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Economic impacts of alternative water policy scenarios in the Spanish production system: an input-output analysis*

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Abstract

The objective of this paper is to analyse the economic impacts of alternative water policies implemented in the Spanish production system. The methodology uses two versions of the input-output price model: a competitive formulation and a mark-up formulation. The input-output framework evaluates the impact of water policy measures on production prices, consumption prices, intermediate water demand and private welfare. Our results show that a tax on the water used by sectors considerably reduces the intermediate water demand, and increases the production and consumption prices. On the other hand, according to Jevons' paradox, an improvement in technical efficiency, which leads to a reduction in the water requirements of all sectors and an increase in water production, increases the amount of water consumed. The combination of a tax on water and improved technical efficiency takes the pressure off prices and significantly reduces intermediate water demand.

JEL Classification: C67 ; D57 ; Q25.

Keywords: Production prices; Consumption prices; Water uses; Water policy; Water taxation.

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1. Introduction

In recent years, the idea that economic activity has to be compatible with natural resources and the environment has acquired particular significance in both economic and ecological research. The concept of sustainable development has become one of the main objectives in the processes of policy definition and policy implementation. In an economic system, firms and households use natural resources to produce and consume goods and services, and the way in which natural endowments are spent is a very important economic issue. Consequently, a general consensus has been reached that environmental policies must take into account not only the negative effects caused by economic activity but also the use and preservation of natural resources.

The availability of water is one of the most important problems of resource analysis, because it is clearly limited in terms of quantity and demographic and economic growth mean that demand is continuously rising. Moreover, the quality of water must be high if both the economic and the sociological development of an economy is to be guaranteed. Water analysis has given rise to the academic question of how policy measures should be defined and implemented in an attempt to ensure sufficient quality and quantity to achieve both economic growth and sustainable development.

In the field of resources research, it is well known that improvements in the use of any natural resource may not result in the expected reduction of global resource use. This effect, known as the Jevons' paradox or rebound effect, plays an important role in water analysis and, consequently, has to be taken into account in any theoretical and empirical water study.[2] Applied to the issue of water, Jevons' paradox means that any improvement in the technical efficiency of water requirements reduces demand, and this leads to a corresponding decrease in the price. This in turn leads to an increase in demand and use, and the initial efficiency is partially or completely cancelled. To prevent this subsequent increase in water use, it is commonly accepted that efficiency measures have to be accompanied by price intervention in order to obtain the desired effect on water resources and water scarcity.

What is more, the complexity of water demand and water consumption means that water policy may be implemented at different levels of use, which involve different economic agents. In particular, households need and consume water in their private lives, production sectors use water as intermediate input to produce goods and services, and public agents consume water in order to supply public goods. The consequence of this complexity is that the final effects of water measures will essentially depend on the level of application and the economic agents involved.

The objective of this paper is to use an input-output price model to analyse the economic impacts of alternative water measures applied within the production system. The input-output price framework captures the interdependences between sectors by taking into account the cost linkages within the production sphere. This approach provides disaggregated information about the underlying effects that help to define prices in an economy.

In recent decades, the input-output price model has become a useful tool for analysing the effects of different policy scenarios on production prices. For example, Manresa, Polo and Sancho (1988) used a generalised input-output price model to evaluate the new indirect taxation established in Spain after joining the EEC. McKean

[2] Recently, Alcott (2005) discussed the Jevons' paradox and made a survey of the relevant literature.

and Taylor (1991) used the input-output model to analyse the inflationary effects caused by changes to the primary input prices of the Pakistan production system. Cardenete and Sancho (2002) studied the price burden of indirect taxation in the Spanish region of Andalusia. More recently, Llop and Manresa (2004) used an input-output price model to evaluate the influence of factor prices and import prices on regional prices in Catalonia.

The Leontief approach can also be used to analyse the effects caused by new water policy scenarios. However, as far as I know, the literature on input-output price methods contains no contributions on water applications. In this paper, I use the input-output price model to evaluate how the Spanish production sectors react to new policy scenarios that modify water provision and water taxation. In particular, I define two versions of the input-output framework: a competitive definition and a mark-up definition. The competitive definition can be interpreted as a short-term situation in which production prices are equal to the average cost of production. The mark-up definition can be interpreted as a long-term situation in which production prices lead to a fixed capital rent. The two versions of the model assume, therefore, that firms behave differently and they reflect different hypotheses about the way in which sectors define and establish production prices.

