Revisiting Decoupled Agricultural Policies in CGE frameworks: Theory and Empirics

Emanuele Ferrari
European Commission, JRC-IPTS
emanuele.ferrari@ec.europa.eu

Pierre Boulanger
European Commission, JRC-IPTS
pierre.boulanger@ec.europa.eu

Aida Gonzalez-Mellado
Johann Heinrich von Thünen Institute
aida.gonzalez@ti.bund.de

Scott McDonald
Oxford Brookes University
smcdonald@brookes.ac.uk

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Revisiting Decoupled Agricultural Policies in CGE frameworks: Theory and Empirics

Emanuele Ferrari[a], Pierre Boulanger[a], Aida Gonzalez-Mellado[b], Scott McDonald[c1]

[a] European Commission, JRC-IPTS
[b] Thünen Institute of Market Analysis
[c] Oxford Brookes University

Abstract: The Common Agricultural Policy (CAP) is moving away from coupled payments towards an increasing emphasis on decoupled payments. However current CGE models to study effects of decoupled payments remain limited. This paper introduces the application of a CGE model framework for a comparative analysis of possible effects caused by coupled and decoupled support on agricultural and food sectors in an economy. The CGE model used is the STAGE_AGR which is an extension of the STAGE model containing equations that permit modellers to introduce different system of decoupled payment representation. We have taken as empirical example the case of Ireland for modelling agricultural payments either as fully or partially decoupled.

Keywords: CAP, Decoupling, CGE, Ireland

JEL: C68, Q18

1. Introduction

The development of agricultural policy instruments has a long, and arguably opaque, history. Prior to the latter part of the 19th century agriculture in most countries was, to a large extent, insulated from changes in world prices by large trade and transport costs. Even so, domestic producers were often protected by trade restrictions; for instance in the UK wheat prices were protected by a system of, effectively, variable import levies under the auspices of the Corn Laws[2]. The repeal of the Corn Laws in 1848 introduced a period liberalised agricultural trade in the UK, arguably associated with a change in the political power of landowners relative to the emerging manufacturing sectors and urban population (see McCord, 1958), but it did not immediately cause a fall in domestic agricultural prices. In fact between the mid and late 19th century European agriculture boomed in a period of strongly growing demand before transport

[1] The views expressed are purely those of the author and may not in any circumstances be regarded as stating an official position of the European Commission.

Corresponding author: Pierre Boulanger, European Commission, JRC-IPTS, Edificio Expo, C/ Inca Garcilaso 3, 41092 Seville, Spain. pierre.boulanger@ec.europa.eu.

[2] In this case the 'corn' refers to wheat, not maize.

costs fell very sharply and facilitated a rapid growth of trade and falling world prices - a so-called 'golden age' of European agriculture. For the vast majority of the 20th century, European agriculture has been extensively insulated from world markets primarily through the use of trade barriers.[3] Such trade policies instruments are transparently coupled payments that are supposed to influence directly the prices of agricultural commodities paid by consumers and thereby protect agricultural producers; the economic modelling of coupled policy instruments involves ensuring that the instruments enter into the determination of the prices paid and received by agents and hence into decisions made by agents. Such coupled payments can be analysed by standard applications of price theory, see for instance Josling (1969), Timmer (1986) and Tsakok (1990); hence it is little wonder that these techniques have been used and taught by agricultural economists for 50 or more years.

In the European Union (EU), the 1992 and subsequent reforms of the Common Agricultural Policy (CAP) were manifest as shifts away from price support towards direct payments. In parallel, rural development policies emerged, bringing together a range of targeted structural and environmental measures. The 2003 reforms initiated the progressive and partial decoupling of direct payments; Single Farm Payments (SFPs), which were (intended) to be unrelated to current market prices and production decisions, were introduced. Although the SFP will indirectly distort markets and resource allocation decisions with the extent of the distortions being influence by how the level and distribution SFPs are computed and allocated. This move away from coupled payments towards an increasing emphasis on decoupled payments is intended to continue with the current round, post-2013, of CAP reforms that are driven by the 2014-2020 European budget, the recent European Parliament co-decision on agricultural affairs, and the Doha Round negotiations. As such, EU agricultural policy is intending to replace coupled payments with decoupled payments. Similar shifts in policy emphasis and instruments are taking place in other OECD countries with highly protected and/or supported agricultural sectors.

