



The Commonwealth

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Impact of Green Box Subsidies on Agricultural Productivity, Production and International Trade

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Abstract

This paper provides empirical evidence on the production- and trade-distorting effects of the Green Box (GB) subsidies of developed countries. It reviews the theoretical and empirical literature, which argues that the impacts of GB subsidies on production and trade operate via increases in risk-taking capacities, land prices, credit availability, labour participation and expectations. It traces the 'box-shifting' of subsidies by developed countries from 1995 to 2011 and the subsequent reforms of US Farm Bill and European Union (EU) Common Agricultural Policy (CAP). The paper estimates the impact of GB subsidies on agriculture productivity and technical efficiency in 26 countries for the period 1995–2007, using Data Envelopment Analysis (DEA). The results show that GB subsidies increased agricultural productivity by approximately 60 per cent in the EU and 51 per cent in the USA in this period. Furthermore, the paper uses Agriculture Trade Policy Simulation Model (ATPSM) to estimate the impact of cuts in GB subsidies of 40 per cent in the USA (excluding food stamps) and 50 per cent in the EU (decoupled payments) in 2007 and to estimate the impact of capping GB subsidies at 2001 levels. The impact is estimated on agricultural production, export and import volumes, export revenue and import costs in both developing and developed regions, including least developed countries (LDCs) and Net Food Importing Countries (NFICs). Results are also reported country-wise for NFICs and CAIRNS, and the impact on the Commonwealth member countries of this group is highlighted. Results show that a cut of 40 per cent and 50 per cent in GB subsidies from the USA and the EU respectively can lead to a major restructuring of agricultural production and international trade. For example, import volumes of agricultural products are shown to rise substantially in the EU (35 per cent) and the USA (67 per cent), with an increase of 17 per cent in the export revenue of developing countries. LDCs gain in terms of a rise in export volume and revenues and a fall in their import costs. NFICs also gain in terms of exports with no rise in their import costs. A capping of GB subsidies at 2001 levels can lead to substantial gains for developing countries, as their export revenues increase by 55 per cent. LDCs and NFICs increase their production of agricultural products (not necessary food), while their import costs decline. CAIRNS countries, as expected, gain in terms of their exports. Given the substantial and continuous rise in GB subsidies since 2000, this paper also provides broad principles on disciplining GB subsidies and suggests prioritising this in the post-Bali work programme.

JEL Classification: Q17, Q18, F13

Keywords: agricultural trade, Green Box subsidies, food production, US Farm Bill, Common Agricultural Policy

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Abbreviations and acronyms

AMS	aggregate measure of support
AoA	The Agreement on Agriculture
ATPSM	Agriculture Trade Policy Simulation Model
CAIS	Canadian Agricultural Income Stabilization
CAP	Common Agricultural Policy
DEA	Data Envelopment Analysis
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GB	Green Box
LDCs	Least Developed Countries
NFICs	Net Food Importing Countries
NISA	Net Income Stabilization Account
OTDS	overall trade-distorting support
SNAP	Supplemental Nutrition Assistance Program
STAX	Stacked Income Protection Plan
TE	technical efficiency
TFP	total factor productivity
VRS	variable returns to scale
WTO	World Trade Organization

1. Introduction

Multilateral trading rules were envisaged to enhance the development impacts of international trade on the global economy and to discourage trade-distorting domestic policies, which affect competitiveness. These rules became particularly important for agriculture products, as the agriculture sector provides substantial employment to the world's poor and offers comparative advantages to many developing and least developed countries (LDCs). The Agreement on Agriculture (AoA), which was negotiated in the 1986–94 Uruguay Round of multilateral trade negotiations, marked a significant step towards bringing trade-distorting domestic support or agricultural subsidies, particularly in developed countries, into the ambit of international rules. Agricultural subsidies were grouped under three boxes: 'Amber Box' – all domestic support measures that distort production and trade; 'Blue Box' – any domestic support measure that would normally be in the Amber Box is placed in the Blue Box if the support also requires farmers to limit production; and 'Green Box' – domestic support measures that are not trade-distorting or, at most, cause minimal distortion. In the Doha Development Round of multilateral trade negotiations, which began in 2002, considerable progress was made in these negotiations, and in July 2004 an agreement was reached on a framework, although modalities remained under discussion. International rules on domestic support, as they stand in 2014, include a reduction in all payments in the Amber Box, whereas those in the GB are exempted from reduction commitment. Detailed rules on GB payments are set out in Annex 2 of the AoA and are expected to cause minimal distortions in production and trade.

Following the AoA, there have been significant reductions in domestic support measures under the Amber and Blue Boxes in developed countries. The total aggregate measure of support (AMS), which combines all support for specified products and those that are not product-specific into a single figure, declined drastically for all developed countries in 2010 compared with 1995. In the USA, total AMS declined from US\$6.2 billion in 1995 to US\$4.1 billion

in 2010; whereas in the European Union (EU) AMS declined from €50.1 billion to €6.5 billion. A similar decline in total AMS was experienced by Japan (from JPY3,507 billion to JPY565 billion).

However, the decline in Amber Box and Blue Box subsidies have been more than compensated by substantial increases in GB subsidies in these countries. The USA increased its GB subsidies from US\$46 billion in 1995 to US\$120 billion in 2010; whereas the EU's GB subsidies increased from €9.2 billion to €68 billion. However, Japan's GB subsidies have declined from JPY3,169 billion to JPY1,408 billion. Australia, New Zealand, Norway and Switzerland have also seen a rise in their GB subsidies. This 'box-shifting' of subsidies from 'amber' to 'green' can be acceptable to World Trade Organization (WTO) members, if these measures comply with the fundamental principle of being minimally production- and trade-distorting. However, if this is not so and the subsidies provided in 'GB' are found to be production- or trade-distorting, then there is a strong case for reopening the issue of domestic support provided under the GB in the post-Bali work programme.

