Ministry of Labour and Social Affairs).

Although the forestry sector does not contribute to the GDP very significantly, its productive aspect should be considered as fundamental, given the strategic importance it has on mountain or depressed areas in rooting the rural population to the region.

Due to the essential role of the forests, both from the economic point of view (timber production) and the ecological viewpoint (maintaining biodiversity, CO₂ sink, water and soil conservation, etc.), investments in forest fire prevention, and therefore the forestry sector, must be considered as strategic, since apart from providing an impulse for the regional economy, they guarantee future quality of life for the public and constitute one of the main pillars of sustainable rural development.

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