The shift towards decoupled payments represents a substantial challenge to economic modellers. While coupled payments entered directly into the price formation processes for commodities and determination of input costs, and thereby influenced agents directly, decoupled payments are intended to avoid directly influencing current market prices and production decisions, although they may enter indirectly into the determination of prices and production decisions. An important dimension of these policy changes is their intention to alter the decision making processes by farmers. Consider the stylised case of a hill/upland farmer who can only

[3] The UK is an exception in that 'free' agricultural trade remained the policy and the prior to entry into the EU agricultural support was primarily achieved through deficiency payment schemes.

produce lambs and store cattle[4]. Under a stylised set of pre reform policies, where all support is coupled, the farmer received support through price instruments that influenced/raised the (net) prices of lamb and beef, i.e., the derived demand, and through direct payments based on the numbers of breeding ewes and cows, i.e., the support instruments directly influenced the farmer's decisions about the outputs of lambs and store cattle since the payments were determined directly and indirectly by a farm's commodity outputs. In a stylised post-reform environment, where all support is decoupled, through some form of SFP determined by, for instance, the geographic location and size of the farm, the farmer's decision making processes will be changed. Specifically, the farmer's output decisions should not be influenced directly by the SFP but by the (expected) relative prices of lambs and store cattle and any conditions imposed on farming systems by the SFP, although the farmer's decision to operate the farm, i.e., employ labour, capital and land, will be influenced with the intensity of the operation of the farm determined by potential profit margins.

One response to the increasing range and complexity agricultural support instruments was the development of Consumer and Producer Subsidy Equivalents (CSE and PSE) whereby efforts are made to convert policy interventions, coupled and decoupled, into measures that are 'equivalent' measures of traditional coupled instruments. This approach, and the data so collected, may have virtues and is especially attractive for partial equilibrium models that seek to identify the supply and demand for commodities at the level of an economy but arguably provides a poor representation of the decision making processes of individual farmers. Specifically, in the scenario developed above, the SFP is paid on the basis of the location of the farm and not on the basis of the outputs. If the SFP is converted into an equivalent support for lamb and beef it will impact on the decisions about the production of lamb and store cattle by ALL farmers, which is not the intended mode of operation, while if it is attached as a subsidy to an undifferentiated and potentially 'mobile' factor land it will influence current prices and production decisions directly, i.e., the SFP will be converted into a *de facto* coupled payment.

Decoupled agricultural support instruments therefore represent a challenge to the conventional analyses of agricultural policies as coupled instruments. This is because they operate in a manner that is contrary to the assumption of separability that is embedded in the conventional analyses. To some extent the problem is analogous to the farm management problem of the separation of variable and fixed costs and their allocations to individual products, a separation that is crucial to the conventional analyses of coupled payments; this approach allows the models to define decision-making at the level of the product rather than at the level of

[4] Weaned calves sold onto other farmers for finishing/fattening.

the production unit, i.e., the farm. Consequently it is argued that any economic model that wishes to analyse the implications of decoupled payments must include the products of agriculture, so that prices faced by consumers are determined, and the agents (farmers) who make output decisions based on output prices and costs including any coupled and decoupled payment subject to the constraints imposed on their decisions by the land they farm.

This paper presents a CGE model framework for the analysis of the coupled attribute of policy instruments either to commodity or activity. The model is given empirical content using Ireland as a robustness test. The paper is organised as follows. Section 2 provides a review of the literature the representation in economic models of decoupled payments, limits and implications. Thus section 3 describes STAGE_AGR, a single country CGE model for agricultural policies able to address such issues. Section 4 reports an application with the case of Ireland and section 5 concludes.

2. General equilibrium framework and decoupled instruments

2.1 Introducing decision-making process

Coupled payments can be defined as policy instruments that directly influence output decisions, e.g., variable import levies and deficiency payments, or input decisions, e.g., fertiliser subsidies and accelerated capital allowances, whereas decoupled payments are intended to provide support for farmers and agricultural communities while not directly influencing output or input decisions. In the context of a CGE model this distinction can be defined as requiring that decoupled payments do not enter directly into any of the price definitions or first-order conditions (FOC) in the model whereas coupled payments do so. Thus coupled instruments may include, for instance, variable import levies, which will enter into the FOC for the quantities of imports supplied, fertiliser input subsidies, which impact on the FOC for the effective area of land, deficiency payments, which impact on the FOC for the quantities of products produced domestically, and factor use subsidies attached to land and/or capital, which enter into the FOC determining factor intensities. Hence the orthodox/traditional agricultural and trade policy instruments can be classified as coupled payments.

