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Does the "green box" of the European Union distort global markets?

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Abstract. The vast majority of domestic support to farmers in the European Union (EU) is notified in the World Trade Organisation (WTO) green box as decoupled payments. The EU considers this support to minimally distort production and/or trade. As demonstrated in the literature, this claim is questionable. This paper aims at analyzing this claim using a global, spatially differentiated, partial equilibrium simulation model with endogenous land supply functions. Comparing a complete elimination of the EU green box measures with a baseline scenario, the model results indicate only small distortionary effects in production and trade. Hence, EU support notified to the green box seems to be compatible with the general requirements of the green box. The finding seems to result from the assumption of unchanged EU border policies.

Keywords. Modeling, agricultural policies, domestic support, green box, trade liberalization, WTO.

JEL codes. F13, Q11, Q17, Q18

1. Introduction

A major achievement of the Uruguay Round Agreement on agriculture (URAA) was the establishment of common rules for international agricultural trade and the establishment of quantitative constraints for domestic support measures to agriculture (Josling and Tangermann, 1999), which were placed into three 'boxes' according to their distortionary effect. However, the extent to which notified support measures do in fact comply with the specific criteria set out for the three boxes remains unclear. That question is especially relevant for the European Union (EU) which by now shields the overwhelming part of its domestic support from reduction commitments by notifying it under the so-called "green box". The Single Farm Payment (SFP) of the EU alone amounts to about 40 bio € per year and pays to farmers, on average, close to 300 € per hectare of farmed land (European Commission, 2011: Figure 8). Can such expensive support measures really only minimally distort trade and/or production as required to satisfy the green box requirements? There is both a legal and an economic approach to this question. The

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legal approach would carry out an assessment of whether the measure in question complies with the policy-specific criteria set out in the URAA. Albeit Swinbank and Tranter (2005) raise doubts as to whether the SFP complies with the requirements for the green box; we will not consider legal questions in the following. There are so far no comparable cases in the dispute settlement mechanism of the World Trade Organization (WTO) which would provide information beyond the arguments of Swinbank and Tranter (2005) whether the EU's green box payments, including the SFP, meet the criteria for notification in the green box (Rude 2001).

Focusing on economic issues, theoretic approaches such as Dewbre *et al.* (2001) or Viaggi *et al.* (2011) highlight possible pathways regarding how fully decoupled payments, which are not linked to current production, still might impact allocation decisions. This can happen if decoupled payments affect risk attitude, reduce the costs to finance investments, or if farmers expect updates of entitlements to decoupled payments depending on their current production program. In all cases, the theory suggests higher production levels and thus a potential impact on trade. Quantitative approaches focus either on the trade implications of potential decoupling scenarios of EU direct payments (e.g. Banse et al., 2008; Boulanger *et al.*, 2010; Brockmeier *et al.*, 2008; Anderson *et al.*, 2010) or on EU domestic production effects (Bhaskar and Beghin, 2009; Schokai and Moro, 2009; Balkhausen *et al.*, 2008; Rude, 2008; Gohin, 2006). Where simulation models are used, usually little production – and thus trade – and welfare effects are found. However, the pathways described by Dewbre *et al.* (2001) are often not considered in these studies, as producers are assumed to be risk neutral, and neither changes in costs for finance nor expectations about future policy changes are considered. Econometric studies which estimate impacts of decoupled payments on production should implicitly capture also effects not covered in simulation models; their findings generally also suggest limited allocative effects. That holds also for the so-called "wealth" effect. This effect regards the asset structure of farm households and how these assets, including land, are affected by the re-design of agricultural policies (Femenia *et al.*, 2010).

The objective of this paper is to analyze the global trade, EU trade and welfare impacts that may result from the abolishment of the EU green box measures. To accomplish this objective, we use the detailed, spatially differentiated, partial equilibrium, multi-commodity model CAPRI[2] that is, due to its endogenous modeling of input markets (such as land) and comprehensive coverage of policy instruments, uniquely suited to analyze this kind of question.

We first link the policy instruments specified in the model (such as the SFP, remaining coupled payments, agri-environmental payments or Less Favoured Area (LFA) support payments) to the detailed categories of the WTO-notification boxes to develop indicators that reflect the official notification of EU domestic support. Thereafter, we implement a scenario in which all green box measures are abolished.

Our research adds to the existing literature by accounting for potential production and trade effects that may result from EU green box support in a modeling framework that considers both in detail EU green box support including pillar II measures and the

[2] Common Agricultural Policy Regionalised Impact Model. Further information can be found in Britz and Witzke (2011) and under: www.capri-model.org.

global integration of EU agricultural markets. This allows for a realistic and up-to-date assessment of the trade impact of the EU green box policies considering the multiple distortionary policy effects present in current markets.

We specifically focus on interactions between EU green box payments and the land market. Here, Kilian and Salhofer (2008) and Kilian *et al.* (2012) show in their theoretical and empirical analysis that the SFP capitalizes on land values over time. We thus explicitly consider that fact by allowing for an endogenous land supply, while modeling the interplay between land farmed and premium entitlements. However, due to the nature of our simulation model, we neglect the pathways described by Dewbre *et al.* (2001).

The paper proceeds as follows. The next section elaborates on the topic of trade distortion and green box payments, while section 3 provides an exposition of the CAPRI model, and section 4 presents an overview on the scenario implementation. Section 5 contains the modelling results followed by a discussion and conclusion in the last section.

