



Measuring the impacts of the CAP in Spain: A CGE model approach

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SUMMARY: The Mid Term Review introduced a decoupling of agricultural support from production decisions, although with opt-out clauses for specific payments in particular sectors. The 'Health Check' seeks to deepen the degree of decoupling, whilst importantly for Spain, offers the option of extending this model of support to the fruit and vegetables sectors. Employing a computable general equilibrium model, this paper sets out to quantitatively assess the agro-food and macroeconomic impacts of the Mid Term Review and Health Check proposals in Spain. With greater decoupling, agricultural output falls slightly, whilst resources are reallocated in favour of arable activities.

KEYWORDS: CAP, CGE modelling, ORANI, mid term review, health check.

JEL classification: C68, Q18.

Una evaluación de los impactos de la PAC en España: Un análisis de equilibrio general computable

RESUMEN: La Revisión Intermedia de la PAC introdujo un desacoplamiento de las ayudas agrarias de la producción, aunque se permitieron excepciones en algunos sectores estratégicamente importantes. El 'Chequeo Médico' intensifica el grado de desacoplamiento e introduce la opción de extender el modelo de apoyo a los sectores de frutas y hortalizas, lo que resulta de especial relevancia para España. Mediante un modelo de equilibrio general computable, se cuantifican los impactos agroalimentarios y macroeconómicos de la Revisión Intermedia y el Chequeo Médico en España. Con los incrementos en el desacoplamiento, el output agrario disminuye ligeramente, mientras que existe una reasignación de recursos en favor de las tierras cultivables.

PALABRAS CLAVE: Chequeo médico, MEGC, ORANI, PAC, revisión intermedia.

Clasificación JEL: C68, Q18.

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1. Introduction

In the early 1990s, the first serious initiative to redefine the workings of the Common Agricultural Policy (CAP) appeared in the guise of the MacSharry Reforms. The thrust of this package was to soften producer surplus losses to farmers from further reductions in EU intervention prices (although notably not in dairy) with the introduction of compensation payments, which ‘partially de-coupled’ support from production decisions through payments related to farm inputs rather than outputs. This policy development markedly changed the nature of CAP support funding, whilst respecting the Uruguay Round trade agreement. By the end of the 1990s, the Agenda 2000 reforms extended the template of the MacSharry initiative, whilst introducing a ‘second pillar’ of funding for rural development initiatives, which diverted funds away from traditional first pillar market support funding.

Under the auspices of the Mid Term Review (MTR), a recent evolution in the model of CAP support was the introduction of a single farm payment (SFP) on registered land area. The SFP was granted independently of production (i.e., decoupled), whilst a minimum requirement for receipt of the payment is that farmers should maintain the land in good agri-environmental condition (GAEC). Accordingly, divorcing payments from production emphasised market orientation, with the result that ‘marginal’ farmers may opt to cease production entirely¹. At the outset, the SFP was set to replace existing support in the crops, beef and dairy sectors, although this ‘model’ has subsequently been extended to olive oil, cotton, tobacco, hops, sugar and most recently, the wine sector. A further development of the MTR was the formalisation of second pillar funding through an ‘obligatory’ requirement to transfer funding from pillar one to pillar two (“modulation”).

In the short to medium term, further CAP reform is inevitable as policy evolves toward greater market orientation through lower support prices, further reductions in border and non-border support and the advancement (through changes in the structure of support payments) of a ‘multifunctional’ agricultural model to encourage traditional agricultural production processes and other rural economic activities (i.e., tourism, service provision, small scale manufacture) in an integrated approach to development. In this context, the ‘Health Check’ proposals seek to further decouple remaining crop and livestock payments whilst, with particular relevance to Spanish agriculture, the proposals also aim to extend (optionally) the remit of the SFP scheme to include fruit and vegetables sectors (MARM, 2009).

In this paper, the aim is to present the empirical findings of a computable general equilibrium (CGE) model of the Spanish economy employing the latest available input-output data. An important model development is that primary agriculture and the downstream food sectors have been disaggregated into 28 and 11 sub sectors respec-

¹ Prior to the 2003 MTR reforms, the farmer reacted to the market price and the support received. Under the MTR reforms, domestic support is granted independently of production. Thus, if the market price received does not cover the variable costs of production, the farmer will cease activity (simply maintaining the land in GAEC) or diversify into another crop/livestock activity.





tively, to allow a more detailed medium to long run assessment of the impacts of the MTR and the Health Check scenarios on Spanish agriculture and the broader macro economy.

2. Literature review

In tandem with developments in CAP policy, there has been a steady flow of quantitative literature examining CAP costs. A cursory review of this body of the literature reveals two important observations: Firstly, the majority of studies employ either partial equilibrium (PE) or computable general equilibrium (CGE) frameworks; Secondly, quantitative assessments of CAP reform in Spain are relatively sparse. A number of multi-commodity PE and CGE model frameworks exist which have been used to assess agricultural policy reform in the European Union. A summary of some of the most widely known PE/CGE models is provided in Figure 1.

FIGURE 1
Modelling employing PE/CGE

Partial Equilibrium Models

AGLINK (OECD); AGMEMOD (European Commission FP6) ESIM (USDA, Stanford University – USA, University Göttingen) FAO World Model (FAO); FAPRI (Universities of Iowa and Missouri); GAPsi (FAL, Germany); MISS (INRA, Rennes); SWOPSIM [(USDA, ERS); WATSIM (University of Bonn, European Commission, Federal Ministry of Agriculture); CAPRI (University of Bonn (Germany))].

Computable General Equilibrium Models

G-cubed (Mckibben and Wilcoxon, (1999), US Environmental Protection Agency); GTAP (Purdue University, GTAP consortium); MEGABARE/GTEM (ABARE Australia); RUNS (OECD); WTO House model (WTO Secretariat).

Source: Own calculations.