The input-output approach makes it possible to evaluate how economic variables adapt to alternative water policy scenarios within the production system. Specifically, the first simulation increases the final production of water and improves the efficiency of the intermediate water requirements of activities. The second simulation analyses the effects of introducing a tax on the water consumed within the production system. Finally, the third simulation combines the first two scenarios: the improvement in the technical efficiency of water uses and the increase in water production are combined with the introduction of a tax on the water prices paid by sectors.

The empirical application is for the Spanish production system, and uses the economic and consumption information for the year 2000. The results show that technical efficiency in industrial water consumption combined with a rise in water production increases the industrial demand for water, in accordance with Jevons' paradox, and it also decreases prices. On the other hand, the introduction of a tax on intermediate water consumption leads to a general increase in prices, and a decrease in sectorial water demand. The combination of the two situations can reduce the pressure of industrial water uses and create non inflationary effects within the production system.

This paper can help to explain the economic impacts of alternative water interventions within the production sphere. How production activities react under new water scenarios is valuable information for the control and preservation of resources. This information can extend our knowledge of the economic-ecologic linkages within production system. All of this is extremely useful for defining and implementing successful resource policies that aim to guarantee the sustainable development of an economy.

The rest of the paper is organised as follows. Section 2 presents two versions of the input-output price model: the competitive formulation and the mark-up formulation. Section 3 describes the databases used in the empirical application to the Spanish production system, and section 4 contains the results. At the end of the paper, I provide some concluding remarks.

2. The input-output price model

The analytical framework that evaluates the economic effects of water policy measures is based on the input-output price model. This approach assumes linear production technology, in which each sector produces a single good or service under fixed coefficients and constant returns to scale, through the combination of intermediate inputs, primary factors (labour and capital) and imports from foreign markets.

The analysis involves two versions of the input-output model: a competitive price definition and a mark-up price definition. The competitive version assumes that sectorial prices are equal to the average cost of production. Thus, if $j = 1,\ldots,18$, are the eighteen production activities we consider in the empirical application, it follows that:

$$p_j = \left[\sum_{i=1}^{18} p_i a_{ij} + rk_j + wl_j\left(1+s_j\right) + p_j^m m_j\left(1+t_j^m\right)\right]\left(1+\tau_j\right), \tag{1}$$

where p_j is the production price of sector j, r is the capital price, w is the wage rate, and p_j^m is the import price of sector j. Additionally, a_{ij} are the input-output technical coefficients, and k_j, l_j, m_j are the technical coefficients of capital, labour and imported goods of j, respectively. Finally, s_j is the social security tax rate paid by sector j, t_j^m is the corresponding tariff rate of imported goods, and τ_j is the ad valorem tax rate on the production of sector j.

The simulation analysis introduces a tax on the water price paid by the production sectors. This means that the basic model described above needs to be redefined. Let $j = 18$ be the activity of water provision and water distribution services.

When a tax on water is introduced, we can evaluate the effects on prices through the following expression:

$$p_j = \left[\sum_{i=1}^{17} p_i a_{ij} + p_{18} a_{18j} \left(1 + t_{18}\right) + rk_j + wl_j \left(1 + s_j\right) + p_j^m m_j \left(1 + t_j^m\right) \right] \left(1 + \tau_j\right), \qquad (2)$$

where t_{18} is the tax on intermediate water uses.

The second version of the input-output model assumes a mark-up price definition. Under this assumption, production prices are defined as:

$$p_j = \left[\sum_{i=1}^{18} p_i a_{ij} + wl_j \left(1 + s_j\right) + p_j^m m_j \left(1 + t_j^m\right) \right] \left(1 + r_j\right)\left(1 + \tau_j\right), \qquad (3)$$

where r_j is the benefit tax or mark-up of sector j. In this case, the introduction of a tax on water is analysed through the following expression:

$$p_j = \left[\sum_{i=1}^{17} p_i a_{ij} + p_{18} a_{18j} \left(1 + t_{18}\right) + wl_j \left(1 + s_j\right) + p_j^m m_j \left(1 + t_j^m\right) \right] \left(1 + r_j\right)\left(1 + \tau_j\right). \qquad (4)$$

Note that the competitive and the mark-up formulations differ in their treatment of sectorial benefits. For the competitive approach, we assume that r is constant, and this leads to a constant benefit in all the production activities (rk_j). This situation can be interpreted as a short-term scenario, in which the price of capital and the amount of benefit are fixed. In this version of the model, therefore, the simulation analysis will show the immediate effects on production prices caused by the new policy measures. For the mark-up approach, we assume that sectors have a constant benefit tax r_j and this leads to a fixed capital rent in all the production activities. This situation can be interpreted as a long-term scenario, in which changes in production prices preserve a fixed percentage of sectorial benefits.

