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EVALUATING IMPLICATIONS OF AGRICULTURAL POLICIES IN A RURAL REGION THROUGH A CGE ANALYSIS

ANDREA BONFIGLIO

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Andrea Bonfiglio*

Abstract

This paper aims to analyse economic and social effects produced by changes in agricultural policy on an Italian "significantly rural" region, the Marche region. To this aim, a regional CGE model based on a 2004 SAM, constructed for this purpose, has been applied. Two policy scenarios have been analysed: total removal of price support and full decoupling. Results suggest that price support has indeed sustained agricultural output but has limited growth potentialities of the region. Moreover, it turned out that decoupling partly removes obstacles to a higher allocative efficiency and favours an improvement in income distribution.

Keywords: regional CGE model, Social Accounting Matrix, Common Agricultural Policy, policy impact
J.E.L. Classification: C63, C68, O18, Q18

* Dr. Andrea Bonfiglio – Department of Economics, Faculty of Economics "G. Fuà", Polytechnic University of the Marche, Piazzale Martelli, 8, 60121 Ancona (Italy). Tel.: +39 071 2207116, Fax.: +39 071 2207102, e-mail: a.bonfiglio@univpm.it. I am grateful to an anonymous referee for remarks and suggestions on a previous version of the paper.

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1 Introduction

The main novelty contained in the middle-term reform of the Common Agricultural Policy (CAP) is the introduction of a single payment scheme for EU farmers, independent ("decoupled") from production. This payment replaces most of the direct aid payments to farmers currently offered in the beef, sheep, dairy and cereal sectors. The rationale behind decoupling relates to the need to contain budget expenses and to contrast the excess of production. Subsidies to commodities are sources of price distortion affecting production decisions since they interpose between producer and market prices. Removing subsidies should have the effect to eliminate this distortion and to bring agricultural and food production systems near a more market oriented logics (European Commission, 2006).

Several studies have attempted to assess possible effects coming from changes in the CAP. Many of them concentrate on direct impacts of decoupling on specific sectors within agriculture using farm level models and partial equilibrium models (see for example Bienfield *et al.*, 2004; Esposti and Lobianco, 2005; Balkhausen and Banse, 2007). However, impact estimated by the use of these models is not able to capture indirect effects generated by the existence of linkages between agricultural sector and the rest of the economy. Moreover, it neglects all those effects that come from relationships between productive sectors and institutions (in particular households) and within the latter.

In the last years, there have appeared in the literature a growing number of studies oriented to the whole economy that examine spill-over effects of changes in the CAP on the wider economy and explicitly take account of potential policy implications for rural and urban households.

For instance, Gelan and Schwarz (2006) adopted a Computable General Equilibrium (CGE) model based on two macro-sectors (agriculture and non-agriculture) and two types of households (rural and urban) for analysing the effects produced by two scenarios (reduction of price support and decoupling) on aggregated macro-variables of Scotland. Their results indicate that the removal of agricultural subsidies has negative effects on agriculture, because of output contraction in this sector, and positive spill-over effects on sectors other than agriculture, given the release of production factors to the rest of the economy. Overall, the net impact on the aggregate GDP should be positive. Balamou *et al.* (2008) used bi-regional CGE models, based on the disaggregation in urban and rural areas, to analyse the effects of a change in agricultural support on two different case study regions located in Scotland and Greece, respectively. Results show that a reduction in price support produces in the Scottish region negative effects in terms of real GDP in the rural area because of the negative dynamics of agricultural sector while the other sectors of rural areas and the whole urban area are positively affected. In the Greek region both rural and urban areas suffer from negative effects that are explained with stronger links between agriculture and first stage processing sectors and the ownership of agricultural factors by urban residents. Full decoupling produces negative aggregate effects on both study regions and this is justified with the

high import intensity in terms of consumption. Overall, the aggregate effect on real GDP is negative in both scenarios and in both regions.

This paper can be included within the second category of studies mentioned based on the use of general equilibrium models. In particular, the objective consists in analysing economic and social effects produced by changes in agricultural policy on an Italian "significantly rural" region, the Marche region.[1] To this aim, a regional CGE model based on a 2004 SAM, constructed for this purpose, has been applied. Two scenarios are analysed. One contemplates the total removal of price support. The other one is based on full decoupling. The rest of this paper is structured as follows. The next section briefly describes the area under study. The third section is dedicated to illustrate the methodology adopted. The fourth section presents the results of the application. Finally, the last section reports some concluding remarks.

2 Description of the area under study

The Marche region is one of 20 in Italy. It is located in the Central-Eastern part and has a geographic area of 9,692 km^2, equivalent to 3.2% of the national territory. In 2004, employment amounted to 708 thousand units whereas the GDP at basic prices was 32.4 billion euro, corresponding to 2.9% and 2.6% of the national one, respectively. The region was in 2004 a net importer at international level with a current account deficit which equals 1.2 billion euro where it was a net exporter at an interregional level.

It is divided in five districts (Pesaro and Urbino, Ancona, Macerata and Ascoli Piceno) and comprises 246 municipalities with a total population amounting to 1,511,800 inhabitants, equivalent to 2.6% of the national one.

The average population density is 156 inhabitants per km^2 (lower than the national one) and shows different levels in the four districts because of both territorial morphology and economic organization. Since 1960s, the most favourable economic conditions of areas located near the coast have pushed people to migrate from mountain and hill areas, which are less competitive and profitable, provoking ageing and abandon phenomena in the hinterland.

Based on OECD methodology, the Marche region can be considered as a significantly rural region. The population living in rural municipalities in 2001 (having an average population density which is below 150 inhabitants per km^2) amounts to 29% and is thus included between 15% and 50% of total population.

The agricultural surface of the region is little fertile and has been dividing in fractioned properties since the times of sharecropping, i.e. a no-longer-in-force agricultural contract, which was very widespread in the region. Following mechanization and economic development, countryside has increasingly depopulated as demonstrates the trend of agricultural employees who passed from 386 thousand units in 1951 to 130 thousand units in 1971 to 30.4 thousand units in 2001. Owing to common agricultural policy and its incentives to

[1] There are further studies that have attempted to analyze effects generated by economic and fiscal reforms in the Marche region by using a CGE approach. In this regard, see for example Fiorillo (2005).

capital-intensive production, the landscape and production systems have changed radically over time. Mediterranean crops (vineyards, olive groves and orchards) and extensive livestock that characterized the Marche agriculture have been gradually displaced by high-capital-intensity crops such as cereals, industrial crops (in particular, soya, sunflowers and sugar beet) and intensive livestock, producing several and unpleasant environmental implications (Bonfiglio, 2000). In 2000, the used agricultural surface amounted to 507 thousand hectares (3.8% of the national one), of which only 3% was used for Mediterranean crops. Of the rest of surface, about 60% was used for cereals and industrial crops. The strong importance of high-capital-intensity crops in the Marche region and the high integration between agriculture and the other sectors (in particular food and beverages) makes the region a very interesting case to study the effects that changes in the common agricultural policy might produce in the regional economy.