In the context of Spanish agriculture, there have been a number of single commodity PE model representations for oranges (Albisu and Blandford, 1979), peppers (Berbel, 1987) and cereals (Astorquiza and Albisu, 1994). However, as noted in Garcia *et al.* (2008), there is not a strong tradition of multisectoral model building in Spain, although some examples exist. Complex PE econometric specifications are comprised of a series of subsystems of equations to characterise different agricultural sectors and agent behaviour. Ibañez and Pérez Hugalde (1993; 1996; 1999) made significant strides in quantifying the impacts of the 1992 Macsharry reforms in Spain. A further example of note is that of García Álvarez Coque and Rivera (1995), which extends the agricultural multisector framework to examine the implications of the 1992 reforms in five Spanish regions. However, since these seminal modelling efforts, there has been something of a time gap in the Spanish PE literature. Casado and Garcia (2004) tailor the FAPRI model to examine the impacts of the Mid-Term Review



(MTR) agreement for the Spanish economy against the baseline of the Agenda 2000 reforms. Assuming full decoupling of Spanish support (one of several possible options), the model results suggest, as expected, small reductions in the larger supported activities (wheat, cattle and sheep), although in the case of crops, factor inputs are anticipated to be reallocated to barley and maize production. Perez and Wieck (2004) employ CAPRI to examine the implications of the MTR package for Spain under different decoupling options using the same Agenda 2000 baseline.

A distinct branch of modelling which runs parallel to the PE framework is the input-output (IO) and CGE approaches. The advantage of these models is that they capture the variety of interactions between agrifood and non-agrifood activities (Josling, 1985). Firstly, there is an interface in the hiring of factors of production (labour and capital in particular) where the degree of integration between rural and urban markets influences farm production techniques. Secondly the interlinkages with non-agrifood sectors through intermediate input purchases of non-agricultural produced goods (i.e., tractors, pesticides, services). Finally, the value of farm assets (capital/land) is reflected by non-farm demands for agricultural output. To summarise, the real strength of the CGE approach is the relationship between changing macroeconomic conditions (i.e., government revenues, trade policy, wage rates etc.) and agrifood markets.

A further important advantage of CGE is the degree of theoretical consistency, relying on neoclassical constrained optimisation techniques (utility maximisation/cost minimisation) to characterise consumer and producer behaviour. Indeed, it is possible to extend the CGE model framework to include pertinent micro-economic consistent extensions such as (*inter alia*) imperfect competition; dynamic saving-investment behaviour over subsequent interdependent time periods; and in the context of the current paper, the specific vagaries of primary agricultural sector input and output markets (e.g., intervention prices, export subsidy controls, import tariffs, production quotas and rents, land substitutability, etc.).

Clearly, like all economic modelling frameworks, these models also have a significant weakness vis-à-vis PE, in that they lack statistical rigour. Whilst the process of calibration employs 'borrowed' elasticity estimates from the literature, the model results are not subject to statistical tests of validity. A common response to this is to employ a sensitivity analysis (i.e., rerun the model systematically varying elasticity values each time in order to establish 'central tendency' estimates). Whilst this may be a useful remedial measure, it cannot be considered as an entirely satisfactory substitute for time series estimation.

A review of the relevant literature reveals a paucity of economy-wide CGE studies assessing agricultural reform in Spain, although Spanish input-output (IO) studies focused on agriculture are in evidence. Like their younger CGE cousins, IO rests on the same accounting and market clearing conventions, although are based on slightly simpler theoretical (Leontief) assumptions. Central to the analysis is the derivation of a matrix of IO multipliers which measure the total 'direct' and 'indirect' effects of an exogenous unit change in, say, final demands, for a commodity and thus quantify the extent of the impacts on the interrelationships between production sectors in an economy within a consistent modelling framework.



Agricultural IO applications to Spain include those of Enciso and Sabaté (1995) and López (1995), which both examine the evolution of agro-food production throughout the 1980s, whilst Titos *et al.* (1996) perform a similar study for Spain between the period 1970 and 1988. Spain also has a rich supply of 'regional' IO tables, which has enabled a number of researchers to employ IO multipliers to analyse the structural impacts of exogenous demand changes on agro-food production in (*inter alia*) the Basque Country (De La Grana and Azaceta, 1990), Aragón (Pérez and Feijoo, 1993), Catalonia (Artis *et al.*, 1994), Valencia (García Álvarez-Coque and Enguádanos, 1999), and Navarra (Apezteguía and Gárate, 2001). In the context of CAP reform, Gómez Valle (1999) employs IO multipliers to calculate the state of the agricultural sectors in Castilla y León under pre-MacSharry reform prices. To ascertain the impact of the MacSharry agreement, agricultural outputs derived under the no-reform scenario are compared with actual data for the period 1993-99. Other authors (Gómez-Plana, 2000; Fernández and Polo, 2001) have even further extended the IO framework to build Social Accounting Matrices (SAM) of Spain, although both choose to focus on Spanish macro policy rather than on an impact analysis of specific policy measures (i.e., CAP).

As noted, CGE relevant agricultural studies are scarce. One study employs the GTAP (Global Trade Analysis Project) multi-country model to examine the impact of the Agenda 2000 CAP reforms (Philippidis and Hubbard, 2003) for each EU15 member relative to a *status quo* (i.e., no reform) scenario. Similarly, GTAP has also been employed to assess the impacts of the proposed Doha reforms for agricultural modalities on the Spanish economy (Philippidis, 2005). Unfortunately, large scale *multi-country* undertakings such as GTAP inevitably lose a degree of sector specific detail when the focus is the construction of a world-wide trade database. In response, national CGE models, which have a simpler treatment of trade, have been constructed to examine specific policy issues pertinent to the Spanish economy. A number of authors, including Polo and Sancho (1993a) and Corboda and Kehoe (2000), employ CGE to assess the impact of Spain's 1986 fiscal reform programme, and the removal of all barriers to trade with European partners which accompanied entry to the then EEC. Other studies (Kehoe *et al.*, 1988; Polo and Sancho, 1993b) run the same scenarios, but focus on the predictive performance of CGE models through variations in behavioural assumptions and comparisons with actual data from later time periods. More recently, CGE has also been used to analyse the importance of tourism demand (Blake, 2000; Gillham, 2004) and energy policy (Labandeira *et al.*, 2009) on the Spanish economy.

3. Model development

3.1. The ORANI-ESP database

This study employs a modified version of the ORANI CGE model template, developed by the Centre of Policy Studies (CoPS) at Monash University in Australia (Horridge, 2003). At the current time, ORANI adaptations exist for Pakistan, Brazil,



China, Denmark, Indonesia, Ireland, Japan, Korea, Philippines, South Africa, Taiwan, Thailand, Venezuela and Vietnam. The Spanish variant discussed here is called 'ORANI-ESP'. A detailed description of the ORANI data structure can be found in Horridge (2003). This section focuses on the main developments required in the construction of the database for Spain.