Contrastingly ‘pure’, i.e., non-conditional, decoupled payments should have non distortive properties similar to lump-sum payments and they should be payments to the activity of farming not to the ownership of land. Thus decoupled payments should enter into the cost structure of the production activity, which means they will impact on the decision of farmers to operate farms. As such they are distinct from lump sum payments to farm households since such payments will *de facto* be determined by the ownership of land not the use of land, unless land ownership and use

are non-separable[5]. If such decoupled payments are made to the farmer then the farmer's decisions over outputs and inputs should be determined by market prices, with the expectation that the decoupled payments would be capitalised into land prices (Ciaian *et al*., 2010). If the decoupled payments include conditions on uses to which land is put, e.g., output or input requirements, then by definition the farmer would be required to operate in a potentially sub-optimal manner and hence the capitalised value of the decoupled payments would be reduced.

Consequently it is argued that CGE modelling of decoupled payments requires the inclusion in the model of all of the key decision-making agents and the constraints under which they operate. Overwhelmingly farms are multi-product activities wherein farmers make decisions of the basis of input and output prices subject to constraints imposed by 'fixed' factors, specifically land and the entrepreneurial abilities of the farmer. Ultimately such decision-making by each farm activity can be distilled down to the mix of outputs produced subject to the constraints imposed by the available land. In contrast a CGE model based on an input-output structure, and accounts based on product definitions, i.e., single product activities, defines the input cost shares (production functions) for each product as averages of the input cost shares across all farm types. The model then allocates the land available to the 'national' farm so as to produce the optimal mix of products determined by market forces, i.e., the model's decision-maker is, implicitly, a central planner. The inclusion of multiple land types in such a model does not alter the nature of decision-making; it simply reduces the substitution possibilities through the inclusion of more constraints – the amounts of different land available. CGE models are thus used to simulate appropriately the implications of coupled and decoupled support instruments for agriculture, and other activities. They should include an appropriate set of decision-making agents together with appropriate specifications of the constraints on their decisions.

2.2 Previous CGE analyses of CAP Instruments

A large proportion of the CGE analyses of the agricultural support measures in OECD countries has been conducted using the GTAP database with derivatives of the GTAP model (Hertel, 1997) and the agricultural support measures included in this database, and much of the other CGE analyses has followed the same procedures[6]. Considerable effort and expertise has been devoted to adapting estimates of domestic agricultural support for inclusion in the GTAP database (see

[5] The majority of farmers may be owner-occupiers in which case it could be argued that payments to farm households represent a reasonable approximation, but at the cost of obscuring the pathways through which household incomes are determined.

[6] One of the major reasons for reviewing these CGE analyses using examples from GTAP is the transparency of the methods used and the quality of the documentation.

Bouet *et al*., 2005; Jensen, 2008), and the difficulties associated with distinguishing between agricultural market support (AMS) and green, amber and blue box support to derive measures of overall trade-distorting domestic support have been recognised (see Jensen *et al*., 2009). This process has drawn upon the Producer Support Estimate (PSE) tables developed by the OECD to derive price wedges that can be incorporated into the database and thence into the model: the results are a series of subsidies attached to the intermediate inputs and to the land and capital used to produce each agricultural commodity. Thus these subsidies enter directly into the FOCs that determine the resource allocation decisions of the central planner who determines outputs and input use.