2. Market distortions and the WTO green box

The URAA classifies domestic agricultural policies into three categories that differ according to the extent to which they distort production and/or trade. Trade-distorting policies are notified in the amber box (or Aggregate Measurement of Support – AMS), for which spending limits apply, while trade-distorting policies that underlie production-limiting programmes are grouped in the blue box. These two boxes thus are sector specific exemptions from the general WTO "Agreement on Subsidies and Countervailing Measures" (SCM) rules, introduced to prevent the failure of the Uruguay Round and thought of as an intermediate step towards trade liberalization. Indeed, the so-called "peace clause" did not allow to open dispute settlement cases against notified measures under the boxes until 2004. Policies are placed in the green box, and thus thought to comply with general WTO rules, if they "meet the fundamental requirement that they have no, or at most minimal, trade-distorting effects or effects on production" (WTO 1994: 59). The green box is further divided into twelve categories for which policy-specific criteria apply. For seven of the twelve categories, the policy-specific criteria requires that (a) the amount of the payment may not be related to, or based on, the type or volume of production and/or that (b) no production shall be required in order to receive such payments.[3] Although these categories, with their policy-specific criteria, may simplify the assessment as to whether a given policy instrument meets the overall green box requirements, they provide little help to evaluate the abovementioned fundamental requirement. One reason might be that the economic concept of market distortions is seemingly intuitive, while its practical applicability is less straightforward. As we only analyze changes in the EU green box in the following, we keep all other policies unchanged.[4]

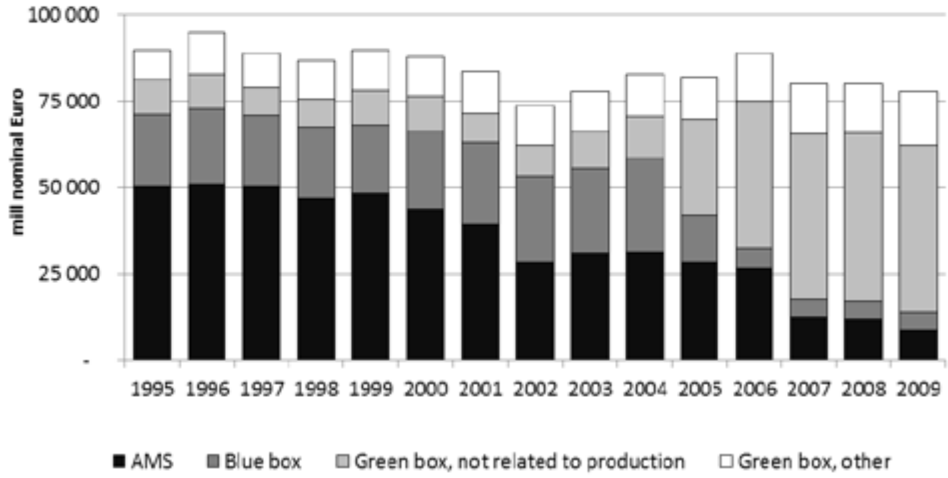
[3] See Agreement on Agriculture. Part of Annex 1A «Multilateral Agreements on Trade in Goods» of the Agreement Establishing the World Trade Organization. Marrakesh Declaration of 15 April. Marrakesh. The seven categories are: decoupled income support, income insurance and income safety-net programmes, natural disaster relief, structural adjustment assistance through resource retirement, structural adjustment through investment aid, regional assistance programmes, and other direct payments.

[4] Concerning empirical studies, and especially when agricultural sector models are involved, the non-intervention situation required to assess the size of market distortions might have the character of a structural break for

The basic green box requirement has so far been at stake in only one WTO dispute settlement case (WTO, 2004), relating to US support to cotton. After the end of the peace clause, six new dispute settlement cases regarding agricultural products and policies have been filed to the WTO since January 2004, compared to nineteen cases in the period between 1996 and 2003. However, none of the new cases address green box measures.

Figure 1 shows the development of the three types of support for the EU between 1995 and 2008 where the green box is split between the seven categories that must not be related to production and the remaining five categories which encompass, for example, agri-environmental measures.

Figure 1. Support to agricultural producers in the European Union as measured by the WTO by type of support, 1995-2009 (mill Euro).



Source: Authors' calculations based on WTO (var.).

The numbers clearly show that the EU has continuously reduced its trade-distorting domestic support since the WTO-agreement came into place in 1995. As an effect of the 2003 CAP-reform to decouple direct payments, domestic support has been shifted almost completely from the blue box to the green box. It is now mainly channelled through green box categories for which the relevant policy-specific criteria state that neither the payment amount nor the payment eligibility must be related to production. The green box share of total support from the EU has increased further since 2009 as most remaining coupled support regimes are integrated in the SFP. At the same time, EU countries gain some flexibility as part of the CAP 2013-reform to introduce national coupled payment programs financed under the CAP. Member states have not yet come forward with detailed program

which the model's parameters are not longer valid (Lucas, 1976). We therefore refrain from simulating in here also a fully liberalization scenario where also EU border protection for agricultural products is removed.

implementation measures. In any case, these programs are still restricted and could fall at least partially under *de-minimis*, i.e. agreed upon thresholds under the SCM up to which subsidies are allowed. Recently, the EU has declared that it will no longer provide export subsidies. Formally, the EU has still considerable amber box support based on guaranteed market prices (or administrative prices). The resulting AMS is measured using world market prices from the mid-eighties. Any possible new agreement would update these prices; at least at current price levels, the AMS would basically altogether vanish. That leaves indeed only the green box payments as WTO relevant support and motivates the focus of our analysis.