With reference to secondary production, handicraft and small-medium industry are flourishing in the region. Firms, which are mostly of modest size and located on the coast and along valley bottoms, cover the most various productive sectors: engineering, textile, electronics, food and beverages, chemicals, pharmaceutics and manufacturing. Other important sectors are furniture, household appliance sector, footwear and musical instruments as well as paper and shipyard.

The structural weakness and the lack of regional resources did not restrain the high vitality of firms, mostly represented by family businesses, which strongly specialized in the territory. This brought about the creation of several industrial districts by which we mean both firms and artisans which produce elementary parts for the big industry and the whole of direct and indirect services which make the industrial area function.

As regards service sectors, trade, especially wholesale, has been playing an increasing role. In this regard, the port of Ancona in recent years has experienced a very positive dynamics from a both trade and touristic standpoint, becoming one of the main ways joining Italy to Greece and the Dalmatian coast. A further strategic sector is tourism that in the Marche region exhibits favourable development conditions thanks to the location of the region near the sea and the presence of a rich cultural and natural patrimony.

3 The Methodology

The methodology adopted is based on a regional standard CGE model. Over the last few decades, CGE models have become a widely used tool for empirical economic and policy analysis in both developed and developing countries. This method has been employed in order to evaluate the overall effects generated by policy changes in the economy of the Marche region.

To apply the CGE model, a 2004 58-activity-by-58-commodity SAM has been constructed for the Marche region, starting from the corresponding national SAM. As usual, the CGE model has been estimated on the basis of information related to the SAM (parameter calibration) in addition to other data

(elasticities). In order to carry out simulations, the model was first solved for the reference run and then with counter-factual scenarios in order to identify changes from the base run. This methodological section is articulated as follows. The following sub-section concerns the construction of a 2004 SAM for the Marche region. The second one describes the regional CGE model adopted. Finally, the last section illustrates the scenarios analysed and the main transmission mechanisms of effects generated by policy shocks.

3.1 The regional Social Accounting Matrix

3.1.1 Description of the SAM

The framework for the Social Accounting Matrix (SAM) was first developed in the 1950s as an extension of the core national accounts in order to integrate the economic and social aspects of development (Pyatt and Round, 1985). The SAM began to be implemented for policy aims in the 1970s, when it was clear that economic development, measured by growth in GDP, could not guarantee poverty reduction, and that an instrument tool to evaluate income distribution was needed.

As known, a SAM is an extension of an Input-Output (I-O) table. The latter describes all the good and services flows among intermediate sectors and between them and final sectors (in terms of consumption from households and government, investments and exports). Moreover, it contains data about the use of primary inputs (generation of income by each industry), taxes and imports. In addition to an I-O table, a SAM describes factor market balance, income distribution, redistribution of incomes among institutions, investment-saving balance, payments and receipts of taxes and so on. Each account in the SAM is represented by a row and column. Reading the SAM across a row shows the incomes or sales revenue of an account, while reading the SAM down a column shows the expenditures or outlays of that account. The principle of accounting requires that total revenue (row total) equals total expenditure (column total).

The SAM, which is employed in this paper, consists of eight blocks: activities, commodities, factors, institutions, capital account, taxes, interregional account and foreign account (Table 1).

The activity block shows by column inputs of commodities and factors used for production and taxes paid on activity of each producer. By row, it shows which commodities each activity produced. The column sum represents gross input whereas the row sum is gross output.

The commodity block shows by column the distribution of outputs among producers, transaction costs (trade and transport margins), imports and net indirect taxes on domestic and imported commodities. By row, it shows the destination of outputs. Specifically, commodity output can be sold to producers for their activity (intermediate demand) or to households and government for their consumption. Moreover, it can be used for investments or sold to foreign demanders. The sum of consumption, investments (plus changes in stock) and exports represents the final demand.

The factor block shows by row inputs of factors used by each producer (labour and capital, which includes rent on property) and thus factor receipts and by column payments for them (income distribution between factor owners).

The institution account registers receipts and payments of institutions. In this study, only two institutions are represented: households and government. Households are distinguished in rural and urban. In general, households obtain their income from their ownership of capital and labour and from transfers from other institutions and from the rest of the world (remittances from abroad). This is shown in the relevant row. Looking at the corresponding column, household income is used for consumption, savings, paying direct taxes on factor income and transfers to the rest of the world. Government gains from collecting taxes and from the rest of the world. The relevant income is for purchasing goods and services, for savings and for transfers to households (i.e. social security).

The capital account consists of savings across the row and expenditures for investment down the column. The capital account can be thought as an investment bank that carries out the entire domestic investment in the economy, financing its activity by savings from institutions, the rest of Italy and the rest of the world.

The interregional account show by row the revenues of the rest of the Italian regions coming from imports and by column both the use of the relevant income for purchasing domestic products (interregional exports) and the interregional balance of payments, referred as to rest-of-Italy savings.

The foreign account shows by row the revenues of the rest of the world related to imports and transfers from domestic institutions whereas by column the use of the relevant income for purchasing domestically produced commodities (international exports), for transfers to domestic institutions and foreign net borrowing/lending which represents the balance of payments.

3.1.2 Derivation of a regional SAM

For deriving a SAM for the Marche region for the year 2004, it was first necessary to construct the national SAM. Fortunately, the rich availability of information at a national level has made the work of building a national SAM relatively straightforward. To this aim, the information sources used were: the 2004 supply and use tables expressed at basic prices (Istat, 2007b); national accounts (Istat, 2008a), non-financial accounts by institutional sector (Istat, 2007a) and the national 2000 I-O table (Rampa, 2007). The supply table describes the purchases of 59 commodities used as intermediate inputs from 59 activities[2] and the use of value added at a sectoral level. The value added is expressed in an aggregate form and had to be decomposed into labour and capital. Data on total compensation of employees at a sectoral level were obtained from statistics on national accounts. Capital data were obtained as residual.

[2] In particular, there are three, 31 and 25 primary, secondary and tertiary activities and commodities, respectively.