Previous studies, with global or single-country models, have sought to include decoupled payments in two ways. First, they have been modelled as subsidies to agricultural land, which may be used to produce any agricultural commodity or forestry product (Frandsen *et al*., 2003; Rae and Strutt, 2003; Dixon and Matthews, 2006; Brockmeier and Pelikan, 2008; Novicki *et al*. 2009; Philippidis, 2010), where the subsidy rate to land depends on the commodity it is used to produce. In such a context it is claimed that farm incomes increase and more production factors stay within the agricultural sector thus land abandonment is lower than predicted by Partial Equilibrium models (Novicki *et al*. 2009). The second alternative is to model decoupled payments as (direct) lump-sum transfers from the government to households (e.g., Miller *et al*., 2011 for Ireland), which is argued to produce enhanced incomes to farm households. Unfortunately neither of these approaches can satisfy the definition of decoupled payments as not directly entering into the FOCs determining output or input choices while entering into the decision-making processes of farmers. In the first case, subsidies enter directly the FOC for the allocation of land in production and make the subsidy rate, at least partially, dependent on the output produced, thus decoupled payments are modelled *de facto* as coupled. In the second case, the lump-sum transfer to farm households does not enter into the decision-making processes of the agricultural activity.

A review of modelling the decoupling in the EU in the context of the CAP reform (Balkhasuen *et al*., 2008) compared the likely effects of decoupling from six partial equilibrium (PE) models and two CGE models, i.e. GTAP (Hertel, 1997) and GOAL (Gohin, 2006). The review identified three key elements when implementing decoupled payments in economic models: the importance of (i) including fodder and pasture in the model, (ii) allowing flexibility among livestock feeds, and (iii) modelling the operation of the land market. The review argued that failing to include fodder and pasture in the model meant the model would underspecify the demand for land, e.g., exclude the possibility of more or less land being devoted to pasture as opposed to arable. Similarly if fixed input coefficients are used for animal feeds the possibility of

farmers switching between, for instance, cereal based animal feeds and pasture would be excluded. Finally it was argued that an assumption fixed allocation of land to specific products or inelastic land transformation (CET) functions cannot produce the reductions in agricultural area the authors expected from decoupling CAP payments: Gohin (2006) shows that assumptions on degree of capitalisation of direct payments to land can strongly affect model results[7]. These arguments about the treatment of land seem to derive from the consequences of treating decoupled support as subsidies to agricultural land, a procedure already questioned, whereas the issues with respect to pasture and livestock feeds are clearly relevant since they will be important outcomes of farmer's decisions.

In CGE models land market is endogenous, and the rental price for land adjust against a fixed supply. In GTAP the land demand is inelastic and land is modelled through a Constant Elasticity of Transformation function. In these cases, according to Balkhasuen *et al*. (2008), effects of decoupling are smaller than in model with elastic land supply, but artificially restricting the ability of agents to response to prices so as to allow decoupled payments to be approximated by coupled payments is a questionable modelling strategy.

2.3 Database and Model Implications

The arguments developed above provide a basis for defining the implications for formulating a CGE model that simultaneously facilitates the modelling of coupled and decoupled agricultural policies. Coupled policies can be appropriately modelled using conventional price wedges that enter into price definitions, e.g., import duty price wedges between world and domestic (basic) prices of imports, and domestic commodity taxes (VAT and general sales taxes) between basic and purchaser prices, and/or FOCs, e.g., intermediate (fertilisers) and primary (land) input subsidies. These coupled policies require that the database and model have well-articulated commodity and factor accounts/agents. Similarly the standard domestic institutions – representative household groups (RHGs), incorporated business enterprises[8], government accounts (national and local) and savings/investment accounts – are required; these accounts allow for direct taxes on institutions and lump sum transfers between domestic institutions, e.g., farm households, and transfers to and from the rest of the world, e.g., (net) CAP transfers between the EC and member states.

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[7] Empirical evidence on the level of subsidies capitalization is limited for the EU and not conclusive. Different authors estimated the capitalization rate of coupled subsidies between 20% and 100%, whereas the capitalization rate of decoupled subsidies varies between 20% and 80% (Michalek et al., 2014).

[8] Incorporated business enterprises are institutions that own productive activities (firms, etc.,) and hence are recipients of the profits generated by activities. These institutions pay income/corporation taxes, save (for reinvestment) and pass on the surplus to their owners, i.e., share holders.

The inclusion of decoupled instruments requires the inclusion of the agents, i.e., activities, which are the direct recipients of the payments. In the context of agricultural policies these agents can be defined as representative farm groups (RFG). How these RFG are defined is likely to be context specific: the options include *inter alia* agronomic zone, e.g., classified by altitude, land quality, etc.; principal products[9], e.g., dairy, arable, livestock, etc.; and geographic/administrative zone, e.g., North West Germany, provinces. Whichever set of criteria are adopted the RFGs will inevitably be dominated by multi-product activities, since farms are overwhelmingly multi-product activities, and any aggregation across farms will produce a yet more diverse output mix, and the RFGs will be defined so that the total area of land, either a single or multiple types of land, e.g., arable, pasture, rough grazing, etc., available to each RFG is fixed.