3. Overview on CAPRI modeling system and modeling of SFP

3.1 Overview

The CAPRI model (Britz and Witzke, 2011) is a global comparative-static deterministic partial equilibrium model with a strong focus on Europe, consisting of a detailed supply module for selected countries and a global market module in which the detailed supply module is integrated. The supply module, covering only the EU, Norway, Turkey and Western Balkans, comprises independent aggregate non-linear farm programming models covering approximately 50 crop and animal activities at either regional (NUTS 2[5]) or farm type level. Each non-linear programming model maximises regional or farm type agricultural income with explicit consideration of the CAP instruments of support at given prices, subject to technical constraints for feeding, young animal trade, fertilization, set-aside, a land supply curve and production quotas. The farm type level (Gocht and Britz, 2011) provides for the whole EU a consistent disaggregation from the regional level to about 1850 farm type models differentiated by farm specialization and economic size. Prices for agricultural outputs are endogenous based on a sequential calibration (Britz, 2008) between the supply models and the global market model. The latter is a global spatial multi-commodity model covering 77 countries or country aggregates in 40 trade blocks and about 50 products.[6] The Armington approach (Armington, 1969), assuming that the products are differentiated by origin, allows simulating bilateral trade flows and related bilateral, as well as multilateral, trade instruments, including tariff-rate quotas. CAPRI has been intensively used for the assessment of the different Common Agricultural Policy (CAP) reforms (see e.g. Britz *et al.* 2012; OECD, 2011), but also to address trade policy questions: Piketty *et al.* (2009) and Burrell *et al.* (2011) have used CAPRI for the assessment of bi-lateral trade liberalization between EU and Mercosur countries, whereas Renwick *et al.* (2013) used CAPRI in conjunction with a land use model to investigate the removal of Pillar I and a possible WTO compromise with a focus on land abandonment.

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[5] The "Nomenclature d'Unités Territoriales Statistiques" (NUTS) refers to spatial administrative units in the EU context where the layers of NUTS 1, NUTS 2, and NUTS 3 are usually distinguished with NUTS 1 referring to the highest administrative level below state level.

[6] Raw commodities in the supply model correspond roughly to the products of the market model. For the dairy sector and the oil seed sector, however, there is processing of raw commodities into products for final demand.

3.2 Policy instruments and WTO policy indicators

For the EU, the programming models cover in rich detail the different coupled and decoupled subsidies of the first pillar (Pillar 1) of the CAP, as well as major ones from Pillar 2 (i.e., LFA support, agri-environmental measures, Natura 2000 support). The interaction between payment entitlements and eligible hectares for the SFP (including the single area payment schemes – SAPs) as well as the different SFP implementation rules at member state level are considered explicitly in the model and explained in detail in the next two sections. Decoupled payments are thus simulated in CAPRI relatively closely to their definition in existing legislation.

The remaining payments like possibly coupled payments for suckler cows, sheep and goats, as well as national "specific support programs" under article 68 of Council Regulation (EC) No. 73/2009 are also implemented closely to their specific eligibility rules, and accordingly allocated to different production activities.

The rather high disaggregation regarding production activities of the regional farm model template and the resolution by farm types inside of NUTS 2 regions clearly provides an implementation advantage. Currently, more than 30 coupled payment schemes are differentiated, in addition to decoupled income support (SFP). The schemes cover almost all payments within the first pillar of the CAP.[7] As mentioned in the previous paragraph, important payments of the second pillar of the CAP are covered as well.

Each premium scheme is defined by four attributes: (1) the groups of production activities covered; (2) payment rates for each group of activities; (3) the way the premium is implemented (per ha, per head, per slaughtered head or per main output coefficient); and (4) possible ceilings in values and/or physical limits, such as the maximum number of hectares or heads eligible. The numerical attributes of the premiums can be differentiated in a hierarchical manner from EU over Member States, and sub-regional EU differentiation (NUTS 1, NUTS 2), and finally to farm types in NUTS 2 regions, and are typically stored as a time series. During models runs, payments are endogenously updated subject to national value ceilings so as to ensure that they do not violate those ceilings. This is done by first calculating the amount of payments based on eligible acreage/animals and actual payment rates. This amount is compared to the national ceiling. If the national ceiling is overshot, payment rates are reduced using a flat percentage reduction rate. The regional programming models are then solved again to adjust the amount of eligible acreage/animals. This procedure is repeated until the national ceilings are no longer violated.

The market model endogenously captures market interventions and subsidized exports as a function of market and administrative prices as well as support to consumers and processors, respectively. Border protection is based on specific and ad-valorem tariffs which can be defined bi-laterally. Tariffs and per unit quota rents under bi-lateral and multi-lateral Tariff Rate Quotas (TRQs) are explicitly modelled. These tariffs are endogenous in the model as

[7] Premiums to arable land ("Grandes Cultures"), durum wheat premiums in traditional regions, durum wheat premiums in established regions, rice premiums, premiums to pulses, premiums to energy crops, silage premiums in Sweden and Finland, suckler cow premiums, direct premiums to dairy cows, extensification premiums to bulls, steers and suckler cows, payments to sheep and goats, and supplementary payments to sheep and goats, to olives, to fruits and vegetables, to the wine sector, to tobacco, to cotton, to starch potatoes; different type of Nordic aid premiums in Northern Sweden and Finland as well as complementary national premiums in the new Member States during the transition period.

they can change dependent on minimum import price regulations. Care is given to capture the different trade preferences with respect to tariff reduction and TRQs granted by the EU under the Everything-but-Arms agreement and other preferential trade agreements.

CAPRI contains information regarding the EU's domestic support notifications to the WTO and calculates endogenously whether some elements of product-specific AMS qualify for the de-minimis rule. If this is the case, that AMS is taken out of current total AMS. Besides AMS, CAPRI calculates blue box and green box support. In addition, overall trade-distorting support (OTDS) consisting of AMS, de-minimis support and blue box support is calculated.