In the empirical application, the simulation results will reflect both the absolute and the percentage variation in prices, because the calibration procedure assumes all the benchmark prices to be equal to unity. So, the results will be a measure of the producers' price indices ($p_1,\ldots,p_{18}$), which are considered to be endogenous in the model definition.

In addition to the effects on production prices, we can also calculate how the new policy scenarios affect consumption prices. Specifically, consumption prices (p_c) are defined endogenously by using a normalised basket of goods that define the weights for final prices:

$$p_c = \sum_{j=1}^{18} p_j \alpha_j \, , \tag{5}$$

where p_j is the production prices, and α_j the consumption share of the good j over the total private consumption: $\alpha_j = \frac{C_j}{C}$.

It is also possible to analyse the effects on the amount of water used by the production system. If we assume that the intermediate costs of water remain constant in all the production activities, for every $j = 1,\ldots, 18$, it follows that:

$$p_{18} x_{18j} = p_{18}^{'} x_{18j}^{'} \, ,$$

where p_{18} is the water price in the benchmark equilibrium, and $p_{18}^{'}$ is the corresponding price in the simulations. Similarly, x_{18j} is the intermediate water demand in the benchmark equilibrium and x'_{18j} is the corresponding demand in the simulations. Taking into account that all the benchmark prices are equal to unity, that is p_{18} = 1, the new water uses in sector *j* are calculated as:

$$x'_{18j} = \frac{x_{18j}}{p'_{18}}.$$

In this expression, the values x_{18j} are directly available from the water statistics. Finally, the total water used within the production system (X'_{18}) after the new scenarios have been introduced is equal to:

$$X'_{18} = \sum_{j=1}^{18} x'_{18j} = \sum_{j=1}^{18} \frac{x_{18j}}{p'_{18}}. \qquad (6)$$

We can also approximate the influence that every scenario causes on the consumers' welfare. A comparison between the private expenditure in the benchmark situation and the expenditure of the new policy measures will provide an estimation of the changes in consumers' real income under the new prices. Specifically, the changes in private welfare (ΔW) are calculated using the following expression:

$$\Delta W = \sum_{j=1}^{18} p_j C_j - \sum_{j=1}^{18} p'_j C_j. \qquad (7)$$

The analytical method described above makes it possible to evaluate the effects on production prices, consumption prices, intermediate water demand and private welfare under alternative policy scenarios that affect industrial water markets. All this information is extremely helpful for defining and implementing successful measures for improving the industrial efficiency of water consumption and water uses. This may help to reduce the pressure of water demand in an economy, and it could be a way to ensure not only the efficient use of natural resources but also sustainable economic development.

3. Database

The data used in the empirical application come from the Input-Output Table for Spain (Instituto Nacional de Estadística, 2005) and the Water Satellite Account (Instituto Nacional de Estadística, 2005). Both databases contain the latest available information, which is for the year 2000.

The Input-Output Table consists of the Supply and Use matrices for the Spanish production system, which are expressed in basic prices. The Supply and the Use matrices are given in terms of industry by product classification, using the National Classification of Economic Activities (CNAE93) and the National Classification of Products (CNAP96). These matrices were aggregated for as many as 18 homogeneous production activities, in which the provision and distribution of water is reflected as a differentiated sector. The matrix of direct structural coefficients, or input-output coefficients, was derived from the Use matrix in two steps. First, the elements in the Use matrix were divided by the domestic output of the absorbing industry. Second, the resulting matrix E was pre-multiplied by the transpose of the share matrix D: $A = D'E$.[3] Matrix D was derived from the Supply table and its elements were calculated by dividing each commodity by the total commodity output.

The original data on Spanish water uses operate in 24 sectors of disaggregation. This information was aggregated in the same 18 activities that are used in the input-

[3] Miller and Blair (1985) describe these calculations.

output accounts. Because my aim is to analyse the production system, I do not take into account the final water uses, which are also provided by the Water Satellite Account. So, in the empirical application I only consider the information about the consumption of water within the Spanish production system. The units of measurement in the Water Satellite Account are given in m^3.