The specific identification of RFG has five important consequences

1. input price wedges are defined with coupled taxes/subsidies;
2. output price wedges are defined with coupled taxes/subsidies;
3. the decision to farm will be directly influenced by the SFPs;
4. constraints on farming practices imposed by SFP will be tied to specific RFGs; and
5. each RFG's output mix decision will be influenced by output prices, which, subject to any SFP imposed constraints, will determine the allocation of the fixed land resource between different outputs.

The major disadvantage is that the cost functions for agricultural activities are underspecified. Specifically, while the output mixes of agricultural activities are responsive to changes in output prices the cost structures are invariant to the output mixes. This is a standard consequence of the use of CET functions (McDonald, 2007) in CGE models where the law of one price holds. To overcome this problem requires the development of cost functions/structures for each product produced by an activity[10], which requires the ability to allocate fixed costs across different products - a well-known difficulty with agricultural activities.

3. STAGE_AGR: A Single Country CGE Model for Agricultural Policies

STAGE (STatic Applied General Equilibrium) (McDonald, 2007 and McDonald et al. 2005) is a single country CGE model descendant of the approach by Dervis et al., (1982) and of the development of models reported by Robinson et al., (1990), Kilkenny (1991) and Devarajan et

[9] Using principal products is open to the standard criticism of using principal products to classify activities.

[10] Except for those products that are by-products produced in fixed proportions.

al., (1994). The model is written with the GAMS (General Algebraic Modeling System) software. The model requires a Social Account Matrix (SAM) as database. The SAM serves to identify the agents in the economy and provides the database to calibrate the model.

The original STAGE model has been modified to take into account the specificity of the agricultural sectors and the main agricultural policies instruments. Specific agricultural policy instruments – commodities tax instruments, activity tax instruments and a direct payment instrument –have been added to the original model. The introduction of these instruments allows modelling the SFP either as fully (support directly paid to agricultural households) or partially decoupled payments (subsidies to activities which influence the process that determines employment and output of the activities), and fully coupled payments (subsidies linked to amount of commodities produced). Thus the modeller can represent any agricultural policy instrument in terms of decoupling, and compare results of policies under different scenarios.

Thanks to its richness and flexibility, the model could be employed (when data are available in the correct format) for detailed policy analysis of different way of distributing SFP in the EU, including flat rate or hybrid allocation of SFP and further enriched with the inclusion of explicit modelling of other instruments as Less Favoured Areas (LFA) support. Nevertheless, in section 4 we will present results not based in any relevant policy simulations for Ireland but a mere modelling exercise to test the robustness of our assumptions.

The main novelty of these instruments is represented by the fact that the ad valorem equivalent tax introduced is endogenously determined. This specification allows keeping the value of the policy intervention exogenously fixed by the policy makers (e.g. CAP budget), while the ad-valorem equivalent varies according to the variation of the output. This mechanism is represented in Equation (1). The ad valorem equivalent instrument (TASUBEQV) is defined as the revenue of the activity a from a range of policy instruments divided by the value of the respective output (PXa * QXa).

$$TASUBEQV_a = \frac{\left((taqsub_a * QX_a) + decup_a + \sum_{land} FD_{land,a} * tl_{land,a}\right)}{(PX_a * QX_a)} \qquad \textbf{(1)}$$

This specification allows modelling decoupled payments as subsidies to activity which, without entering any of the first order condition of farmers' maximisation process, influences the agents' allocation of resources and output mix. In addition, in equation (1) the decoupled transfer to agents can be treated in three different ways: through *taqsub* as a transfer weighted by the activity production level (the bigger the activity a the larger the amount received), through

decoup as a pure lump-sum transfer to activities independent from any other factors or through *tl* (land) as a transfer weighted by the land owned by each activities.