Table 1: Structure of the regional SAM

		Activities	Comm.	Factors	Institutions		Taxes	Capital	ROI	ROW	TOTAL
					Households	*Government*					
Activities			Marketed output								Gross output
Commodities		Intermediate inputs	Transaction costs		Household consumption	Government consumption		Investments plus change in stocks	Interregional exports	International Exports	Demand
Factors		Value added									Factor income
Institutions	***Households***			Factor income	Inter-household transfers	Transfers from government to households				Transfers from ROW to households	Household income
	Government				Direct taxes	Inter-government transfers	Activity and commodity taxes less subsidies			Transfers from ROW to government	Government income
Taxes		Activities taxes less subsidies	Indirect taxes less subsidies on domestic and imported commodities								Tax receipts
Capital					Household savings	Government savings			ROI savings	Foreign savings	Savings
Rest of Italy (ROI)			Interregional imports								Interregional exchange outflow
Rest of the World (ROW)			International Imports		Transfers from Households to ROW						Foreign exchange outflow
TOTAL		Gross input	Supply	Factor expenditure	Household expenditure	Government expenditure	Tax payments	Investments	Interregional exchange inflow	Foreign exchange inflow	

From the supply table, information about total taxes less subsidies is available. The latter include taxes on production and products less subsidies. To estimate single categories of taxes, information from the national 2000 I-O table was used. Ratios between production taxes and total production at factor cost obtained from the national I-O table were applied to the production emerging from the supply table to obtain a first estimate of net activity taxes. Ratios between taxes on products and total production were instead employed to get an approximation of net taxes on domestic products. Finally, ratios between import taxes and total imports at c.i.f. prices were used to estimate taxes on imported commodities. Estimated taxes were then balanced constraining their sum to the total amount of net taxes emerging from the supply table.

Data about transaction costs related to each commodity (trade and transportation margins) come from the supply table.

As regards international trade, imports were obtained from the supply table whereas exports were obtained from the use table.

Data related to savings and transfers among institutions and the rest of the world come from statistics on non-financial accounts by institutional sector. However, detail about the destination of transfers is not specified. Only totals of transfers received and made are shown. Therefore, in order to estimate flows among institutions, a RAS-type technique was applied to the matrix describing the transfers between institutions and the rest of the world. The matrix was initialised with a value of one in the cells describing flows from an institution to another, only if transfers are supposed to occur, and a value of zero in cases where no transfers are assumed to happen. In particular, a value of zero was inserted for inter-rest-of-the-world flows and transfers from government to the rest of the world, whereas a value of one was used elsewhere. Received and made transfers were used as row totals and column totals, respectively.

The next stage consisted in balancing the national 2004 SAM by using a non-linear minimization technique of the differences between initial and final values under constraints based on accounting identities.[3]

The regional SAM was derived by regionalising the national SAM and inserting superior data. The regionalisation of intermediate inputs was made by using the Flegg et al. Location quotient (FLQ) (Flegg *et al.*, 1995; Flegg and Webber, 1997). This technique has been chosen since it has demonstrated to be superior to other regionalization techniques in estimating real input-output coefficients (Flegg and Webber, 2000; Tohmo, 2004; Bonfiglio and Chelli, 2008). By using the FLQ, interregional imports and exports were also measured. A first estimate of other components such as activity taxes, domestic and imported commodity taxes, international imports and exports, primary factors, commodity outputs and margins were made by using ratios between regional and national sector value added. Data on value added at a sectoral level were

[3] As an objective (or penalty) function, the Pearson χ^2 (or normalized square of differences) function (Friedlander, 1961), adjusted to take account of negative values, was used. Adjustment was made using the absolute value of known data as a denominator. Indeed, there are several penalty functions that can be adopted and each one owns its specific properties. For more information about alternative optimization techniques in balancing SAMs, see for example Robinson *et al.* (2001).

obtained from regional accounts (Istat, 2008b). Estimates of household and government consumption were obtained using final consumption ratios whereas those of gross capital formation plus changes in inventories were derived by using gross capital formation ratios. Inter-institutional transfers and savings were estimated by using total value added ratios. Finally, foreign savings and rest-of-the-regions savings were obtained as a difference between receipts and spending of the rest of the world and the rest of Italy, respectively.

In order to increase the level of analysis related to the household account, the latter was disaggregated into urban and rural households by using statistics from the survey on Italian household balance sheets (Banca d'Italia). In particular, to this aim, shares of total transfers, consumption, labour income, capital income and savings between rural and urban households were employed to disaggregate the corresponding aggregates of the regional SAM.[4]

The regional SAM was then balanced by using a non-linear technique of minimization subject to accounting identities.[5] Moreover, in order to increase the reliability of the final regional SAM, constraints associated to superior data were also inserted such as agricultural intermediate purchases, sectoral value added, net taxes, household and government consumption, gross capital formation, net imports and total supply. Superior data come from regional accounts and Inea (2005).

The resulting regional SAM is a 2004 SAM with 58 commodities, 58 activities[6], three institutions (rural households, urban households and government), the interregional account, the rest of the world account and the capital account (Table 2).

3.2 The regional CGE model

The model used is based on the theoretical framework of standard CGE models (Lofgren *et al.* 2002; Hosoe *et al.*, 2004). Since algebraic formulations and theoretical foundations of standard CGE models have been widely discussed in the literature, the discussion that follows will be broad and focused on the main and novel aspects. The mathematical specification of the model is shown in the appendix.

[4] The distinction between rural and urban is still a widely debated issue. One of the most used and simplest criteria to identify a rural (urban) area is the OECD methodology, based on the population density. To apply this, the knowledge of the municipality where households surveyed live is necessary. However, this information is not provided for external uses for privacy reasons. Therefore, we decided to apply another criterion based on the localisation of the main residence where households live. Rural households were identified as those families living in houses located in non-urban and non-high-quality areas, which comprise agricultural areas, peripheral areas, areas located between centre and periphery, small centres and particularly degraded areas. Urban households were obtained as a residual.

[5] See note 3.

[6] The activity and the commodity "uranium and torious", appearing in the national SAM, were found to be not existing in the region and were therefore removed.

The model is based on the small-region assumption according to which the region is too small to affect prices in international and national markets. Thus, import and export prices that the region faces are fixed.

The model distinguishes between 58 producing activities. Each producer (represented by an activity) is assumed to maximise profits, subject to a production technology. For their production, firms use intermediate inputs and value added made up of labour and capital. Production can be divided into two stages (Figure 1). At the bottom stage, value-added is specified as a Cobb-Douglas function of primary factors. At the top level, the technology is represented by a Leontief function of the quantities of value-added and intermediate inputs. Through maximization of profits at bottom and top stages subject to the relevant production technology, value added, intermediate input and factor demands are derived. Given the non-differentiability of the Leontief type production function with respect to its inputs and the possible difficulties in numerical computation, the formal intermediate input demand is replaced with a zero-profit condition according to which activity revenues less net taxes on the activity (i.e. taxes net of subsidies) equal the cost of value added and intermediate inputs used. This can be justified by assuming that all the firms are competitive and cannot earn excess profits.

Each activity produces one or more commodities on the basis of fixed yield coefficients. Therefore, a commodity can be produced by more than one activity. As a result of a profit-maximising behaviour, each producer demands for a quantity of factor corresponding to the point where the marginal revenue product of each factor equals its price (wage for labour, rent for land, interest for capital).