Based on a comparison of those policies included in CAPRI and those notified to the WTO, we expect that CAPRI mirrors all blue box payments and the majority of total green box payments. Based on value, almost all payments in CAPRI belong to the green box. The two most important blue box payments are coupled payments to suckler cows and cereals, the latter related to national programs. What is missing in CAPRI are very specific payments such as natural disaster payments and more general payments such as general services, public stockholding, structural adjustment and Member States' specific programs such as gas rebates. We also expect CAPRI to correctly reflect the market price support component of AMS, and de-minimis support.

3.2 Micro-economic analysis of the Single Farm Payment

Consider the following optimization problem:

$$\begin{aligned} \max_{x,z} \; & \Pi = p'y - w'x + s'Z \\ s.t. \quad & y = f(x,z) \\ & z \le Z \quad [\lambda] \end{aligned} \tag{1}$$

where y and x are vectors of marketable outputs and inputs with prices p and w while z are non-marketable inputs with given farm endowment Z, with attached per unit subsidies s, and f is a general multi-input multi-output production function. The First Order Condition (FOC) of the above problem reveals that the marginal value of the product must be equal to per unit costs, which are either equal to the market price w or the opportunity costs λ minus the subsidy s:

$$p'\frac{\partial f}{\partial x} - w = 0 \tag{2}$$

$$p'\frac{\partial f}{\partial z} - \lambda + s = 0 \tag{3}$$

Given the fact the SFP covers by now all crops and is also paid to idling land, the SFP may be appropriately considered to be a uniform premium s as in the model above. As the subsidy rates are not entering the FOC for the marketable inputs (2), they will not change optimal input use and output quantities; therefore, they will have no allocative effects. For the case of land, equation (3) states that the return to land for each crop including the SFP must be equal. Accordingly, an absolute change in *s* will provoke the same absolute change in the opportunity cost λ.

Next, we extend the model in (1) to a utility maximization problem (see (4)) for the farmer (e.g., accounting for risk, preferences for certain output or input mixes). As long as the first derivative towards any of the variables *p*, *y*, *w*, *x* in the model above does not depend on the per unit subsidy, i.e. if the subsidy sum enters as a separate additive term in the utility function as in (4), we arrive at the same basic finding, i.e. the subsidy will only change the opportunity costs of the fixed endowments:

$$\begin{aligned} \max_{x,z} \; & U = g(p,y,w,x,z) + s'z \\ s.t. \;\; & y = f(x,z) \\ & z \leq Z \quad [\lambda] \end{aligned} \tag{4}$$

The discussion around possible production effects of such per unit subsidies thus relates to extensions of the decision problem in (4) through the inclusion of premium *s* into the utility function *g*. As Dewbre *et al.* (2001) points out, there are several such extensions. If *U* is related to income and risk, the farmer's attitude towards risk might depend on its income, such that there is no additive relation as in (4) since *s* is an argument of *g(.)*. Equally, the prices paid by farmers, e.g., interest on credits, might depend on their income or on their asset value which might depend on λ, and thus indirectly on *s*. And finally, an endowment such as land in the case of the SFP might not be considered fixed. The subsidy *s* would be attached to *x* in that case, and then clearly provoke an allocative effect.

However, in the case of the SFP, even considering land as a marketable input would not change the picture from (4) for increases of *s* as the subsidy is upper-bounded by the number of entitlements. Hence, at an optimal program where the entitlements are binding, an increase in *s* cannot change the optimal allocation. In the following, we will use the deterministic model CAPRI where land is considered a marketable input while explicitly considering premium entitlements which are assumed to be non-tradable across NUTS2 regions.

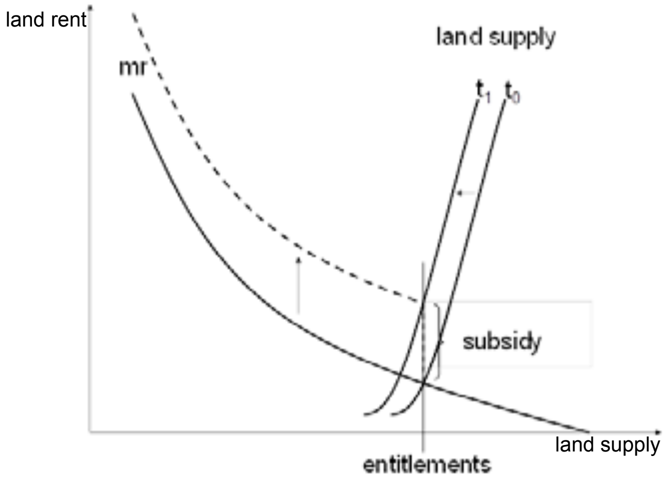
3.4 Modelling land supply and total agricultural land use

The CAPRI model comprises land supply and transformation functions at the regional level and for different farm types within a region which allows for the endogenous supply of arable land and grassland in response to a change in marginal land rents. The behavioural functions for land supply were parameterised based on the results of van Meijl *et al.* (2006) and Golub *et al.* (2006). In addition, some adjustments based on Geographical Information System (GIS) analyses and simulation experiments using the Dyna-CLUE[8] model, were necessary in order to capture the regional resolution of CAPRI. The

[8] A dynamic version of the 'Conversion of Land Use and its Effects' model. Further information can be found in Verburg *et al.*, (2010).

core of the farm programming model reaction when CAP support is reduced, results from the interaction between the land supply function and subsidies to land (the SFP and the support to LFA under Pillar 2) which together account by far for the largest share of CAP spending.

Figure 2. Effects of the SFP on land markets



Source: Britz *et al.* (2012).