4. Empirical results

The input-output price model shows how the Spanish production system adapts prices when new policy scenarios that affect the intermediate uses of water are implemented. Additionally, as has been described in section 2, the model calculates the impacts on such aggregated indicators as consumption prices, water intermediate demand and private welfare. All this information tells us how alternative water measures, applied in the production sphere, will affect the relevant economic variables. As is logical, this information can extend our knowledge of the impacts of different policies that aim to reduce water scarcity in an economy and improve the efficiency of water consumption and water uses.

The simulation analysis consisted of introducing three modifications to the benchmark equilibrium. The first of these improved the efficiency of the intermediate uses and increased the final water production. More specifically, I assume that all production activities simultaneously reduce their water requirements by 20% and that there is a 20% increase in the final production of water.[4] The second simulation consists of imposing a 40% tax on the price that sectors pay for water.[5] This high imposition

[4] In fact, this simulation affects the water market as far as quantity is concerned, because it increases water supply and decreases water demand.

[5] Note that this simulation affects the prices of the water market, as it increases the effective price of water paid by production sectors.

may seem very unrealistic and difficult to implement, but it is useful because it clearly shows the effects that this measure would have on the production sphere.[6] Finally, the third simulation makes a joint evaluation of these two situations: that is, an increase in water production (20%) and a reduction in water intermediate uses (20%) combined with a 40% tax on intermediate water uses.

The input-output price model will provide interesting information about how the alternative policy measures affect both the production and consumption prices in industrial water markets. The results will also show the impacts on the amount of water demand, which is very valuable information for water preservation and water control. This kind of empirical evidence can help to explain the effects that alternative water scenarios have on both the production system and water markets, and this information may be useful for defining and implementing policies for the sustainable development of an economy.

Table 1 contains the changes in production prices reported by the model. The rows show the production activities, while the columns show the competitive and the mark-up versions of the three scenarios analysed.

[PLACE TABLE 1 HERE]

The first two columns in table 1 show how production prices are affected by an improvement in the technical efficiency of water production and intermediate water requirements. The price index of water production (sector 18) decreases by 16.7% in the

[6] In fact, there is the general consensus that in most developed countries water pricing is not efficient, because marginal water prices are generally smaller than the corresponding marginal water costs. For instance, Garcia and Reynard (2004) analysed the efficiency of water pricing in France and concluded that the current pricing policy was not efficient, as it had to increase marginal prices by an average of 8.6% approximately.

two versions of the model, because the water supply increases and the intermediate water demand decreases. Table 1 also shows small impacts on the other production prices, which as a general trend react with low intensity to increases in water efficiency. We should point out, however, that the sectorial effects behave asymmetrically. Agriculture (sector 1), food (sector 8) and commerce (sector 13) show the largest price adjustments, which means that these activities benefit most from improvements in water efficiency. Table 1 also shows that the competitive model is associated with smaller price adjustments, while the mark-up model shows the greatest reductions in production prices. We can conclude, therefore, that the short-term prices are less sensitive to improvements in water efficiency than long-term prices.

The introduction of a 40% tax on the water price is associated with a general increase in production prices. In particular, the water price in sector 18 increases by 0.1165% in the competitive scenario and 0.1536% in the mark-up scenario. Once again, the results show a wide range of sectorial variation, and the prices of agriculture (sector 1), food (sector 8) and commerce (sector 13) are the most sensitive to water taxation. Note that the two versions of the model have different impacts on production prices, and the long-term values are greater than the corresponding short-term ones.

The last two columns in table 1 show the effects of an improvement in water efficiency combined with taxation on water in the production sphere. An interesting result is that, with the exception of water production (sector 18), the changes in production prices are now very close to zero. This suggests that it is possible to implement a water policy that simultaneously intervenes in water prices and quantities, and which hardly changes production prices.

The conclusion that can be drawn from table 1 is that water policies have very different consequences on production prices. Price measures tend to increase prices, while quantity measures tend to reduce them. The combination of price and quantity measures suggests that it is possible to generate practically no effects on production prices indices. These empirical results indicate that policy makers have the opportunity to implement industrial water measures which have negligible impacts on prices. This is very valuable when the aim is to avoid inflation.

The analysis of water intervention can be completed by calculating some additional aggregated indicators, which help to understand the complete economic impacts of the various scenarios. In particular, table 2 shows the changes in the consumption price index, the intermediate water demand and, finally, private welfare.