In a standard neo-classical CGE model, the factor price is free to vary in such a way to assure that the factor market is in equilibrium (the sum of demands from all the activities equals the quantity supplied, which is, on the contrary, fixed). Therefore, there is no unemployment of factors. Moreover, this implies that any shock brings about "compositional" changes and no effects on aggregate employment and hence GDP are produced. In this model, with reference to labour factor, following a structuralist macro approach, we assume that price factor is rigid, while the labour supply is free, so employment is not fixed. The firms are assumed not to be on their demand curves for labour. A "labour distortion" parameter is introduced which measures the degree to which the wage deviates from the marginal product of labour. The parameter adjusts so that firms are "induced" to hire the labour at the fixed wage (Robinson, 2003). As regards capital, the neoclassical closure is instead used.

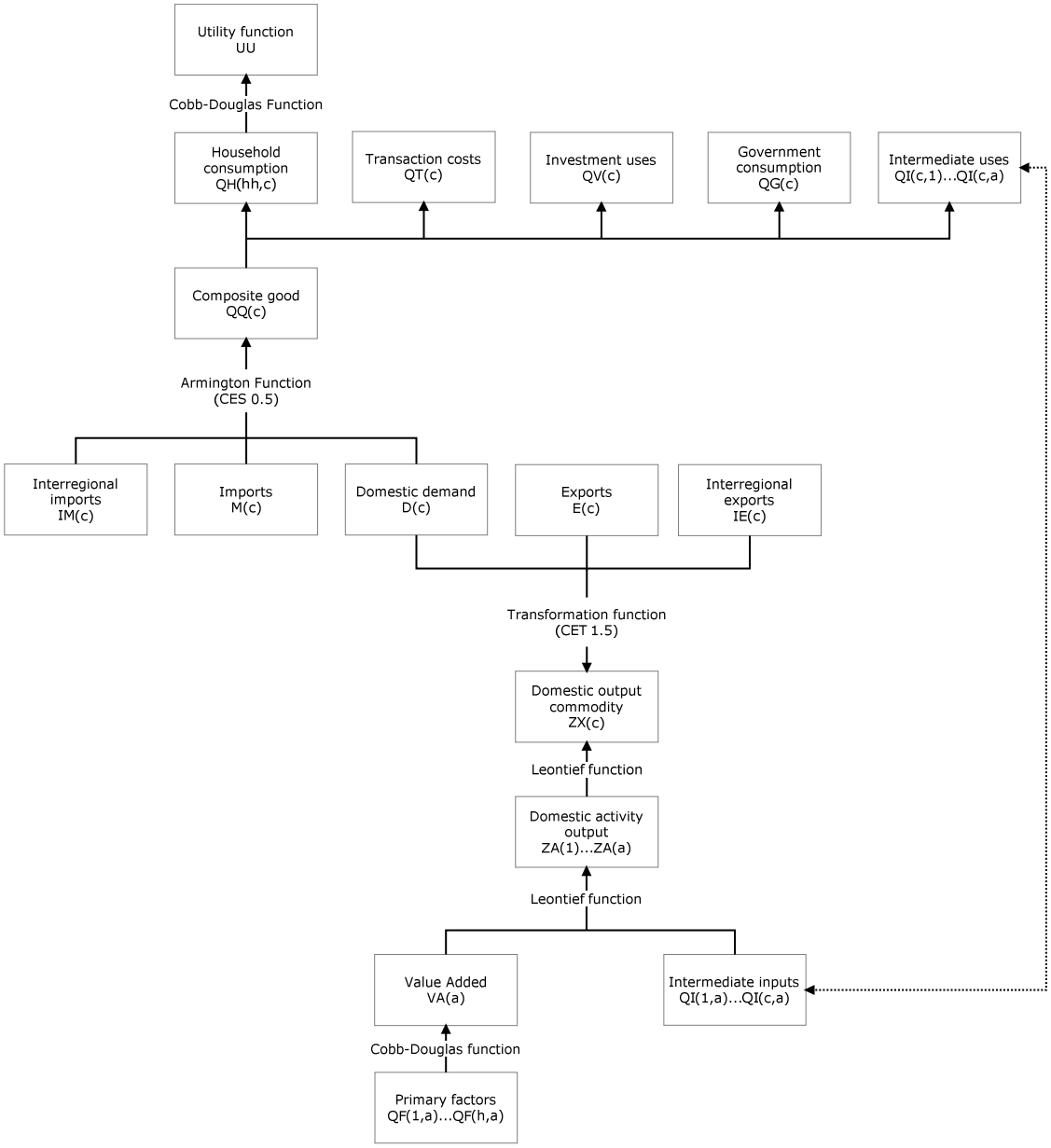
Two macro institutions are modelled: households and government. Households are assumed to own all the factors of production. They are distinguished in rural and urban. Labour factor, which is free to vary, is distributed among different categories of households according to fixed shares. The households receive income from the factors of production and transfers from other institutions. The latter are fixed. The households use their income to pay direct taxes, to consume, to save and to make transfers to other institutions. Direct taxes and savings are defined as fixed shares of household income.

Table 2: The aggregate SAM of the Marche Region, 2004 (million euro)

	Prim.	Sec.	Tert.	Agr. products	Ind. products	Services	Labour	Capital	Rural House.	Urban House.	Gov.	ROI	ROW	Capital account	Activity net taxes	Comm. net taxes	Import tariffs
Primary	0.0	0.0	0.0	1,235.9	0.0	42.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Secondary	0.0	0.0	0.0	0.0	21,026.9	797.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tertiary	0.0	0.0	0.0	0.0	673.4	25,296.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agricultural products	141.3	383.5	116.7	380.9	0.0	0.0	0.0	0.0	0.1	545.9	17.7	16.3	124.8	10.8	0.0	0.0	0.0
Industrial products	239.2	7,355.6	1,520.4	0.0	3,411.8	0.0	0.0	0.0	1.8	7,457.9	383.7	3,125.2	5,142.8	6,762.1	0.0	0.0	0.0
Services	137.7	2,304.3	3,752.3	0.0	0.0	86.8	0.0	0.0	3.5	13,992.6	6,494.6	0.9	938.7	1,262.0	0.0	0.0	0.0
Labour	212.9	6,060.7	9,390.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital	507.0	5,077.8	11,190.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rural Households	0.0	0.0	0.0	0.0	0.0	0.0	1,326.1	4,573.7	657.4	0.0	772.2	0.0	24.3	0.0	0.0	0.0	0.0
Urban Households	0.0	0.0	0.0	0.0	0.0	0.0	14,337.6	12,201.1	0.0	426.9	501.4	0.0	42.3	0.0	0.0	0.0	0.0
Government	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	756.8	3,404.2	3,557.3	0.0	167.4	0.0	682.1	2,684.8	365.5
Rest of Italy (ROI)	0.0	0.0	0.0	244.0	1,286.5	1,144.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rest of the World (ROW)	0.0	0.0	0.0	52.2	6,538.9	844.0	0.0	0.0	227.7	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital account	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5,706.5	1,675.3	-108.8	-467.1	1,228.8	0.0	0.0	0.0	0.0
Activity net taxes	40.1	642.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Commodity Net taxes	0.0	0.0	0.0	-176.9	2,301.7	560.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Import tariffs	0.0	0.0	0.0	1.9	161.4	202.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: our elaborations

Figure 1: Production, aggregate commodity supply and demand in the Regional CGE Model



Transfers to other institutions are fixed. The remaining share of income is spent on consumption.