Input-Output (IO) data published by the Instituto Nacional de Estadística (INE) constitutes the principle source of data for the construction of the Spanish database for ORANI-ESP. The IO data provide tables at basic prices (prior to indirect taxes and transport/retail margins) and purchaser's prices (inclusive of both taxes and margins) for 118 commodities and 75 industries as well as final demands. Moreover, IO tables are subdivided between domestic and imported activities in Spain across all intermediate and final demand accounts. Importantly, the conditions imposed by the IO Table (demands equal supplies; output equals expenditure equals income) underlie the fundamental accounting conventions of the CGE model framework.

In an attempt to elaborate a full ORANI-ESP database from the IO Tables, a series of arduous steps are required employing further secondary data sources and judgement. The 'main' steps are as follows: (1) create separate tax and margin matrices from a compound margin PLUS tax matrix; (2) create an investment matrix from a single column of data; (3) divide imports and exports by EU and non-EU usage; (4) subdivide labour into different skill levels; (5) disaggregate private household purchases by income groups; (6) disaggregate primary agriculture into specific activities (columns) and commodities (rows); (7) assign support data to the agricultural sectors on the relevant production process; (8) derive tariff and trade data for the individual agricultural commodities; (9) disaggregate estimates of land value usage from gross operating surplus; (10) creation of biofuels sectors. To perform each of these tasks an array of secondary data sources are required. For the interested reader, further details of these steps are discussed in the technical appendix.

3.2. *ORANI-ESP model framework*

As a basis, the study employs the well known ORANI comparative static CGE framework, which is described in detail in Horridge (2003). ORANI is a 'demand' led model, based on a system of neoclassical final, intermediate and primary demand functions. With the assumption of weak homothetic separability, a multi-stage optimisation procedure allows demand decisions to be broken into 'nests' to provide greater flexibility through the incorporation of differing elasticities of substitution. Moreover, accounting identities and market clearing equations ensure a general equilibrium solution. After appropriate elasticity values are chosen to permit model calibration to the database, and an appropriate split of endogenous-exogenous variables is selected (i.e., 'model closure')², specific exogenous macroeconomic or trade

² In this paper, a medium to long run closure is employed. Real wage rates are assumed fully flexible, the trade balance is fixed as a proportion of GDP, public and private consumption grow in proportion to regional income, whilst investment is a function of exogenous changes in the capital stock (see section 4.1).



policy ‘shocks’ can be imposed to key policy variables (i.e., tax/subsidy rates, primary factor supplies, technical change variables etc.). The model responds with the interaction of economic agents within each market, where an outcome is characterised by a ‘counterfactual’ set of equilibrium conditions.

In this study, a number of modifications are made to ORANI-ESP. Firstly, the representation of energy demands follows the nesting structure of the GTAP-E model (Burniaux and Truong, 2002)³, where separate energy nests allow for a more flexible representation of substitution possibilities between differing energy types (e.g., electricity, coal, petroleum, biofuels). Additional changes are implemented to capture the specifics of the agricultural sector. Thus, the structure of agricultural support is altered in the updated 2005 ORANI-ESP data to reflect payments on land (set-aside, area payments) capital (headage payments on productive cattle, investment aids), output (e.g., production aids, stock purchases) and intermediate inputs (seed payments, irrigation aids, distribution and marketing payments, etc.). Moreover, the model code incorporates explicit quantitative constraints (quotas) in the milk and sugar sectors (Lips and Rieder, 2005), set-aside restrictions, intervention prices and export subsidy and quantity controls under the Uruguay Round (Bach and Pearson, 1996), whilst the SFP is introduced as a uniform subsidy rate on the land factor (Frandsen *et al.*, 2003).⁴ In factor markets, capital and labour move sluggishly between agricultural and non-agricultural sectors to capture rental and wage differentials between sub-sectors (Keeney and Hertel, 2005). Land, which is exclusively used by agricultural sectors, also moves sluggishly between agricultural activities whilst the ease of transformation of land from one agricultural sector to another is differentiated by activity (OECD, 2003).

Given the lack of relevant Spanish data sources, calibration is facilitated through usage of substitution and expenditure elasticities from the standard GTAP version 7 database (Narayanan and Walmsley, 2008). In the energy module, substitution elasticities from GTAP-E econometric estimates for developed countries are employed. Export demand elasticities and labour supply elasticities by occupation are borrowed from the Australian ORANI database, whilst the transformation elasticities for land (between uses); and capital and labour (between agricultural/non-agricultural uses) are borrowed from Keeney and Hertel (2005). Finally, in the case of agro-food products, private household expenditure elasticities are taken from a study by Moro and Sckokai (2000) on Italian households stratified by wealth.

4. Scenarios and results

4.1. Scenarios

As noted above, the benchmark year for the model is 2005, one year prior to the introduction of the MTR reforms in Spain. Whilst the full database consists of 146 commodities by 112 industries, a smaller aggregation is chosen focusing on the agro-

³ GTAP-E is a ‘energy’ focused variant of the well known GTAP model.

⁴ In this way, the payment is linked to registered land, but decoupled from production.