To obtain the full SFP, a farmer must not only possess one hectare of land in good agricultural and environmental condition but must also have a (tradable) payment right (the following description is cited from Britz *et al.*, 2012). Figure 2 depicts the impact on the land rent, and it helps illustrate the reactions to changes in the SFP. For simplicity, we did not graphically capture changes in other CAP support. In the absence of the SFP, the amount of land under agricultural cultivation is determined by the intersection of the marginal returns in agriculture to land (*mr)* and the land supply from other sectors (t_0 in figure 2). The SFP, as a subsidy to land use in agriculture, shifts the *mr* curve upward according to the size of the subsidy. Without further restrictions, agricultural land use would be expanded to a new intersection between the two curves. Because of the introduction of the entitlements, such an expansion does not occur, as the old and the new *mr* curves are identical beyond the entitlement point, where the subsidy cannot be claimed. Accordingly, immediately after its introduction, the subsidy is capitalised into the payment rights. However, each year some agricultural land is lost to non-agricultural uses such as building, infrastructure, recreation and other needs for society. According to Eurostat (2012), the share of agricultural land converted to non-agricultural uses (soil sealing) has been 0.2% p.a. in 38 European countries between 2000 and 2006. Therefore, the land supply curve shifts to the left over time. Depending on the slope of the land supply curve and the speed and size of the shift, the economic rent linked to the SFP will be partially re-distributed from the entitlements to land. Once the new intersection between the *mr* and the land supply curves is to the left of the original entitlements, at that point (t_1), the subsidy will be fully capitalised in the land rent.

Because the land supply curves are rather steep in many countries and due to a continuous decline in agricultural land as observed in almost all EU member states, as we assume in our 2020 baseline (i.e., more than fifteen years after the introduction of the policy reform called "Mid Term Review), the capitalisation only occurs on land and not on payment rights. This interpretation follows a theoretical (Kilian and Salhofer 2008) and empirical analysis carried out by Kilian *et al.* (2012) and is further supported by the present legislative text (European Commission, no year), which states that entitlements that are not claimed for two consecutive years, will be withdrawn. Femenia *et al.* (2010) argue that there may be large wealth effects for farmers generated from the capitalization of farm subsidies in land prices if farmers are also the owners of the land.

4. Baseline and counterfactual scenario

While the model is calibrated to the base year 2004, a reference run or baseline is composed for the year 2020. The baseline captures developments in exogenous variables. These include policy changes foreseen in current legislation, population growth, GDP growth and agricultural market development for the year 2020 (Table 1). It relies on a combination of three information sources (for a detailed description see Britz and Witzke, 2011): (1) most importantly, the Aglink-COSIMO baseline, (2) analysis of historical trends and (3) expert information (Blanco Fonseca *et al.*, 2010).

Table 1. Exogenous drivers considered for the baseline construction.

Exogenous drivers	Value
Inflation	1.9% per annum
Growth of GDP per capita	2.0% nominal per annum for the EU, 10.5% for India, 1.5% for USA, 4% for Russia, 1.5% for Least Developed Countries and ACPs, and 1% for rest of the world
Demographic changes	EUROSTAT projections for Europe and UN projections for the rest of the world
Technical progress	0.5% input savings per annum (affecting exogenous yield trends), with the exemption of N, P, K needs for crops where technical progress is trend forecasted
Domestic policy	National decisions on coupling options and premium models, with their expected implementation date for the 25 EU member states (25 different premium schemes, compliation by Massot Martí, 2005)
Common Market Organizations	Supply and demand shifted according to the expert forecasts (European Commission, 2005)
Trade policy	Final implementation of the 1994 Uruguay Round Agreement plus some further regional trade agreements, such as NAFTA
World markets	Supply and demand forecasts (FAO, 2005)

Source: Own compilation.

The share of green box payments covered by CAPRI in the 2020 baseline is considerably higher compared to the 2004 base year as the national envelopes now include several policy instruments that were either not in place or accounted for differently in 2004. In 2020, the national envelopes include: the SFP, the remaining coupled payments and national support under Article 68. Equally, the ex-ante data base covers a major part of Pillar 2 spending, such as agri-environmental schemes, Less Favoured Area (LFA) supports, and Natura 2000 payments.

The counterfactual scenario is composed of all elements of the baseline in addition to a complete removal of all EU agricultural support notified in the WTO green box and captured by CAPRI. The construction of the scenario hence allows us to study how production and trade are influenced by the EU green box support. It is important to keep in mind, however, that all other policy instruments, in particular market access, remain unchanged. That is, we evaluate the potentially trade-distorting effects of the EU green box support in the presence of all other EU policy instruments.

5. Model results

This section presents the most important results of the counterfactual scenario. The main finding is a small overall change in production volumes indicating some coherence between the classification of the EU green box support and the support's production-distorting impact.

Compared to the baseline, the elimination of total green box support in CAPRI leads to a less than 4 per cent reduction in the net production of major commodities such as cereals, oil seeds, meat, eggs and dairy products (table 2). Similarly, there are even smaller changes in the demand volumes of these commodities. The changes in traded volumes are also limited, although the percentage changes may be quite high as the absolute volumes are low. Imports increase across all commodities, while exports show a decrease. For instance, there is a 19 per cent increase in EU cereals imports, while EU exports decrease by 14 per cent. The percentage changes are even more pronounced for products based on feed-concentrates like pork and egg, while they are smaller for products based on rough-fodder such as beef and dairy. Therefore, if measured in percentage changes, the trade-distorting impact of the EU green box support seems to be greater than its production-distorting effect.