The representative household is assumed to choose its consumption pattern so as to maximise its utility subject to its income constraint. The household's utility depends on the amount of consumption of commodities which are purchased from firms and is modelled through a Cobb-Douglas type function. Solving this problem of utility maximization, a demand function for each commodity is derived.

The government collects taxes net of subsidies (direct tax from households, activity taxes from production sectors, indirect taxes on domestic and imported commodities) and receive transfers from other institutions. All taxes are at fixed *ad valorem* rates. Except for direct taxes from households, which are recorded as transfers from households to the government, all the others are treated as a dependent institution such as tax and custom offices. They receive tax revenues from producers and importers, which are then transferred to the government.

The latter uses its income to purchase commodities, for savings and for transfers to other institutions. Savings are defined as fixed shares of government income whereas transfers are fixed. The income that remains after making transfers and savings is spent for consumption according to fixed ratios between consumed quantity of each commodity and total government consumption.

In order to represent trade relationships of the Marche region, two accounts are modelled: the rest of Italy and the rest of the world. With regard to the former, the relevant spending is represented by exports of the Marche region to the other regions whereas receipts are given by imports from other regions to the Marche region. The difference between receipts and spending represents rest-of-Italy savings (or rather the current account deficit related to interregional trade). The interregional import and export prices are held constant, whereas the rest-of-the-regions savings are made free to satisfy the interregional balance-of-payment constraint (imports to other regions equals exports to other regions plus the rest-of-the-regions savings).

As far as the rest of the world is concerned, the relevant spending is represented by exports of the Marche region to abroad plus transfers from the rest of the world to institutions whereas receipts are given by imports from abroad to the Marche region and transfers from institutions to the rest of the world. All transfers are fixed. Foreign savings (or the current account deficit) is the difference between foreign currency receipts and spending. The exchange rate is held constant (meaning that import and export prices in domestic currency are constant) whereas foreign savings are made free to meet the balance-of-payment constraint (imports from abroad plus transfers to the rest of the world equals exports to abroad plus transfers from the rest of the world plus foreign savings in foreign currency).

Aggregated domestic output of a given commodity derives from the output of different activities and is specified as a Leontief function. The aggregated domestic output can be exported abroad, to other regions or sold domestically. The assumption is that producers maximise sales revenue for any aggregate output level, subject to imperfect transformability between international exports, interregional exports and domestic sales, defined by a constant

elasticity of transformation (CET) function. On international and interregional markets, exports demands are infinitely elastic at given prices. The price received by domestic suppliers for selling commodities abroad is expressed in domestic currency.

Domestic demand is given by the sum of household and government consumption, investments, intermediate inputs and trade and transport margins. Domestic demanders ask for a composite commodity made up of international imports, interregional imports and domestic output. The demand for a composite commodity derives from the assumption that domestic demanders minimise cost subject to imperfect substitutability between international imports, interregional imports and domestic products, expressed by a CES aggregation function, which is also referred to as an Armington function (Armington, 1969). The derived demands for imported commodities are met by supplies that are infinitely elastic at given prices. The price paid by domestic demanders for international imports is expressed in domestic currency and adjusted for import taxes (at fixed *ad valorem* rates).

Flexible prices equilibrate demands and supplies of domestically marketed domestic output.

With regard to investments, we assumed that investment demand of each commodity is a fixed share of the total amount of savings in the economy. In other word, it was assumed that the economy under analysis is savings-driven (the value of investment adjusts).

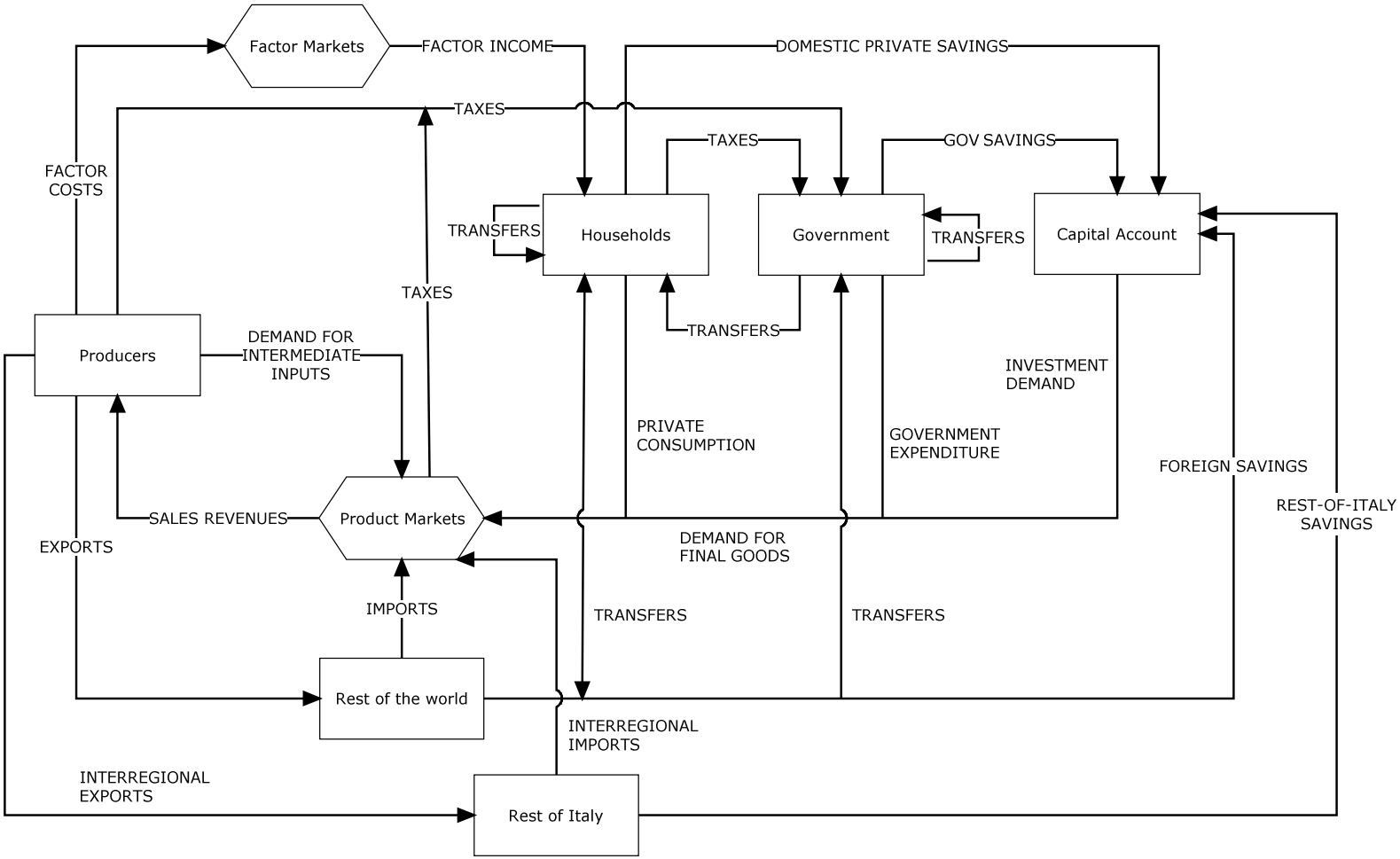
To guarantee the general equilibrium in all the markets, market-clearing conditions equilibrating demand and supply and related to commodity and factor markets are imposed. In particular, with regard to commodity market, composite goods (imported from abroad, from other regions and produced domestically) can be used for private and public consumption, investments uses, as intermediate inputs and for purchasing trade and transport margins.