food sectors. In addition, energy sectors are disaggregated, whilst remaining non-food related sectors are aggregated into ‘manufacturing’ and ‘services’ sectors. In the **baseline**, a ‘business as usual’ scenario is implemented consisting of projections to 2015 on real GDP, capital growth, inflation (IMF, 2009); productivity by sectors (Ludena *et al.*, 2006, Jensen and Frandsen, 2003); 2% increase in the milk quota in accordance with the EU’s April 2008 agreement in response to market conditions; consumer preferences between red and white meats (OECD, 2008); estimated increases in the consumption of biofuels (OECD, 2008); and world price projections on agricultural commodities (OECD, 2008). In addition to these baseline shocks, three scenarios are run: In the **MTR scenario 1**, a ‘historical’⁵ calculated SFP replaces coupled direct payments on cereals, potatoes, hops, cattle, sheep, raw milk, olive oil, cotton, tobacco and wine production. Given its fragmented agricultural production structure, the Spanish government opted to minimise its level of decoupling to smooth the path of transition within the reforms. Thus, payments remain specific to seeds (100%); arable crops (25%); hard wheat quality premium (100%), starch premium on potatoes (60%), cotton subsidy (35%), olive production aids (6%), sheep and goat premiums (50%); suckler cow premium (100%); slaughter premium for calves (100%); and slaughter premium for adult bovines (40%). Intervention prices are cut in sugar and dairy sectors; export subsidy limits are maintained (in line with the EU’s Uruguay Round commitment), sugar quotas are cut 40% under the 2006 sugar reform and modulation of 5% is applied. **Scenario 2** is an initial ‘Health Check’ scenario, where all remaining area and headage payments and production aids are decoupled (except the suckler premium, sheep and goat premiums and the cotton subsidy which remain unchanged). In addition, the milk quota is now eliminated (scheduled for 2015), all set-aside is removed and a rate of 10% modulation is applied. **Scenario 3** is identical to scenario 2 except the remit of the SFP now extends to the fruit and vegetable sectors⁶. All results are presented in comparison with the 2005 benchmark year. Given the similarity between these simulations, results are only presented for scenario 2, whilst results for scenario 3 are discussed in the text.

TABLE 1
Macro impacts in Spain (% changes)

	Baseline (vs. 2005)	MTR (vs. Baseline)	HC (vs. Baseline)
Consumption	23,7	0,2	0,4
Investment	12,6	0,4	0,5
Exports	7,9	0,7	0,7
Imports	14,4	0,5	0,5
GDP	17,4	0,2	0,4

Source: Own calculations.

⁵ No attempt is made to assess the impact of ‘historical’, ‘flat rate’ and ‘regional rate’ SFP systems in Spain.

⁶ In the Health Check agreement, decoupling in fruit and vegetables is optional. Spain has not opted for this reform. In scenario 3 we decouple measures for dry fruit and aids on nuts, processing aids on tomatoes, citrus fruits, other fruits (apples, pears, plums etc.), processing aids on grapes for raisin production, banana aids.



4.2. Results baseline⁷

Table 1 presents the macro components of aggregate demand for the Spanish economy. Over the ten year time horizon, real GDP rises 17.4%, with concomitant increases in Spanish consumption and investment of 23.7% and 12.6%, respectively. Compared with exports (7.9%), imports increase more rapidly (14.4%) such that the trade balance in Spain deteriorates €3.143 million (not shown).⁸ Given increases in Spanish macro growth, the majority of sectors witness increases in output (Table 2). Nominal prices rise given the inflation projection of 23.6%, whilst real price changes compared with 2005 are presented on the right side of Table 2. Model estimates indicate 9.6% growth in primary agriculture, where there is a relative redistribution of agricultural activity in favour of crops (12.1 %) and away from livestock production (5.7%). Due to the inelastic income demands for agro-food products, this relatively low growth rate signals an ongoing trend toward a reduced importance of Spanish agriculture as a proportion of GDP.

Notable output increases in the crops sectors occur in cereals and oilseeds due to favourable world market conditions and strong biofuels demand projections⁹. In oilseeds, output is estimated to increase 50.4% compared with 2005¹⁰, whilst wheat, barley and maize see important rises of 24.3%, 15.4% and 27.1% respectively. In the livestock sectors, the substitution effects in favour of white meat consumption lead to relatively larger increases in pork and poultry meat production in both upstream (herd sizes) and downstream sectors, compared with the red meat supply chain. As noted previously, the result is that livestock production grows less than crop production. In the raw milk sector the quota remains binding, matching the agreed 2% quota increase granted in April 2008 with an equivalent increase in dairy production (1.9%).

On the right hand side of Table 2, real price changes compared with 2005 are presented. Given zero profits in all sectors, changes in costs directly impact on prices. With equivalent rates of agricultural subsidies in the baseline, the main forces motivating real price changes are shifting demand- (income elasticities of demand, export demands for cereals/biofuels, biofuels demand for energy crops) and supply-curves (productivity improvements). In addition, with perfectly inelastic supply in raw milk production, increases in quota rents result in notable increases (14.1%) in real prices compared with 2005. Moreover, the impact of biofuels demand has the effect of increasing feed prices (9.1%) as greater land is diverted into energy crops. With increased economic activity, derived demands in factor markets impact on factor prices (Table 3), where the real cost of capital, labour and land rises 3.5%, 7.4% and 6.8% respectively. Comparing labour wages by occupation (also Table 3), real increases are between 4.3% for (elastic) unskilled labour and 12.6% for (inelastic) professional labour. Overall, employment in Spain increases by 5.1% (not shown) compared with 2005.

⁷ It should be noted that large percentage changes may also reflect small base values in 2005.

⁸ The trade balance in the benchmark year (2005) is -€82,263 million.

⁹ The large endogenous percentage increases in biofuels production in response to exogenous projections on demand for biofuels are calculated from a very small base in 2005.

¹⁰ Examining Eurostat data, in 2005, Spanish production of oilseeds (mainly sunflower seeds) was historically low.



TABLE 2
Sectoral output and real prices in the baseline, mid term review and health check