Total demand in the EU decreases with increasing market prices. Since the decrease in production is higher than the reduction in demand and lower exports does not offset the increased gap between demand and production, imports increase. However, the still limited increase in imports in absolute terms might be caused by the fact that border protection for major products is still rather high and tainted by instruments which prevent a rapid reaction of imports to changes in EU prices such as TRQs and flexible levies linked to minimum border prices.

Some relative trade effects appear quite high, because the absolute numbers are small. Generally, Table 3 reveals that trade effects seem to be larger than production effects, and the relative effects are quite significant for most sectors except dairy. A closer look at the import flows reveals that, in general, imports to the EU grow mostly from regions with significant exports to the EU in the baseline. This result is straightforward, as the relative

Table 2. Market balance for the EU in 2020 by type of scenario (1000 tons, percentage change compared to baseline in italics).

	Baseline				Elimination of green box			
	Prod. [a]	Imp. [b]	Exp. [b]	Dem. [c]	Prod. [a]	Imp. [b]	Exp. [b]	Dem. [c]
Cereals	306 662	10 912	30 602	286 972	301 539	12 987	26 274	288 252
					-1.7	*19.0*	*-14.1*	*0.4*
Oilseeds	32 364	18 562	1 073	49 853	31 359	19 352	966	49 745
					-3.1	*4.3*	*-10.0*	*-0.2*
Meat	44 903	690	2 696	42 897	44 134	757	2 262	42 629
					-1.7	*9.7*	*-16.1*	*-0.6*
- beef	7 772	217	411	7 578	7 709	219	372	7 556
					-0.8	*0.9*	*-9.5*	*-0.3*
- pork	23 420	20	1 801	21 639	23 018	26	1 528	21 516
					-1.7	*30.0*	*-15.2*	*-0.6*
Eggs	7 187	15	299	6 903	7 075	21	242	6 854
					-1.6	*40.0*	-19.1	-0.7
Dairy products	70 985	243	2 892	68 336	70 547	249	2 827	67 969
					-0.6	*2.5*	*-2.2*	*-0.5*
- milk powder	865	5	76	794	853	5	73	785
					-1.4	*12.3*	*-3.9*	*-1.1*
- cheese	10 278	30	565	9 743	10 188	31	553	9 666
					-0.9	*3.3*	*-2.1*	*-0.8*
Oils	18 542	5 341	6 743	17 140	18 333	5 390	6 604	17 119
					-1.1	*0.9*	*-2.1*	*-0.1*
Sugar	15 548	6 387	1 373	20 562	15 504	6 482	1 348	20 638
					-0.3	*1.5*	*-1.8*	*0.4*

Notes: [a] Net production, [b] Excluding intra-EU trade, [c] Demand composed of human consumption, processing, feed use, and change in intervention stocks.
Source: CAPRI Modelling System.

competitiveness between the world regions are unchanged in the counterfactual scenario, and is also caused by the Armington Assumption on the imperfect substitution of imported goods from different destinations. One exception is sugar, where Africa, the largest exporter to the EU covering more than 50 percent of total exports in the EU, enjoys a smaller increase (1.2 per cent) than its trade competitors in Australia and New Zealand (3.6 per cent) Middle and South America (3.3 per cent). A reason for this might be the EU trade policy for sugar with tariff rate quotas and bilateral trade arrangements.

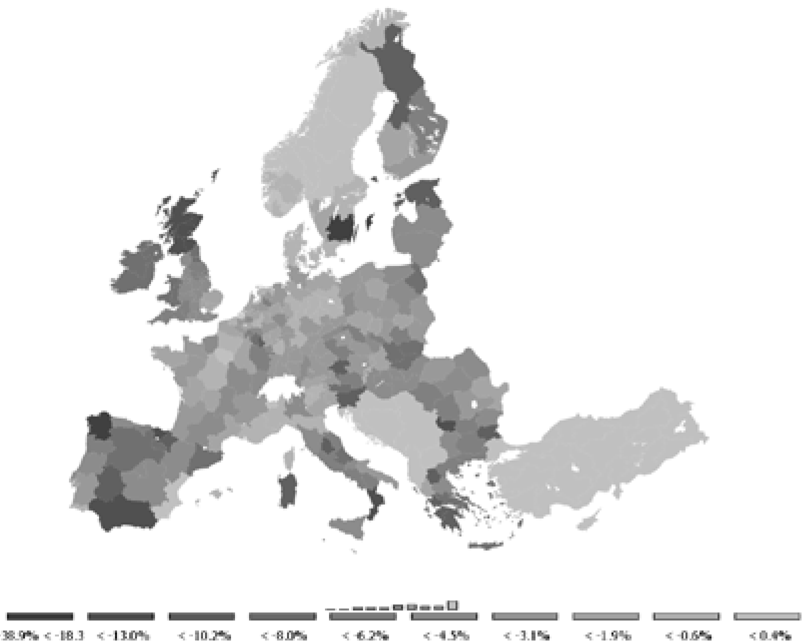
The removal of the EU green box leads to ambiguous land use change across the regions in Europe (Figure 3). Dark red coloured regions experience the largest reduction in land use (41.2 per cent compared to the baseline), while dark green coloured regions are characterized by virtually no change or even a slight increase. The reduction of agricultural land in most regions in the EU is less than 5 per cent. Broadly speaking, regions at the boundary of the EU experience a larger reduction in land use than regions in the middle of the EU.

Table 3. Imports to the EU in 2020 by geographic region [a] and type of scenario (1 000 tons, percentage change compared to baseline in italics).