Finally, to assure the closure of the model, we fixed the aggregate investment demand.

The model is a squared system of linear and nonlinear simultaneous equations. One of the equations is redundant because of Walras' law according to which the total value of excess demand is identically zero for any price (see for example Varian, 1992). We chose the supply price of a commodity as numéraire and we fixed its price at unity.

In Figure 2, the basic structure of the model is shown.

Figure 2: Structure of the Regional CGE Model



3.3 Policy scenarios and impact transmission

Two scenarios were modelled. A first scenario consists in removing the price support for agriculture, integrally.

In 2004 the total amount of public support to agriculture of the Marche region was 347 million euro, of which 236 million euro was represented by transfers and 110 million euro by facilitations (Inea, 2005). Transfers comprise both aids to the activity (research and experiments, services for development, aids to processing and marketing, aids to investments, infrastructure and general support) and price support. Unfortunately, the disaggregation of transfers in sub-categories is not available at a regional level but only at the national one. For this reason, we estimated regional price support, by applying the national share of support to commodities, which is about 30%, to regional transfers. The estimated amount is equivalent to 70.8 million euro. Summing the latter to regional facilitations we obtained an amount of subsidies to agricultural commodities which is 180.8 million euro. In the model employed, subsidies to agricultural commodities appear as a negative indirect tax on agricultural commodities. Therefore, the price support removal is modelled as an increase in the net indirect tax rate of agricultural commodities. From the regional SAM, it turns out that agricultural commodity taxes net of subsidies amount to -177.39 million euro[7]. Knowing the total amount of regional subsidies to agricultural products, it is straightforward to obtain the value of taxes which is thus 3.4 million euro. The total elimination of coupled support brings about a new amount of net taxes, equivalent to -106.59 million euro, and thus an increase in the net agricultural commodity tax rate from the current -12.6% to -7.6%.

An increase in sale taxes is transferred to agricultural commodity price. This leads to a decrease in domestic demand and consequently to a decrease in agricultural production. Labour will be freed from agriculture and the price of capital tied to agriculture will diminish as a direct effect of the policy.

The explanation behind this is that producers of supported agricultural commodities react in face of the removal of price support through an increase in prices rather than an immediate decrease in production, in order to guarantee the same levels of revenues. Only successively, production will decrease as an effect of a contraction in the demand.

The reduction in agricultural value added will produce a decrease in household income and thus in spending. Moreover, since agriculture is linked with other sectors of the regional economy (buying inputs and selling output), a decline in agricultural output may affect the levels of production of other sectors and indirectly the same level of agricultural output through second-order production and price effects. The latter can be positive or negative depending on inter-industry and household relationships.

[7] This value differs from the one emerging from Table 2, since in the latter agricultural products embed other products inherent to agriculture such as forest commodities and fish.

The second scenario contemplates full decoupling, which implies the total elimination of coupled support and a direct transfer of the equivalent value of support to agricultural households. It is consistent with the decisions of Italian Government of totally decoupling support for most agricultural commodities. This scenario is modelled as an increase in the net indirect tax rate of agricultural commodities and a direct transfer from government to the income of rural households. The final result will be a combination of the effects generated by both the first scenario and an income direct transfer. In particular, the latter will produce a direct increase in income and, consequently, in spending for market commodities of rural households. If most of demand is addressed to domestically produced goods and services, the increase in income will generate a pressure for an increase in factor prices, an expected increase in commodity prices and thus an increase in domestic production. Otherwise, if preferences are in favour of imported commodities, different effects could be produced. The net aggregate effect generated by income transfer will be thus determined by consumption preferences of rural households and import intensity of the region.

4 Empirical results

Main results from the simulation of the two policy scenarios are shown in Tables 3, 4 and 5. Results are aggregated per macro-sector. The effects of the scenarios are presented in terms of deviations from the base year values.

As Table 3 shows, the total removal of public support to agricultural commodities generates an aggregate positive effect on real GDP, even if the magnitude of this impact is very small (+0.2%). This result is a consequence of a larger decrease in real GDP in the primary sector (-9.1%), which partly compensates the gains obtained by secondary and, especially, tertiary sectors.

The output quantity increases overall by 0.1%. This slight increase is a consequence of opposite trends in the sectors. In the primary sector, output decreases significantly by 10.1%. This variation can be considered as a measure of the degree of distortion in the regional economy generated by price support and confirms that the presence of the latter pushed farmers to expand their levels of production. For every million euro of price support removed, agricultural output decreases by 0.14%. On the contrary, in the secondary and tertiary sectors, there is an increase in production, which contrasts the contraction in agricultural output and leads to a slight expansion at an aggregate level.

In line with output variation, employment in the regional economy is expected to increase by 0.4% thanks to positive dynamics involving secondary and tertiary sectors. On the contrary, in the primary sector, the number of employees decreases by about 8% because of a reduction in the relevant output.

From the trade standpoint, both total exports and imports increase. At an international level, exports diminish while the volume of imported commodities rises with the consequence that the balance of payments deteriorates.