Results in % changes	Output			Real Prices		
	Baseline (vs. 2005)	MTR (vs. Baseline)	HC (vs. Baseline)	Baseline (vs. 2005)	MTR (vs. Baseline)	HC (vs. Baseline)
Wheat	24,3	-1,0	-8,9	22,3	1,2	5,9
Barley	15,4	1,8	2,4	21,0	-3,2	-6,5
Maize	27,1	-1,0	-3,6	15,9	1,0	2,7
Rice	9,0	-10,6	-17,0	-1,0	12,2	23,3
Other cereals	9,0	-1,4	-2,7	3,0	3,0	5,3
Potatoes	1,3	7,6	7,1	4,1	-4,4	-4,2
Sugar beet	6,0	-65,2	-65,0	1,1	-13,4	-13,5
Oilseeds	50,4	6,8	15,8	25,8	-5,0	-12,5
Textile crops	17,1	-29,5	-29,9	-4,2	34,0	35,2
Other industrial crops	10,6	1,8	2,1	-0,8	-0,6	-0,7
Animal feed	5,6	-2,6	-2,7	9,1	0,8	0,9
Tobacco	11,7	-12,2	-12,0	-1,3	7,6	7,5
Olives for oil	4,5	-1,2	-1,4	-1,6	4,0	5,5
Vegetables	11,7	2,7	3,1	-0,5	-0,4	-0,5
Table olives	3,5	-0,1	-0,1	-2,1	2,2	2,4
Dry fruits	9,8	2,7	3,1	0,9	-0,1	-0,2
Table grapes	11,5	3,1	3,5	0,3	-0,3	-0,4
Other fruit	12,1	2,9	3,3	-0,3	-0,4	-0,5
Citrus fruit	6,3	1,3	1,5	1,6	0,0	0,0
Tropical fruit	5,9	1,2	1,3	1,7	-0,1	-0,2
Other crops	12,2	2,2	0,9	-3,5	-0,8	0,9
Cattle	4,7	-7,4	-10,2	2,5	10,1	14,2
Pigs	8,4	1,1	1,1	2,5	-0,8	-0,8
Sheep & Goats	2,7	-4,0	-3,7	1,8	11,7	10,9
Poultry	6,7	0,1	0,3	5,0	-0,5	-0,4
Raw milk	2,0	0,0	3,1	14,1	-17,5	-23,1
Other animals	-1,0	2,4	2,4	4,7	-0,7	-0,7
Crops	12,1	-0,1	-0,3	4,1	-0,2	-0,1
Livestock	5,7	-1,8	-1,9	4,5	0,9	0,9
Agriculture	9,6	-0,8	-1,0	3,5	0,4	0,3
Beef	1,5	-5,7	-8,3	3,5	5,2	7,2
Pork	7,7	1,0	1,0	3,5	-0,5	-0,4
Lamb	-1,4	-2,5	-2,4	3,3	6,0	5,6
Poultry meat	7,8	0,4	0,3	4,8	-0,3	-0,2
Other meat	4,2	0,2	0,2	3,4	0,0	0,0
Dairy	1,9	-2,8	2,2	7,3	-6,0	-7,9
Oils & fats	4,5	-0,9	-0,9	7,2	-0,2	-0,8
Sugar processing	4,7	-64,9	-64,9	3,6	-11,3	-11,3
Other food	-0,9	0,9	0,6	5,2	-0,3	-0,2
Beverages (incl. wine)	9,9	1,2	1,5	3,2	-0,6	-0,7
Food & drink	5,7	-1,0	-1,1	4,2	-0,4	-0,5
Biodiesel	292,8	12,9	49,6	12,4	-0,5	-6,2
Bioethanol	264,4	2,2	1,1	12,3	-0,7	-0,2
Other energy	18,7	0,2	0,2	4,5	0,1	0,1
Natural Resources	11,6	-0,3	-0,3	2,8	0,1	0,1
Manufacturing	19,4	0,9	1,1	-4,2	-0,2	-0,2
Services	12,0	0,2	0,3	3,1	-0,1	-0,1

Source: Own calculations.

TABLE 3
Spanish real factor prices (% changes)

%	Baseline (vs. 2005)	MTR (vs. Baseline)	HC (vs. Baseline)
Real Capital Rents	3,5	-0,2	-0,2
Real Land Rents	7,4	31,0	34,5
Real Labour Wages	6,8	-0,3	-0,3
Real Wages by occupation			
Managers	12,4	-0,3	-0,3
Professionals	12,6	-0,3	-0,3
Technical support	6,8	-0,1	-0,1
Administration	6,8	-0,1	-0,1
Services & sales	6,5	-0,1	-0,1
Skilled rural labour	7,2	0,0	0,0
Other skilled labour	6,4	0,0	0,0
Machine operators & fitters	5,1	-0,3	-0,3
Unskilled labour	4,3	-0,1	-0,1
Armed forces	6,5	-0,1	-0,1

Source: Own calculations.

Examining real agricultural incomes¹¹, estimates indicate an increase of 5,6% compared with 2005. CAP related pillar 1 payments, fixed in nominal terms, decline by -15,1% in real terms. Real income from on-farm factors increases 12,8% due to increases in real factor prices (see Table 3), whilst quota rents increase 27,7% (€179 million). Finally, slight rises in the real price index for food due to the impact of feed cost increases in the livestock and meat sectors, impact negatively on private household welfare from food consumption. Utility from food consumption falls slightly across all households (see Table 4), although given Engel's Law, the impact is felt most (-2,7%) in the poorest households (HH1). In contrast, the wealthiest households (HH8) face a minor utility loss of -0,9%. Aggregating over all purchases, total private household real incomes rise by €2,986 million, or 1,1% compared with 2005 (not shown), although this average masks the variability between households, with a moderate rise of 0,2% in HH1 compared with a rise of 1,4% in HH8 (not shown).

TABLE 4
Spanish private household utility from food consumption (% changes)

	Baseline (vs. 2005)	MTR (vs. Baseline)	HC (vs. Baseline)
HH1 < €500 month	-2,7	0,5	0,6
HH2 €500-€999 month	-2,5	0,5	0,5
HH3 €1000-€1499 month	-2,2	0,3	0,3
HH4 €1500-€1999 month	-2,0	0,3	0,3
HH5 €2000-€2499 month	-1,7	0,2	0,2
HH6 €2500-€2999 month	-1,5	0,2	0,2
HH7 €3000-€4999 month	-1,2	0,2	0,2
HH8 > €5000 month	-0,9	0,1	0,1

Source: Own calculations. Discrete household groupings based on INE statistics.

¹¹ Calculated as the sum of agricultural factor returns (including quota rents) and pillar 1 CAP payments (but not pillar 2). These results are not shown in the tables.

4.3. Results Mid Term Review (MTR)¹²

As noted in section 1, the (partial) decoupling of support into a single farm payment (SFP) is expected to encourage marginal farmers to leave production altogether or specialise in a different farming activity with potentially greater profitability. In the context of the model, those sectors with disproportionately higher support as a proportion of production costs and relatively poorer market expectations (i.e., lower prices) will witness more notable reductions in output. Comparing with the baseline, the long run impacts of decoupling on ‘agriculture’ and ‘food and drink’ aggregates are relatively mild, resulting in a slight reallocation of primary resources into non agro-food activities (Table 2). Compared to the baseline, manufacturing and services activity increases by 0,9 and 0,2 percentage points (%p) respectively. Consequently, macro growth (Table 1) increases 0,2%p, resulting in Spanish consumption and investment increases, whilst despite slightly higher growth in exports compared with imports, the Spanish trade balance deteriorates by a further €216 million (not shown) compared with the baseline.