	Non-EU Europe [a]		Africa		North America [b]		Middle and South America		Asia		Australia and New Zealand	
Baseline												
Cereals	3 539		2		5 415		1 917		10		35	
Meat	45		9		20		373		19		231	
Dairy products	106				47		6		24		77	
Sugar	372		3 765				999		1 233		19	
Elimination of green box												
Cereals	4 571	*29.2*	3	*12.7*	6 105	*12.8*	2 258	*17.8*	12	*19.4*	44	*27.9*
Meat	50	*10.7*	10	*18.5*	30	*44.9*	421	*12.7*	23	*18.4*	232	*0.3*
Dairy products	110	*4.4*			49	*2.8*	6	*-2.2*	25	*1.8*	77	*0.7*
Sugar	382	*2.6*	3 810	*1.2*			1 032	*3.3*	1 238	*0.5*	19	*3.6*

Notes: [a] Non-EU Europe: Switzerland, Norway, Western Balkans, Russia, Ukraine, Belarus, Kazakhstan, Morocco, Turkey, Tunesia, Algeria, Egypt, Israel, and Middle East; [b] North America: USA, Canada and Mexico.
Source: CAPRI Modelling System.

Figure 3. Regional land use change (percentage change relative to baseline).



Source: Own map based on CAPRI-results.

For instance, reductions in land use are particularly high in Southern Spain, Southern Italy, Greece, the Baltics, North-Eastern Finland, parts of Sweden, and Scotland. On the contrary, regions in Central France and Central Germany show almost no change in agricultural area use.

The removal of the EU green box support decreases production mainly by a reduction of agricultural land use, although there are also direct impacts on production from removing remaining coupled support (suckler cows, sheep and goats; smaller national coupled programs) and removing the agri-environmental programs. As a result, EU market prices increase as do crop and animal output yields which are due to both intensification and a change in the underlying cropping pattern. Table 4 shows that EU producer prices increase by up to 5 per cent compared to the baseline, while the effect on consumer prices is somewhat lower. As market prices increase, the EU loses its relative competitiveness to other actors in the world market, hence leading to reduced exports. The same is true for countries outside the EU like Norway, Turkey and the Western Balkans.

The model results underscore the fact that the major part of the OTDS and the current total AMS of the EU in its current definition are rather detached from the price and quantity developments in EU agriculture (Table 5). As administrative prices remain unchanged, only changes in quantity for those products for which AMS is calculated may potentially trigger changes in AMS. About half of blue box payments are tied to land use in EU agriculture. Eliminating the green box support thus has the effect of reducing blue box payments through a decrease in overall land use. However, production activities still benefitting from coupled (blue) support show lower decreases or even slight increases compared to those not directly supported. Equally, some non-exempt measures such as processing aid are reduced since productions is lowered.

Table 4. Commodity prices for the EU in 2020 by type of scenario (Euro per ton, percentage change compared to baseline in italics).

	Baseline		Elimination of green box			
	Consumer price	Producer price	Consumer price		Producer price	
Cereals	2 523	135	2 529	*0.2*	140	*3.7*
Oilseeds	2 401	290	2 417	*0.7*	305	*5.2*
Meat	5 440	1 758	5 518	*1.4*	1 822	*3.6*
- beef	7 975	3 029	8 057	*1.0*	3 106	*2.5*
- pork	5 388	1 418	5 446	*1.1*	1 472	*3.8*
Eggs	2 949	672	2 996	*1.6*	710	*5.7*
Dairy products [a]	1 683	270	1 712	*1.7*	286	*5.9*
- skim milk powder	2 014	1 974	2 092	*3.9*	2 031	*12.3*
- cheese	4 823	3 354	4 906	*1.7*	3 435	*2.4*
Oils	3 004	1 237	3 031	*0.9*	1 263	*2.1*
Sugar	6 793	449	6 795	*0.0*	451	*0.5*

Note: [a] Producer price for cow and buffalo milk.
Source: CAPRI Modelling System.

Table 5. WTO policy indicators [a] for the EU in 2020 by type of scenario (in mio Euro).

	OTDS	Curr. tot. AMS	MPS	Non-ex. dir. pay.	De minimis	Blue box	Green box
Baseline							
Total of commodities	12 764	9 344	8 591	753	698	2 722	47 213
Primary commodities	7 889	4 497	4 479	18	671	2 722	47 213
- cereals	5 001	4 497	4 479	18	473	32	15 319
- meat	61					61	
- fodder	958					958	20 336
Dairy products	1 375	1 375	838	536			
Secondary commodities	3 500	3 473	3 274	199	27		
Elimination of green box							
Total of commodities	12 413	9 236	8 493	743	676	2 501	
Primary commodities	7 581	4 418	4 401	17	662	2 501	
- cereals	4 919	4 418	4 401	17	469	32	
- meat							
- fodder	956					956	
Dairy products	1 353	1 353	828	526			
Secondary commodities	3 478	3 464	3 265	199	14		

Notes: [a] OTDS: Overall total direct support calculated as sum of MPS, non-ex. dir. pay., and blue box; Curr. tot. AMS: Current total AMS calculated as sum of MPS and non-ex. dir. pay.; MPS: Market price support; Non-ex. dir. pay.: Non-exempt direct payments.
Source: CAPRI Modelling System.

The overall welfare effects of eliminating green box support are quite limited. Rather, welfare is distributed differently between farmers, the tax payer and indirectly, via the price changes, consumers. The decomposition of total welfare into consumer surplus, producer and processor surplus, and taxpayer costs indicates that consumers remain largely unaffected (-8 208 mio €), while taxpayers gain (+47 672 mio €) at the expense of producers and processors (-40 626 mio €) (Table 6).

Table 6. Decomposition of welfare for the agricultural sector of the EU in 2020 by interest group and type of scenario (mio Euro, percentage change compared to baseline in italics).