In this paper we break the one to one correspondence between agricultural activities and commodities to allow a better modelling of SFPs agricultural activities are represented by regional agricultural activities. By breaking the typical input-output structure of the SAM, we create regional agents which can take decision on how to allocate other resources and which agricultural commodities they produce. The main feature which characterizes regional agricultural activities is land which at least in the medium-long run is fixed.

The regional agricultural activities are multi-output agents which adapt their output mixes (composed by the agricultural commodities they produce) to price movement and market incentives. The original STAGE model (as many standard single country models, e.g. Lofgren et al. (2002)) allows for a simple modelling of multiple product activities through an assumption of fixed proportions of commodity outputs by activities with commodities differentiated by the activities that produce them (by-product assumptions). In this frame, agents cannot react to market incentives given the hypothesis of fixed shares, and simulations might lead to counterintuitive results. The new version of the model allows substitutability among outputs through the introduction of a CET function for the agricultural activities and for the rest of activities the by-production assumption is retained. This function, once exogenously determined the elasticity of substitution among output, allows multiproduct agents to choose their output mix which maximises their profits on the basis of the commodities' and factors' price changes (Gelan and Schwarz, 2008). Agricultural activities, can adapt their production of agricultural commodities (cattle, pig, sheep, milk, other livestock, cereals and forage) according to the price changes coming from the market. At the same time, we assume that commodities produced in different regions are not perfectly homogenous. To aggregate commodities produced over different regions we employ a CES function which allows imperfect substitutability among commodities as suggested by Balkhasuen et al. (2008).

The labour and capital markets have been segmented between agricultural and non-agricultural uses with a migration function regulating the movement between uses. Average national wage and return of capital are compared with the current wage and return of capital which, together with a given migrant supply elasticity; determine the flow between the different use. Capital has being modelled with the lowest elasticity to underline the difficulty to transform agricultural capital into different uses.

Land is modelled a fix endowment to representative farmers in each region. An alternative closure rules is possible by fixing the land return and let the land "un/employment" to change. In

the first option the land return will absorb the shocks on the land market while in the second one the land supply will be the adjusting variable.

4. Empirics

4.1. A regional agricultural SAM for Ireland 2007

Data have been organized in a regional agricultural SAM for Ireland for 2007 (Ferrari and Boulanger, 2014). The base source used is the Supply- and Use Table (SUT) published by EuroStat. The commodity 'agriculture' has been disaggregated into cattle, sheep, pigs, milk, other livestock products, cereals, forage and other crops. The activity 'agriculture' has been disaggregated following the administrative division of Ireland at Nomenclature of territorial units for statistics (NUTS) 3 into seven activities (Dublin plus Mid-East, Border, Midland, West, Mid-West, South-East and South-West).

The Ireland SAM contains 61 commodities and 60 activities. The regional agricultural data highlight that in the first NUTS2 region (composed by the provinces of Border, Midland and West) more than 90% of agricultural income is represented by net subsidies, while in the second NUTS2 (Dublin plus Mid-East, Mid-West, South-East and South-West) region subsidies account for 60% of agricultural income. In terms of value of agricultural goods output, livestock accounts for approximately 40% of total agricultural output (cattle alone represents more than 26%); milk almost 30% while crops account for the remaining 28% (out of it forage plants represent approximately 16%). From the regional point of view, South-West region produces a third of the total national milk and 20% of total national cattle. A third of total cereals are produced in South-East region while the West region produces more than a quarter of national sheep output.

The SAM has been further extended by disaggregating the agricultural factor markets. The farmed area has been allocated to three different types of land (pasture, crops and rough grazing). Pasture occupies approximately 80% of arable land at national and regional level. At national level, crop land accounts for around 8%, with greater variability among regions (20% in Mid East and South-East, and only 2% in West and Mid-West regions). Finally, rough grazing accounts for 2%. The agricultural labour market has been segmented into four labour types: farm holders, other family workers and two non-family regular workers. The agricultural capital has been segmented from other uses of capital. The national household sector has been disaggregated following the regional NUTS3 classification into seven households.

The final balanced SAM has been estimated with the cross-entropy (CE) methodology (Robinson et al., 2001), staring from the a-priori SAM built with the data reported above. The aggregated values for the 2007 Macro SAM for Ireland are presented in Table 1.