In the cereals sectors, there are moderate output falls (Table 2) in wheat (−1,0%p), maize (−1,0%p) and larger falls for rice (−10,6%p). Notwithstanding, given greater land substitutability between cereals/oilseeds/protein crops, barley and oilseed production rises slightly (1,8%p and 6,8%p respectively). Indeed, the size of coupled support removal in these two industries is a relatively smaller proportion of agricultural value, resulting in a substitution effect in production. Furthermore, the increase in oilseeds production benefits biodiesel output (12,9%p). Despite 94% decoupling in the olive sectors, production falls are muted in comparison with the baseline, because as a permanent crop, land movement is modelled as highly sluggish implying inelastic supply responsiveness to policy changes. Notable negative output impacts from decoupling are felt in textiles (−29,5%p) and tobacco (−12,2%p), whilst significant output contractions of approximately −65%p are recorded in sugar beet and processed sugar sectors, due to reductions in intervention prices, whilst the quota remains non-binding¹³. In the animal feed sector, there is a slight reduction in production compared with the baseline due to the contraction in livestock production. In fruit and vegetable sectors, given the absence of decoupling, output rises slightly compared with the baseline as resources from contracting agricultural activities are diverted.

In the case of individual Spanish livestock sectors, there is a further substitution effect in favour of white meat production due to the decoupling of support in cattle and sheep/goats sectors. Accordingly, the herd size in cattle and sheep/goats sectors falls 7,4%p and 4,0%p respectively. In turn, these herd size reductions imply corresponding output falls in the downstream beef and lamb sectors. Despite intervention price reductions in dairy resulting in output reductions, the raw milk quota remains binding.

¹² In this section, percentage point changes (%p) are compared with the baseline scenario.

¹³ Given that Spain is relatively uncompetitive in sugar production, the quota is also modelled as non-binding in the benchmark year (2005).



Examining real prices (Table 2), given the assumption of zero profits, changes in cost conditions from the reconstitution of agricultural support, impact directly on prices. In those agricultural sectors with poorer market expectations and/or where direct (coupled) aids in 2005 represent an important component of farming sustainability, decoupling will result in real price rises as farmers leave the industry and registered land receiving the SFP is diverted into other farming (or non-farming) activities.

Wheat and maize experience slightly higher real prices (1,2%p and 1,0%p respectively), whilst given the reallocation of (subsidised) land, real prices in barley and oilseeds fall (-3,2%p and -5,0%p respectively). A more marked relative real price increase is apparent in rice (12,2%p), textiles (34,0%p) and tobacco (7,6%p) sectors, whilst sugar (upstream and downstream) prices fall compared with the baseline due to intervention price reductions. In the remaining fruit and vegetables sectors (where no decoupling occurs), prices remain relatively static, although the trend is a slight fall due to a limited reallocation of (sluggish) land into these sectors. Turning to the Spanish livestock sectors, real prices rise in cattle (10,1%p) and sheep/goats (11,7%p) sectors due to the additional impact of decoupling support, which in turn are passed onto the downstream red meat sectors¹⁴. In raw milk production, intervention price reductions in dairy impact negatively on the value of quota rent (-€657 million compared with baseline), such that the raw milk price declines in real terms.

Examining Table 3, with the exception of land, the impacts of the MTR reforms on Spanish factor prices is small compared with the baseline. In capital and labour, the general trend on real returns is slightly negative as more resources are released by primary agriculture. On the other hand, the coupling of agricultural support to the land factor in the relevant agricultural sectors (i.e., SFP) results in a recapitalisation of the aggregate Spanish pre-subsidy land return of 31,0%p. Consequently, this wealth effect leads to corresponding rises in agricultural incomes (7,7%p), despite reductions in dairy quota rents and pillar 1 support (due to 5% modulation in the MTR scenario).

Perhaps surprisingly, Table 2 shows a slight fall in the index of real food prices compared to the baseline (despite the small increase in primary agricultural prices), owing principally to small falls in real returns to capital and labour and significant real price falls in dairy and sugar (due to policy adjustments). This implies very small gains in private household welfare from food consumption (see Table 4), ranging between 0,1%p (HH8) to 0,5%p (HH1). Aggregating over all purchases, in money metric terms aggregate household utility is improved only moderately compared with the baseline scenario (€49 million – not shown), largely due to minor falls in the real prices of non-food purchases.

4.4. Results Health Check (HC)¹⁵

Unsurprisingly, the Health Check (HC) results largely resemble those of the MTR given the relatively mild policy evolution of the proposals. Indeed, with slightly in-

¹⁴ The 'cattle' sector only captures production for meat activities (and not milk) and is therefore not affected by milk quota changes. All milk production is captured in the 'raw milk' sector.

¹⁵ In this section, percentage point changes (pp) are compared with the baseline unless otherwise stated.



creased primary resource reallocations toward manufacturing and services activities, the model estimates a moderate rise in real GDP growth of 0,4%p (Table 1), or a further increase of 0.2%p compared with the MTR. Moreover, the impact on crop, livestock and food production in comparison with the MTR is negligible. Table 2 shows that wheat, maize and 'other cereal' production fall due to additional decoupling (most notably in the wheat sector, with the decoupling of the quality premium on hard wheat). In contrast, oilseeds and barley output rise as the impact of additional land from set-aside elimination outweighs the effect of further decoupling. The largest single output increase occurs in oilseeds (15,8%p), which is in response to strong demand for biodiesel production. Indeed, the elimination of set-aside results in a 49,6%p increase in bio-diesel, whilst with reductions in wheat and maize offsetting production increases in maize, bio-ethanol production remains relatively unchanged.

Rice production declines sharply compared with the baseline (and the MTR) under full decoupling, whilst tobacco and textile sector contractions are similar to the MTR since the level of decoupling remains unchanged¹⁶. In the livestock sectors, only the cattle herd (and consequently, beef production) registers further reductions due to additional decoupling¹⁷, whilst in sheep and goats the degree of decoupling remains unchanged compared with the MTR. In the case of the raw milk (dairy products) sector, elimination of the quota results in moderate production increase of 3,1%p (2,2%p), a result which is consistent with the work of Witzke *et al.* (2009).