Table 3: Impact from removing price support (% changes from base year)

	Primary	Secondary	Tertiary	TOTAL
Real GDP at factor costs	-9.083	0.323	0.436	0.188
Output quantity	-10.136	0.356	0.379	0.104
Employment	-8.299	0.316	0.626	0.389
Exports	-17.535	1.274	0.009	0.858
International	-19.835	0.154	0.009	-0.271
Interregional	0.076	3.103	0.008	3.086
Imports	4.457	0.672	0.474	0.742
International	3.148	0.600	0.121	0.563
Interregional	4.737	1.078	0.710	1.238
Producer's Prices	0.273	0.047	-0.003	0.038

Source: Author's elaborations

Table 4: Impact from full decoupling (% changes from base year)

	Primary	Secondary	Tertiary	TOTAL
Real GDP at factor costs	-9.095	0.623	0.192	0.125
Output quantity	-10.148	0.708	0.164	0.133
Employment	-8.314	0.608	0.239	0.260
Exports	-17.542	2.194	-0.044	1.663
International	-19.842	0.332	-0.044	-0.133
Interregional	0.073	5.238	-0.064	5.210
Imports	4.436	1.037	0.230	0.968
International	3.123	0.910	0.044	0.827
Interregional	4.717	1.750	0.354	1.361
Producer's Prices	0.271	0.045	-0.005	0.035

Source: Author's elaborations

Table 5: Impact on income (% changes from base year)

	Scenario 1	Scenario 2
Factor income	0.152	0.087
Labour	0.389	0.260
Capital	-0.069	-0.073
Household income	0.142	0.284
Rural households	0.027	0.964
Urban households	0.172	0.103
PCIDVC	0.049	-0.514

Scenario 1 = Total removal of price support; Scenario 2 = Full decoupling
PCIVC = Per capita income variation coefficient. This coefficient is obtained as a ratio between standard deviation of incomes of rural and urban households and the relevant mean.

Source: Author's elaborations

With reference to interregional trade, exports increase at a higher rate than imports. In the primary sector, exports, pulled by a contraction in output, decrease significantly by about 18%. This reduction is due to a decrease in international exports attenuated by a slight increase in the interregional ones. Conversely, both international and interregional imports increase in order to satisfy that part of consumption needs that are no longer satisfied by domestic output. In the secondary and tertiary sectors, trade registers a positive variation. However, while in the former the volume of commodities exported increases at a higher rate than imports, in the latter the contrary happens, because of the opposite dynamics of interregional trade.

Turning to the analysis of impact in income, the complete removal of price support generates an increase in factor income. The latter is due to a positive variation of labour income negatively attenuated by a decrease in capital income

and is reflected in an increase in household income (Table 5). Looking at income distribution between households, it turns out that both rural and urban households will benefit from the removal of agricultural support though it is urban households to gain bigger benefits. The consequence is a slight worsening of income inequality between urban and rural households as can be noted by observing the positive variation of the per capita income variation coefficient.

In the case of application of full decoupling, as can be noted in Table 4, the direction of impact is mostly maintained. The main difference is related to the magnitude of the effects. Overall, the aggregate positive effects on real GDP, employment and factor income are less accentuated whereas the variations of output quantity and the volume of traded goods and services are larger. Moreover, the differences between growth ratios of exports and those of imports enlarge. This means that, at an international level, the balance of payments worsens whereas the interregional trade improves.

At a level of single sector, in comparison with results associated to scenario 1, no significant differences can be observed in agricultural sector. On the contrary, in the secondary sector, the effects generated by full decoupling are amplified whereas in the tertiary sector they are more attenuated or even negative with reference to exports.

As far as income distribution is concerned, impact on household income is expectedly larger because of income transfer from government and concentrates on rural households. A bigger increase in income of rural households than the one relevant to urban households reduces the income gap between rural and urban households and thus improves income distribution, more than compensating the negative, even if not high, effects generated by the only removal of price support. This is demonstrated by a reduction by 0.5% in the per capita income variation coefficient.

The discrepancies between the two scenarios can be related to consumption preferences of rural households. Transfer of income to rural households brings about an increase in consumption. Since consumption preferences of rural households privilege secondary commodities, an increase in this kind of consumption sustains secondary production, partly impeding the migration of factors to the service sector. The secondary sector has lower multiplicative effects than service sector. Therefore, the fact that factors are retained in this sector justifies the lower positive aggregate effects in the economy in terms of real GDP, employment and factor income.

5 Concluding remarks

This paper has analysed the magnitude and distribution between sectors and households of effects produced by changes in agricultural policy in the Italian Marche region. Results indicate that the coupled agricultural support has performed a constraining action in the economy. Actually, following the removal of support, the real GDP, employment and factor income of the whole economy are predicted to increase, since production factors move to sectors that are more profitable and with higher multiplicative effects. Moreover, removing price support has the effect of containing agricultural production consistently with policy objectives. In particular, it turned out that for every million euro of price support removed, agricultural output in the region decreases by 0.14%, as a measure of the degree of impact (or effectiveness) of the policy decision.

A further interesting aspect is that full decoupling, that is the removal of support and the contemporary transfer of the same amount of money to rural households, attenuates the positive effects in the economy. This is because transfer of money in favour of rural households is transformed into higher consumption, in particular, of secondary products. This partly impedes the migration of production factors to service sectors, which present higher multiplicative impact than others. However, it is also true that in the case where households had to use their extra income for other aims, the magnitude and distribution of impacts could be different. Moreover, a positive effect related to decoupling is that income transfer is such that negative effects in terms of income distribution produced by removing price support are more than compensated, so favouring an improvement in income distribution between rural and urban households.

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Appendix - System of equations for the regional CGE model

Equation blocks	Equation description
Domestic production	
$QVA_a = b_a \prod_f \left(QF_{f,a}\right)^{\beta_{f,a}}$	Composite factor aggregation function
$QF_{f,a} = \beta_{f,a} \frac{PVA_a VA_a}{PF_f dist_f}$	Factor demand
$QI_{c,a} = iic_{c,a} QA_a$	Intermediate demand
$QVA_a = vac_a QA_a$	Composite factor demand
$PA_a \left(1 - \tau a_a\right) = vac_a PVA_a + \sum_c iic_{c,a} PQ_c$	Zero-profit condition
$PX_c = \sum_a PA_a \frac{\delta ac_{a,c} QA_a}{\sum_{a'} \delta ac_{a',c} QA_{a'}}$	Composite commodity price
$QX_c = \sum_a \delta ac_{a,c} QA_a$	Composite commodity quantity
Government account	
$YG = \sum_h TD_h + \sum_c TX_c + \sum_c TM_c + \sum_a TA_a + \sum_{ins1} TR_{GOV,ins1}$	Government revenue
$TD_h = \tau d_h \sum_f PF_f dist_f QFS_{h,f}$	Direct taxes
$TX_c = \tau x_c \left(1 + trd_c\right) PX_c QX_c$	Domestic Commodity taxes
$TM_c = \tau m_c PMW_c QMW_c$	Imported commodity taxes
$TA_a = \tau a_a PA_a QA_a$	Activity taxes
$QG_c = \mu_c \left(YG - SG - \sum_{ins} TR_{ins,GOV}\right) \frac{1}{PQ_c}$	Government demand