Table 1 – Ireland Macro SAM, million euros, 2007

	Commodities	Margins	Activities	Value added	Households	Enterprises	Government	Savings	RoW	Totals
Commodities		25.0	235.5		90.7		30.6	50.1	153.3	585.2
Margins	25.0									25.0
Activities	402.1									402.1
Value added			166.5							166.5
Households				103.0		4.4	5.2		0.0	112.6
Enterprises				59.8			3.4		-26.3	36.9
Government	22.7		0.1	3.0	16.9	7.1			-2.2	47.6
Investments					5.0	25.4	8.4		11.3	50.1
Rest of the world	135.4			0.7						136.1
Totals	585.2	25.0	402.1	166.5	112.6	36.9	47.6	50.1	136.1	

Source: own elaboration from EUROSTAT

With the 2003 CAP reform, Ireland fully decoupled Irish direct payments under an historical model.[11] This latter model possesses the ability to almost freeze the past distribution of support whereas a regional model shuffles it within a determined territory.

This paper assumes that the distribution of decoupled payments – SFPs – received by each farm in 2007 approximates the distribution of coupled payments received in 2004, one year before the implementation of decoupling in 2005[12]. This assumption is required to integrate in our database the bulk of SFP which are the highest share of domestic support in Ireland. Our analysis considers a support of 1,892.93 million euros which corresponds to about 98 % of all CAP payments in Ireland, of which about two third correspond to SFPs.

4.2. Scenarios

Our research compares different ways of modelling decoupled payments in CGE models. The model is calibrated with the SAM for Ireland 2007, and scenarios are explained below.

In *decoup* scenario, decoupled payments are considered as lump sum transfer to representative farmers in each region. The value of the transfer comes directly from the Irish

[11] When introducing the SFP, Member States had three main options for calculating the value of payment entitlements, either (i) on the basis of the payments received by the individual farmer during a reference period (historical model) resulting in different aid per hectare; (ii) taking all payments received in a region and divide them by the number of eligible hectares (regional model) resulting in a flat rate, or (iii) a mixture between these two models (hybrid model) that can be either static or dynamic (with the latter approximating both elements towards a flatter rate).

[12] Details on the methodology applied to allocate SFP is comprehensively described in Ferrari and Boulanger (2014).

National Accounts and is regarded as lump-sum transfer not linked to any other factor (*decoup* parameter in Equation 1). The total amount of CAP budget is cut by 30% to mimic a reduction in the total amount of payments to farmers (*decoup30* scenario).

In *landsub* scenario, model is recalibrated and decoupled payments are modelled as land subsidies, as described in most of the reviewed CGE literature on coupled and decoupled payments. This recalibration does not affect the model base year. Then the total amount of the CAP budget distributed as land subsidies is cut by 30% (*landsub30* scenario).

In *hh* scenario, we model decoupled payments as lump-sum transfer to households. In this case, in a first step (*hh* scenario) we show the impact of a shift of the support from activities to households and then the effect of a cut by 30% in the given support to the households (*hh30* scenario).

4.3. Primary results

Our results demonstrates that modelling decoupled payments as 'equivalent' coupled payments are likely to produce unreliable results that do not reflect the full implications of policy changes. This arises mainly because the decisions of agents who receive the decoupled payments have not been included within input-output based models.

The discussion of the results concentrates on *decoup* with limited reference to *landsub and hh* scenarios.[13] On the former, this is because the results from modelling decoupled payments as land subsidies confirm that reductions in a transfer payment to land generates marginal shock to agricultural production (*landsub30* scenario). In this case, land price absorbs any policy changes, and decoupled payments here are pure economic rents. Land market representation (i.e. factor mobility) is thus crucial, especially factor mobility. This paper assumes non-factor mobility which drives sharp land price fluctuations. Interestingly, further data refinement would allow differentiating pasture, crops and grazing land and respective price effects.

On the latter (*hh* scenarios), shifting support from activities to households has large impacts for agricultural systems. Indeed modelling decoupled payments as lump-sum transfer to households tends to generate fall in domestic production of any agricultural commodities from 9.7% for cereal up to 21.8% for sheep production. Food production decreases by 17.7% whereas manufacturing and service production increase by about 4% at aggregated level. Returns for all primary factors employed in agricultural production face negative developments. Nevertheless under a cut of agricultural support by 30%, there is no impact on production and factor markets

[13] Full set of results available upon request to the authors.