Examining real price changes, wheat, maize, rice, 'other' cereals and cattle exhibit increases from further decoupling of support. In raw milk (and consequently, dairy), the elimination of quota rent contributes to a larger real price reduction compared with the baseline. Similarly, additional real price falls are observed in oilseeds and barley due to the increased availability of the land factor from the elimination of set-aside. Real oilseed price reductions are passed onto the bio-diesel sector and, to a much smaller degree, the oils and fats sector.

With increases in the application of the SFP to the land factor in the relevant agricultural sectors, the aggregate real return to land rises 34,5%p (Table 3), whilst elsewhere Spanish factor prices are very similar to the MTR scenario. Real agricultural incomes rise 5,1%p or a relative fall of 2,2%p compared with the MTR. The latter result is because the loss in dairy quota rents and reduced pillar 1 CAP income (due to 10% modulation) offset increases in real returns to the land factor. Finally, utility impacts across all private households exhibit very similar trends to the baseline, both in terms of food consumption (Table 4) and total consumption.

In an additional HC scenario, the SFP is broadened to include 100% decoupling in the fruit and vegetable sector (results not shown). Consequently, output and real price effects in non fruit and vegetables activities are unchanged. In dry fruit and tropical fruit sectors, the removal of coupled dry fruit and banana aids¹⁸ translates into output

¹⁶ In the textile sector, the cotton subsidy remains at 65% decoupling, whilst tobacco support is already decoupled 100% in the MTR scenario.

¹⁷ A further experiment was run including the decoupling of the suckler cow premium. This experiment registered an output reduction of -19,0% compared with the baseline.

¹⁸ Footnote 6 lists all the decoupled payments in the fruit and vegetables sectors.



falls of 10,8%p and 9,7%p respectively, whilst primary resources are released to table grapes, 'other fruits' and citrus fruits activities. Thus, output rises by 5,4%p, 6,2%p and 3,1%p in these sectors, respectively. In the vegetables sector, tomato subsidies are now removed, although the impact on aggregate vegetable production is negligible. Compared with the first HC scenario, real prices rise in dry fruits (2,2%p) and tropical (4,4%p) sectors from decoupling, whilst the release of primary factors (notably sluggish land) into table grapes, other fruits and citrus fruits reduces real prices (-1,1%p, -0,8%p and -0,3%p respectively).

5. Conclusions

This paper discusses a new CGE application, designed to quantitatively assess the impacts of recent CAP reforms in Spain. Given the focus on agrifood markets, there is a detailed disaggregation of farming and food activities and two biofuel sectors, whilst a number of agricultural modelling features have also been incorporated. As with all modelling efforts, important caveats to this analysis should be noted. Firstly, no data or modelling adjustments are incorporated to capture the important characteristic of irrigated/non-irrigated land in Spanish agriculture. Secondly, it is assumed that all set-aside land is of good quality. Thus, in the context of the results presented here, its elimination presents an overoptimistic picture of (*inter alia*) biofuel production increases. Thirdly, the comparative static CGE framework does not capture important adjustment costs in the macro economy when moving between equilibrium points. Fourthly, pillar 2 expenditure transfers are not incorporated within this economic representation. Whilst these would undoubtedly have some bearing on the farm income results, such income flows are a function of (exogenous) political considerations and are therefore open to broad speculation. Finally, the dearth of detailed secondary data sources to elaborate biofuels activities must be borne in mind when evaluating the predictive capacity of the model.

Turning to the results, four scenarios are run over a ten year horizon: a 'business as usual' baseline; a Mid Term Review (MTR) scenario; and two Health Check scenarios. In each scenario, agriculture's rate of growth is below that of the macro economy, suggesting a continued downward share of GDP, whilst encouragingly, the largest two primary agricultural sectors ('vegetables', 'pigs') fair relatively well in all scenarios. As a general observation, with a gradual move toward the decoupling of agricultural support in Spain and its subsequent negative impact on agricultural output, non agro-food activities (i.e., manufacturing, services) benefit moderately from the reallocation of primary factors. In turn, efficiency gains imply small benefits for economic growth, consumption and investment in Spain.

Examining the composition of agricultural production, in the baseline there is a relative production shift in favour of cropping activities and away from livestock. This is attributed to the influence of biofuels demands for cereals and oilseeds and declining herd sizes in cattle and sheep/goats sectors from changing consumer preferences. With the addition of decoupling, there is larger decline in livestock production (*vis-à-vis* crops), principally due to reductions in the cattle herd, whilst the gra-

dual coupling of the SFP to land notably appreciates real land rents in the MTR and HC scenarios. Comparing between the MTR and HC scenarios, impacts in general are limited. Notwithstanding, the elimination of set-aside benefits biodiesel production through increased production of oilseeds, whilst the decoupling of the hard wheat quality aid has a notable impact in the wheat sector. Broadening the SFP to include fruits and vegetables, incurs production losses in tropical and dry fruits production. Examining real agricultural incomes, the recapitalisation of land values improves farmers' wealth in the MTR scenario, whilst the loss of quota rent and pillar 1 funding due to increases in modulation rates reduces this real income gain in the HC scenario. Finally, there is a redistribution of welfare from food consumption in favour of wealthier Spanish households due to real food price rises; although this impact is lessened under the MTR and HC scenarios as real food prices fall slightly compared with the baseline, primarily due to factor price falls in capital and labour as agriculture contracts.

Looking ahead, EU agricultural policy will continue to be more market orientated and multifunctional, with gradual transfer payment compensations from both pillars as a means toward easing inefficient enterprises out of commercial production and providing a sustainable approach to rural communities. Whilst it is difficult to see any deviation from this underlying evolutionary trend, the speed of future CAP reform is particularly uncertain. On the one hand, this will greatly depend on 'internal' EU budgetary considerations, particularly in 2013 when the next financial perspective (2014-2020) must be ratified by the 27 member states. Moreover, 'external forces' in the form of the Doha talks have stalled, especially given the wave of protectionist sentiment currently embracing many developed trading partners in the context of the current global recession. In the interests of agricultural market efficiency, both European and global, it is to be hoped that the benefits of economic rational will get the better of political expediency.