[PLACE TABLE 2 HERE]

The technical efficiency in sectorial water requirements and water production decreases the consumption price index, and this reduction is larger in the mark-up situation than in the competitive situation (-0.255% and -0.171% respectively). Because the taxation on water increases production prices, table 2 shows a rise in consumption prices in this scenario (0.290% in the competitive model and 0.391% in the mark-up model). If water policy combines price and quantity measures, the effects on consumption prices are practically negligible (0.051% in the competitive model and 0.034% in the mark-up model). Therefore, it is possible to implement water policies that have hardly any effect on the final prices of the economy. In other words, the pressure on prices caused by a tax on water can be partially or completely compensated for if this taxation is accompanied by improvements in the water efficiency of the production system.

Table 2 also shows the changes in the amount of water used in the production sphere. Improvements in water efficiency increase intermediate water uses by approximately 20%, and it is interesting to point out that this impact is almost equal in the two models. This result is in line with Jevons' paradox, which states that any improvement in the efficiency of use of a natural resource will not lead to the expected reduction in the total resource use. On the other hand, the introduction of a tax on water reduces sectorial water demand by -28.65% in the competitive version of the model, and by -28.68% in the mark-up version. Water taxation, then, is associated with a substantial rise in water costs, which considerably reduces the amount of water used by the production system. Finally, the last columns in table 2 show that the combination of the two measures decreases intermediate water demand by -14.30% in the competitive price formulation and -14.26% in the mark-up price formulation.

The effects on private welfare, which are measured in millions of euros, can depend heavily on the version of the model used and the policy scenario analysed. When there is an improvement in water efficiency, consumer welfare shows a positive effect of 587.35 million euros in the competitive model and of 877.93 million euros in the mark-up model. Note that the overall difference between these two values is approximately 50%, and this suggests that way in which prices are defined can lead to very different effects on households. That is to say, the impacts on private consumers are very sensitive to the way in which the productive system establishes production prices.

Table 2 also shows that the introduction of a tax on water reduces private welfare by -415.04 and -764.42 million euros depending on the version of the model. This situation, then, is associated with a considerable deterioration in private welfare. The negative effect on consumers is particularly significant in the mark-up price formulation, which reduces private welfare by 84% more than the competitive formulation.

In the third simulation, the combination of price and quantity measures causes positive effects on consumers' welfare (311.15 million euros in the competitive situation and 370.13 million euros in the mark-up situation). It is interesting to point out that this situation preserves welfare improvements, which are less sensitive to the model type than the other situations. Specifically, the difference between the two values is now quantified as approximately 20%.

Policy makers have a set of possible measures for preserving water resources, which can generate very different impacts on the main economic variables. This illustrates how important it is to improve our knowledge of the consequences of different water policies. To understand the effects involved, the complex relationships within the economy need to be captured, and the different channels through which the impacts are transmitted need to be taken into account. My results suggest that different water interventions have different effects not only on production prices but also on industrial water demand and private welfare.

The analytical context presented in this paper may be useful for defining and implementing policy interventions aimed at reducing the overall water pressure of an economy. In this respect, the preservation of water endowments has become an important issue in resource analysis, which considers the environmental efficiency of economic activity to be one of the leading objectives of regulatory authorities. All of this makes it necessary to have methodological instruments that can provide accurate information about the economic and ecological impacts of policy decisions that affect the natural resources of the economy.

5. Conclusions

In this paper I have used an input-output price model to analyse the economic impacts of various water measures implemented within the production system. Specifically, I have defined two versions of the input-output framework: a competitive price formulation and a mark-up price formulation. The competitive version can be interpreted as a short-term situation in which production prices are equal to the average cost of production, while the mark-up version can be interpreted as a long-term situation in which production prices lead to a fixed capital rent in all the activities of production.

The two formulations of the input-output model have been used to simulate three water policy scenarios. First, I improve the efficiency of final water production and industrial water requirements. Then I analyse the effects of introducing a tax on the water price paid by production sectors. Finally, the study ends by evaluating the two scenarios together, that is, a technical efficiency of water uses and production, and the introduction of a tax on water.