	Baseline	Elimination of green box	
Consumer surplus	7 691 839	7 683 631	*-0.1*
Producer and processor surplus	117 310	76 684	*-34.6*
Taxpayer costs	43 702	-3 970	*-109.1*
- Budget costs	51 221	3 746	*-92.7*
- Tariff revenues	-7 520	-7 716	*2.6*
Total welfare	7 765 448	7 764 285	*-0.0*

Source: CAPRI Modelling System.

The intuition is straightforward as a large drop in budget expenditures on agriculture foremost benefits taxpayers. Not astonishing given the decoupled nature of the biggest part of the removed subsidies, producers are mostly unable to avoid the budget cut through farm management adjustments such as changes in the optimal mix of production activities as their loss compares to about 85 percent of the taxpayer's benefit. Moreover, the budget costs in the counterfactual scenario are lower than the revenues from agricultural import tariffs such that the taxpayers' surplus turns slightly positive.

6. Discussion and conclusion

The removal of the green box results in a slight decrease in EU domestic production. Less supply is available on the EU market, which in turn drives up market prices to a certain extent. With respect to the international position of the EU food sector, this leads to a decrease in exports and an increase in imports, but these effects are overall small. The main uncertainty in this impact chain relates to the supply reaction induced by the SFP reduction. This depends on the calibration of the land supply function as a somewhat different shape or elasticity of the function leads to change in the supply reaction. As mentioned above, in the calibration of the land supply function, we follow van Meijl *et al.* (2006) and Golub *et al.* (2006).

Thus, the main finding of the simulation indicates that EU support under the green box distorts the absolute volumes of production and trade only to a minor extent. For small trade volumes, the relative changes can be significant for specific commodities. Thus, from an economic point of view, EU support notified to the green box seems to be compatible with the general requirements of the green box. That does not preclude, of course, that those measures may be green box-incompatible for legal reasons. The literature does not report examples from model simulations involving the complete dismantling of the EU green box measures, likely because that scenario is politically unlikely. In any case, such a scenario may provide a useful supplement to theoretical studies on the production effects of the SFP and empirical studies focusing on single farms. Exercises with other large-scale models would be of potential interest. In general, our results support the segment of the literature that finds the production effects of SFP payments to be limited (e.g. Schokai and Moro, 2009; Rude, 2008; Gohin, 2006). In addition, our results seem consistent with Anderson *et al.* (2006) who find that a reduction in domestic support in general provides much fewer welfare improvements than an improvement in market access.

However, both our analysis and other studies using large scale models could face a similar criticism. Most of them assume a risk-neutral, profit maximizing farmer and do not consider possible feedbacks of green box payments on input prices. Unlike our analysis, it seems that other studies neglect the effects of entitlements. The standard assumption in the widely used GTAP model (Urban *et al.* 2012) is that land can only be used in agriculture. The CGE analysis based on that model, which assigns the SFP (as we judge correctly) as a factor subsidy to land, will hence find no allocative effect according to equation (3). Assigning parts of the SFP as a subsidy to land or capital will generate allocative effects in the analysis. Such an implementation of the SFP contradicts its actual implementation, and if introduced to capture the pathways described e.g. in Dewbre *et al.* (2001), is at odds with the micro-economic assumptions and market descriptions underlying the CGE, which assume profit maximization and do not consider a link between wealth and credit prices. Analyses with partial equilibrium models such as AGLINK-COSIMO or AG-MEMOD of the SFP seems to generate results which simply reflect the so-called coupling factors introduced (see Balkhausen *et al.* 2008), so that we do not consider them as a suitable benchmark for comparison. Banse *et al.* (2008) combine, rather loosely, a CGE model, the partial equilibrium model ESIM and the supply side of CAPRI. The scenario which is closest to our analysis encompasses full trade liberalization with the removal of direct payments, but also a partial lift of cross-compliance and changes to Pillar II. Accordingly, results are far more directly comparable. Still, they find, similar to the analysis presented here, only limited production effects from domestic support. The strongest effects are reported for land rent changes, but the article does not provide a decomposition with regard to the underlying drivers (trade liberalization or reduction in domestic support).

Our results demonstrate that the green box support effects are overlaid by the distortionary effects of multiple other policy instruments applied in the EU. The continuously high level of EU border protection and its specific implementation (TRQs, minimal border prices) insulate EU markets to a certain extent on the import side from world markets. Removing subsidies allow EU market prices to increase, which partly offsets the reduction in output. Consequently, the limited trade effects mainly result from the fact that output is slightly reduced and that EU exports decrease with increasing EU market prices. At the same time, land supply functions are in most EU regions inelastic, so that a land subsidy reduction impacts mostly land rents and thus land owner incomes, but only has a small effect on allocative decisions.

From a trade policy point of view, our study addresses the question of how to judge the potential production and trade distortionary effects of agricultural policies in the context of WTO dispute settlement procedures. Should they be assessed in the presence of other policy instruments, or should they be assessed in comparison to a hypothetical non-intervention and unbiased market scenario? Our model results underscore the intuitive finding that less border protection would give rise to a larger effect on production and trade of the complete elimination of green box measures. They thus support a well-known result in economic theory that the distortionary effect of a measure is influenced by the presence of other existing measures. This is, of course, exactly the idea of the blue box which links supply boosting support instruments with supply control measures to reduce their distorting effects. To the best of our knowledge, the few WTO disputes that have addressed the distortionary effects of agricultural policies to date have not utilized large-scale sector models. In this respect, our study indicates that the results from detailed agricultural sector models, like CAPRI, may well be useful as an input for those disputes.

An issue for future research remains the point raised by Femenia *et al.* (2010) indicating that ignoring the downside risk aversion of farmers, if they are also the owners of their land, may lead to an understatement of production effects.

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