6. Annex

6.1. *ORANI-ESP database*

The creation of a separate margins and tax matrix presents a major challenge. At the outset, it is possible to derive a margins *plus* indirect taxes composite matrix (TMC) by subtracting basic values from purchaser's values. Furthermore, the underlying IO data provide row and column totals for the indirect taxes, whilst row (commodity) totals for the indirect usage of margin commodities are also available. In deriving the individual cell entries for the indirect tax matrix, it is assumed that the tax rate for a given commodity is uniform across all users (columns). The balancing of the tax matrix is then achieved employing a maximum entropy algorithm to minimise the disturbances in the database, whilst respecting the row and column totals. Maximum entropy employs a probabilistic function to closely approximate individual cell elements within matrices, based on prior expectations. When sufficient *a priori* information is available, this approach is preferred to the Row and Sum (RAS) scaling



technique, where RAS is only dependent upon column and row total restrictions for estimating matrix elements. Once a tax matrix is balanced, a margin matrix is derived as the residual difference between the TMC and the tax matrix. Subsequent divisions into EU and non EU uses are derived employing use shares from the underlying IO database.

In the IO Table, the investment demand column must be disaggregated by industries to form a commodity by industry matrix. This is facilitated by the usage of a 6 commodity by 30 industry investment matrix at purchaser's prices created by INE. A concordance between the IO table and the investment matrix is performed, whilst the totals in each cell are subdivided employing the row and column shares from the IO Table.

The subdivision of labour into occupation types is aided by the use of labour force survey data from INE describing the total number of persons working across 10 different occupation levels in each of 17 broad activity levels. Given knowledge of the total number of persons working in each of the industries (from the IO data), it is possible to disaggregate the 17 activity levels by each of the IO industries. Employing IO data information, this matrix is subsequently split between paid and unpaid labour totals¹⁹, whilst the former is divided between full and part-time. 'Gross' salary bills for across the 10 occupation levels are derived through the calculation of average full- and part-time salary weights by industry provided from labour force survey data by INE. This matrix of total labour costs is then scaled to accord with the IO industry (column) totals.

Private households are subdivided into categories by disposable income level. Household survey data ('La Encuesta Continua de Presupuestos Familiares') from INE subdivide total household purchases by 8 income levels and across 10 different commodity groups. In this way, a matrix of expenditures by household is mapped to the IO row aggregate through concordance of the 10 aggregate commodity groups with the IO commodity rows. Taxes are assumed uniform across all household purchases or commodities.

The division of the agriculture sub-matrix between 28 different agricultural activities uses an array of data sources. Eurostat data on the values of output by sectors (basic and producer values) are employed to help subdivide the agriculture aggregate by rows and columns. Furthermore, the determination of the intermediate and value added cost shares across agricultural industries is facilitated employing data from the 'Red Contable Agraria Nacional' (RECAN) published by the 'Ministerio de Agricultura, Pesca y Alimentación'. In the IO table, net taxes on agricultural commodity 'i' in agricultural sector 'j' are payments on the usage of commodities in production (i.e., area payments, headage payments, production aids). In contrast, 'net taxes on production' refer to subsidies which are received as a registered member of the industry (i.e., young farmer's premiums, LFA premiums etc.). Employing detailed support data from FEGA, it was possible to allocate sectoral support payments across using sectors. The resulting agricultural basic values, tax and margin matrices are scaled using maximum entropy to accord with the agricultural industry column and

¹⁹ This is particularly pertinent for agriculture which has a sizeable unpaid labour force.

row totals in the IO matrix. Land values by agricultural sector are estimated employing a mixture of land price and area data from the Spanish Agricultural Ministry. In the model database, land rents are estimated by a 2% rate of return on land values.

Balancing of the entire ORANI database employs a modified version of the ORANI GEMPACK balancing/updating program developed by Horridge (2004). The underlying balancing conditions are that (i) in each commodity (row), total sales must equal the row-sum of the MAKE matrix; and (ii) in each industry (column), total costs must equal the column-sums of the MAKE matrix. In addition, multiple target constraints can be exogenously specified for general macro variables (i.e., GDP, total imports) and even very specific cell entries, whilst remaining values adjust endogenously through the model's accounting conventions. Target values are taken from the IO 2001 Table of Spain. The advantage of this program is that one can balance a series of matrices interactively ranging over several dimensions.

In December 2008, INE released an updated IO Table benchmarked to 2005. At that time, ORANI-ESP was still based on 2001 data, which thereby facilitated a need to update and balance the CGE database to 2005. To complete this task, the GEMPACK update facility (Horridge, 2004) is again applied in concert with the 2005 IO data and additional 2005 secondary data sources²⁰ (household expenditures by incomes, trade and average applied and bound tariff rates, land values, labour market, agricultural output and support by sector etc.).

Finally, given the increasing significance of biofuels markets, the 2005 database was further disaggregated to incorporate biodiesel (from oilseeds and vegetable oils and fats) and bioethanol (from cereals) production²¹. To estimate the size of both sectors, the quantity produced in Spain and EU price data for 2005 are required, taken from European Commission (2006) and Birur *et al.* (2005) respectively. Furthermore, estimates of cost shares in each industry are borrowed from US estimates in Taheripour *et al.* (2008) who decompose biodiesel and bioethanol costs by category ('feeds', 'chemicals', 'energy', 'other inputs', 'capital', 'labour') for implementation into the GTAP database. It is generally considered that US biofuel producers are more efficient than their EU counterparts. Thus, the 'feed' cost shares in both biofuels sectors are cross referenced with corresponding EU sources [Bamier *et al.* (2007); Ministerio de Industria, Comercio y Turismo, (2005)] with the remaining cost shares scaled accordingly. Exports and imports of bioethanol²² in 2005 are taken from Ministerio de Industria, Comercio y Turismo (2009). In the case of biodiesel, exports are calculated from supply and demand balance data in Ballesteros (2005). For imports, there is a paucity of data available, whilst domestic consumption of biodiesel in 2005 is only a minor proportion of Spanish production in 2005 (Ballesteros, 2005). Consequently small non-zero import values are assumed to allow database updating in future periods.

²⁰ Except tariff data which relates to 2004.

²¹ It should be noted that the overall quality of the data in the construction of biofuels sectors are not as refined as in other sectors. This factor should be taken into account when examining the model results.

²² More specifically, denatured and undenatured ethanol (HS6 codes 220710 and 220720 respectively).



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