The empirical application is for the Spanish production system with information for the year 2000. The results show that technical efficiency decreases water prices, and this increases industrial water consumption in accordance with Jevons' paradox. On the other hand, the introduction of a tax on intermediate water uses leads to a general rise in prices and this significantly decreases water uses. Finally, the joint application of the two measures reduces the amount of water consumed within the production system, has non-inflationary effects on final prices, and increases consumers' welfare. In other words, a water policy that intervenes in both price and quantity can have three simultaneous results: reduce the pressure on water demand, have negligible impacts on prices and, finally, ensure positive welfare effects.

The comparison of the two formulations of the input-output model allows us to conclude that prices and private welfare are very sensitive to price definition in the production sphere, while the water demand is very similar in the two versions of the model. This may mean that impacts on resource uses are independent of the way in which the production system establishes production prices.

The analytical approach used in this paper provides interesting results that may help policy makers to define and implement measures for improving the overall efficiency of water resources. In this sense, the input-output framework is a simple method that shows the disaggregated effects of new policy scenarios on production activities. This model is also a useful for examining the consequences on prices, water demand and private welfare, because it captures the complex relationships that take place within the production system.

Despite these advantages, a common criticism of the Leontief approach is that it assumes that price formulation is completely rigid, so there is no possibility of substitution between the elements that define the price levels of the economy. However, the Leontief model provides an acceptable price formulation in the short run analysis, when there is little ability to react under exogenous shocks in the elements that compound the production costs. Additionally, this method provides disaggregated information about the cost transmission mechanism and captures the underlying factors that help to define the price levels in an economy. All of this is extremely useful for defining policy measures focused on sustainable economic development.

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Table 1
Changes in production prices (%)

Sectors	Situation 1		Situation 2		Situation 1 and 2	
	Competitive	Mark-up	Competitive	Mark-up	Competitive	Mark-up
1. Agriculture	-0.3270	-0.5992	0.3934	0.7210	-0.0651	-0.1200
2. Energy	-0.0458	-0.0694	0.0551	0.0835	-0.0091	-0.0139
3. Metals	-0.0075	-0.0099	0.0091	0.0120	-0.0015	-0.0020
4. Minerals	-0.0905	-0.1333	0.1088	0.1604	-0.0180	-0.0267
5. Chemistry	-0.1037	-0.1316	0.1248	0.1584	-0.0207	-0.0264
6. Machinery	-0.0433	-0.0586	0.0521	0.0705	-0.0086	-0.0117
7. Automobiles	-0.0309	-0.0432	0.0372	0.0520	-0.0062	-0.0086
8. Food	-0.2102	-0.3433	0.2530	0.4132	-0.041	-0.0687
9. Textiles	-0.0604	-0.0872	0.0727	0.1050	-0.0120	-0.0175
10. Paper	-0.0526	-0.0891	0.0633	0.1073	-0.0105	-0.0178
11. Other Industries	-0.0580	-0.0901	0.0697	0.1084	-0.0115	-0.0180
12. Construction	-0.0493	-0.0882	0.0594	0.1061	-0.0098	-0.0177
13. Commerce	-0.1342	-0.2669	0.1615	0.3212	-0.0267	-0.0534
14. Transportation	-0.0308	-0.0714	0.0370	0.0860	-0.0061	-0.0143
15. Finance	-0.0435	-0.0453	0.0524	0.0545	-0.0087	-0.0091
16. Private Services	-0.0481	-0.0934	0.0578	0.1124	-0.0096	-0.0187
17. Public Services	-0.0856	-0.1066	0.1030	0.1283	-0.0170	-0.0213
18. Water production	-16.7228	-16.7730	0.1165	0.1536	-16.6484	-16.6880

Situation 1: 20% reduction in water uses and 20% increase in water production.
Situation 2: 40% tax on water uses.
Situation 1 and 2: 20% reduction in water uses and 20% increase in water production combined with a 40% tax on water uses.

Table 2
Changes in aggregated variables

	Situation 1		**Situation 2**		**Situation 1 and 2**	
	Competitive	Mark-up	Competitive	Mark-up	Competitive	Mark-up
Consumption prices: p_c (%)	-0.171	-0.255	0.290	0.391	0.051	0.034
Water uses: X'_{18} (%)	20.08	20.15	-28.65	-28.68	-14.30	-14.26
Changes in welfare: ΔW (millions of euro)	587.35	877.93	-415.04	-764.42	311.15	370.13

Situation 1: 20% reduction in water uses and 20% increase in water production.
Situation 2: 40% tax on water uses.
Situation 1 and 2: 20% reduction in water uses and 20% increase in water production combined with a 40% tax on water uses.