Equation blocks (continued)	Equation description
Savings-investment account	
$S_h = mps_h YH_h$	Household savings
$SG = gsv_h YG$	Government savings
$QV_c = \lambda_c \left(\sum_h S_h + SG + exr \cdot SW + SI \right) \frac{1}{PQ_c}$	Investment demand
$\sum_c QV_c = \overline{QV}$	Aggregate investment demand
Household account	
$QH_{c,h} = \alpha_{c,h} \left(YH_h - SH_h - TD_h - \sum_{ins} TR_{ins,h} \right) \frac{1}{PQ_c}$	Household demand
$YH_h = \sum_f PF_f dist_f QF_{h,f} + \sum_{ins} TR_{h,ins}$	Household income
Margins	
$QT_c = \left[trd_c PX_c QX_c + trm_c \left(1 + \tau m_c\right) PMW_c QMW_c + tri_c pmi_c QMI_c \right] \frac{1}{PQ_c}$	Trade and transport margins
International trade	
$PEW_c = exr \cdot pew_c$	Price of exports to the rest of the world (ROW)
$PMW_c = exr \cdot pmw_c$	Price of imports from ROW
$\sum_c pew_c QEW_c + SW + \frac{1}{exr} \sum_{ins} TR_{ins,ROW} = \sum_c pmw_c QMW_c + \frac{1}{exr} \sum_{ins} TR_{ROW,ins}$	International trade balance (in foreign currency)
Interregional trade	
$\sum_c pei_c QEI_c + SI = \sum_c pmi_c QMI_c$	Interregional trade balance
Commodity demand	
$QQ_c = \gamma_c \left(\delta mw_c QMW_c^{\eta_c} + \delta mi_c QMI_c^{\eta_c} + \delta dd_c QD_c^{\eta_c} \right)^{\frac{1}{\eta_c}}$	Aggregate commodity demand
$QMW_c = \gamma_c^{\eta_c} \left(\frac{\delta mw_c PQ_c}{\left(1 + trm_c\right)\left(1 + \tau m_c\right) PMW_c} \right)^{\frac{1}{1-\eta_c}} QQ_c$	Import demand for ROW goods
$QMI_c = \gamma_c^{\eta_c} \left(\frac{\delta mi_c PQ_c}{\left(1 + tri_c\right) pmi_c} \right)^{\frac{1}{1-\eta_c}} QQ_c$	Import demand for goods of the rest of Italy (ROI)
$QD_c = \gamma_c^{\eta_c} \left(\frac{\delta dd_c PQ_c}{PD_c} \right)^{\frac{1}{1-\eta_c}} QQ_c$	Domestic good demand

Equation blocks (continued)	Equation description
Commodity supply	
$QX_c = \theta_c \left(\delta ew_c QEW_c^{\phi_c} + \delta ei_c QEI_c^{\phi_c} + \delta sd_c QD_c^{\phi_c}\right)^{\frac{1}{1-\phi_c}}$	Domestic commodity supply
$QEW_c = \theta_c^{\phi_c} \left(\frac{\delta ew_c (1+\tau x_c)(1+trm_c) PX_c}{PEW_c}\right)^{\frac{1}{1-\phi_c}} QX_c$	Exports to ROW
$QEI_c = \theta_c^{\phi_c} \left(\frac{\delta ei_c (1+\tau x_c)(1+trm_c) PX_c}{pei_c}\right)^{\frac{1}{1-\phi_c}} QX_c$	Exports to ROI
$QD_c = \theta_c^{\phi_c} \left(\frac{\delta sd_c (1+\tau x_c)(1+trm_c) PX_c}{PD_c}\right)^{\frac{1}{1-\phi_c}} QX_c$	Domestic sales
Market clearing conditions	
$QQ_c = \sum_a QI_{c,a} + \sum_h QH_{c,h} + QG_c + QV_c + QT_c$	Commodity market clearing condition
$\sum_h QFS_{h,f} = \sum_a QF_{f,a}$	Factor market clearing condition
Labour	
$QFS_{h,LAB} = \delta lab_h \sum_{h'} QFS_{h',LAB}$	Labour distribution between households
Utility function (fictitious)	
$UU = \sum_h \prod_c \left(QH_{c,h}\right)^{\alpha_{c,h}}$	

Subscripts

a	Activities
c	Commodities
f	Factors of production
h	Households
ins	Institutions and accounts (government, households, ROW)
$ins1$	Institutions and accounts (government, ROW)
GOV	Government
LAB	Labour

Endogenous variables

$dist_{LAB}$	Labour price distortion
PA	Activity price
PD	Domestic sale price of local goods
PEI	ROI export price
PEW	ROW export price
PF	Factor price
PMI	ROI import price
PMW	ROW import price
PQ	Composite commodity price
PVA	Value-added price
PX	Commodity producer price
QA	Activity output
QD	Domestic demand for local goods
QEI	Exports to ROI
QEW	Exports to ROW
QF	Factor demand
QFS_{LAB}	Employment
QG	Government demand
QH	Household demand

QI	Intermediate input
QMI	Imports from ROI
QMW	Imports from ROW
QQ	Aggregate commodity demand
QT	Trade and transport margins
QVA	Quantity of value added
QV	Commodity investment demand
QX	Aggregate commodity supply
S	Household savings
SG	Government savings
SI	Rest-of-the-regions savings
SW	Foreign savings
TA	Revenue from net activity tax
TD	Revenue from net direct tax
TM	Revenue from net indirect tax on ROW imports
TX	Revenue from net indirect tax on local goods
UU	Direct utility
YG	Government revenue
YH	Household income

Exogenous variables

$dist_{CAP}$	Capital price distortion
exr	Exchange rate
pei	ROI export price
pew	ROW export price in foreign currency
pmi	ROI import price
pmw	ROW import price in foreign currency
QFS_{CAP}	Capital endowment
$\overline{QV}$	Aggregate investment demand
TR	Inter-institutional transfers

Exogenous parameters

b	Scaling parameter in production function
iic	Share of intermediate goods in activity output
gsv	Government savings ratio
mps	Marginal propensity to save
trd	Margin rates on locally produced commodities
tri	Margin rates on imported commodities from ROI
trm	Margin rates on imported commodities from ROW
vac	Share of value-added in activity output
α	Share parameter in household demand for goods and services
β	Factor share-parameter in production function
γ	Shift-parameter in commodity Armington function
δac	Share of commodity output in activity output
δdd	Share of domestic goods in total demand for goods
δei	Share of ROI exports in total supply for local goods
δew	Share of ROW exports in total supply for local goods
δlab	Share of total labour supply between households
δmi	Share of ROI imports in total demand for goods
δmw	Share of ROW imports in total demand for goods
δsd	Share of domestic goods in total supply of local goods
η	Elasticity parameter in commodity Armington function
θ	Shift-parameter in commodity transformation function
λ	Share parameter in investment demand for goods and services
τd	Rate of direct income tax
τm	Rate of net indirect tax on ROW imports
τa	Rate of net activity tax
τx	Rate of net indirect tax on local goods
ϕ	Elasticity parameter in commodity transformation function