(*hh30* scenario) that tends to demonstrate that payments are fully decoupled when there are modelled as lump-sum transfer to households.

In the case of *decoup* scenario, reducing decoupled payments induces drops in primary agricultural and food production. Domestic production of agricultural and food commodities decrease by 4.6% and 4.4% respectively; whereas manufacturing and industries production increase by 0.9% and 1.1%. Focusing on NUTS3 regions, we observe highest falls in agricultural production once the support is reduced for regions which receive more support in relative terms. The West province, whose level of support is the highest one, representing 47% of production, experiences a decrease of 9.5% of its agricultural production.

Changes in price mirror changes in production with an increase in agri-food prices and decrease in the rest of the economy. Return for all primary factors employed in agricultural production will face negative changes. The drop in production of agricultural and food products causes a decrease in the demand of production factors and a shift from agricultural use towards other uses. Percentage change of farm holder wage is higher than any other type of labor due to the different migration elasticities assumed for different type of workers. Only non-agricultural capital will experience a positive development following reallocation of resources from agricultural and food sectors towards the rest of the economy.[14] Results can be subdivided by NUTS3 region being then derived from public support commodity and regional specialization.

By construction of the model, agricultural support causes a market distortion, so any cut in these payments are in general GDP and welfare enhancing. *Decoup30* scenario generates an increase in welfare to all households, where the region which receives less support is the one that benefits the most. Regions with small share of agriculture in their GDP absorb resources from more intensive agricultural ones and benefit the most from a cut in support. Nevertheless, the other regions experience an increase in welfare despite the increase of agricultural and food prices, drop of other commodities price enhance the welfare of all regions. Results are magnified under *hh30* scenario where the distortive support is completely dropped in favour of a non-distortive lump sum to households. The same trends are observed for GDP results.

5. Concluding Remarks

The post 2013 CAP has to be adapted to address a range of challenges faced by the European Union and worldwide. One key issue that characterizes the CAP reform post 2013 is a new

[14] Farm holders have the lowest migration elasticities followed by family labour and regular paid workers. Elasticities on capital, due to typical fix assumption of installed capital, are even lower. Sensitivity analysis on migration elasticities change impacts on labour wages but does not affect other results, confirming robustness of the model (full results available upon request).

rationale for – and distribution of – decoupled direct payments. Therefore, this paper proposes a flexible technique to allocate decoupled payments either to land, households, commodities or activities.

To the best of our knowledge, several studies have covered the effects of coupled vs. decoupled payments but mainly using partial equilibrium models. However, changes undergone in the agricultural sector will have impacts on the macro economy and in non-agricultural sectors. We therefore employ a CGE model to assess these effects. With the required modifications of the STAGE model, we take into account the specificity of the agricultural sectors and the main agricultural policies instruments. Thus it allows modelling SFP either as fully (support directly paid to agricultural households or as subsidies to land) or partially decoupled payments (subsidies to activities which influence the process that determines employment and output of the activities).

The empirical part of the analysis compares the impacts of cuts in the CAP budget under different specifications. When decoupled payments are associated to land subsidies, cut in CAP budget has no effects in terms of production or other macroeconomic aggregates. The only effect of this simulation is a drop in the return of land, indicating that in this modelling specification SFP payments are fully capitalised into land. At the same time, when SFPs are modelled as transfer to households, a budget cut has no effects on agricultural and macroeconomic indicators. Nevertheless, to model SFPs as households' transfers, agricultural support has to be shifted from activities, where is generally recorded by national accounts, to households. This shift causes a significant drop in agricultural and food industry production. At the same time, by construction of the model, macroeconomic indicators are positively affected by the shift of the support from activities (distortive support) to lump-sum to households (non-distortive support). Finally, modelling the support as payments to activities shows that they still have a distortive effect. Thus, a CAP budget cut has negative impacts on agricultural production and food, mainly depending on the initial allocation of the support.

Thanks to its richness and flexibility, our approach could be employed for detailed policy analysis on the different effects of SFP distribution in the EU, including flat rate or hybrid allocation of SFP. More specific results can be obtained with the inclusion of the type of land (differentiation between pasture, crops and grazing lands) or specific policy instruments such as support to less favoured or natural handicapped areas, making our approach a suitable methodology for all EU Member States.

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