In this context, this paper empirically estimates the impact of GB subsidies provided by developed countries on productivity, production and international trade in agriculture. Section 2 of the paper illustrates trends in box-shifting in select developed countries; section 3 provides a brief review of existing theoretical and empirical literature on production- and trade-distorting effects of GB subsidies; section 4 presents results of data envelopment analyses (DEA) which estimate the impact of GB subsidies on agricultural productivity in 26 countries over the period 1995–2010; section 5 presents the results of the impact of reduction in GB subsidies on production, export volumes, import volumes, export revenues and imports costs using Agriculture Trade Policy Simulation Model (ATPSM). Results are presented at the regional level, including for LDCs and Net Food Importing Countries (NFICs); section 6 provides suggestions on disciplining GB subsidies; and section 7 summarises, and provides conclusions on, the main findings of the paper.

2. Trends in domestic support in agriculture: 'box-shifting'

2.1 The domestic support commitments

The idea of exempting production and trade-neutral subsidies from WTO commitments was first proposed by the USA in 1987 and subsequently endorsed by the EU (Stancanelli 2009). The rationale for supporting GB subsidies was to compensate farmers in developed countries for any potential losses following agriculture reforms and to allow the governments to deliver on public goods and fulfil their policy objectives without disrupting international trading patterns. The underlying reason was also to make progress in WTO negotiations in the face of stiff resistance from farmers in developed countries.

The AoA has very specific criteria on programmes that can be classified under Blue Box and GB. The Blue Box policies are production-limiting, and payments are based on fixed yield and acreage. These payments are required to be limited to 85 per cent of a base level of production. GB subsidies, however, are not to be linked to current production or prices. Annex 2 of the AoA lists categorically the programmes under GB, with the general criteria that these programmes must have no, or at most minimal, trade- or production-distorting effects. GB applies to both developed and developing countries, although in the case of developing countries, special treatment is provided in terms of government stockholding programmes for food security purposes and subsidised food prices for the poor. These initiatives must be funded by the government and should not involve transfers from consumers or provide price support to producers.

The programmes categorised under GB include:

- decoupled income support or direct payments to producers delinked with their production decisions;
 - public stockholding programmes for food security purposes;
 - domestic food aid;
 - general research, that is, research related to particular products, pests and disease control, etc.;
 - income insurance and income safety-net programmes;
 - payments for relief from natural disasters;
 - structural adjustment assistance, provided through producer retirement programmes;
 - structural adjustment assistance, provided through resource retirement programmes;
 - structural adjustment assistance, provided through investment aids;
 - environmental programmes;
 - Regional assistance programmes.
- Each of the above programmes has guidelines for defining its eligibility.
- The AMS is the annual level of support, which is the sum of expenditures on non-exempted domestic support, aggregated across all commodities and policies. This includes both product-specific as well as non-product specific support and excludes GB subsidies. The AMS is determined by the member country's support provided in the base period, that is, 1986–88. The member countries agreed to limit their Amber Box domestic support to a level at or below the level of domestic support in their base period. The implementation of this commitment began in 1995, with developed countries given 6 years and developing countries 10 years to discipline the extent of their domestic support. It was agreed that developed countries would reduce their AMS by 20 per cent and developing countries by 13 per cent in the specified period.
- In addition to this, the *de minimis* provisions of the Agreement state that there is no requirement to reduce trade-distorting domestic support in any year if the aggregate value of product-specific support does not exceed 5 per cent of the total
- general services provided by governments, such as agricultural training services and extension and advisory services, inspection services, infrastructural services, marketing and promotional services, water supply facilities, etc.;

value of production of the agricultural product and if non-product specific support is less than 5 per cent of total agricultural production. This applies to developed countries, whereas for developing countries the *de minimis* ceiling is 10 per cent. It is interesting to note that the Doha commitments on reducing domestic support have a harmonising approach, with maximum reductions undertaken by countries that have provided the greatest support in the past. Accordingly, for the USA, the overall trade-distorting support (OTDS), which includes current total AMS, *de minimis* AMS support and Blue Box support, will decline from US\$48.5 billion to US\$14.5 billion, and the existing total AMS of US\$19.1 billion will drop to bound AMS of US\$7.6 billion. For the EU, final bound OTDS would be €23.8 billion and the bound total AMS would be reduced from €72.2 billion to €21.7 billion (Orden 2013).

2.2 The changing pattern of domestic support in developed countries

Following their WTO commitments on domestic support, developed countries, in particular the EU countries, the USA and Japan, have drastically reduced their Amber Box domestic support. This has been in line with the agricultural reforms undertaken in these countries. However, the domestic support in GB has increased substantially, in some cases by more than the reductions in Amber Box subsidies.

2.2.1 'Box-shifting' by the European Union in common agricultural policy

The EU has reformed its common agricultural policy (CAP) considerably over the past two decades. CAP was designed to influence agricultural prices, output and incomes of farmers throughout the EU and accounted for roughly 40 per cent of total EU budgetary expenditure. CAP is based on two pillars, where pillar 1 support includes both direct payments to farmers (80 per cent of total support) and market management measures and pillar 2 support focuses on improving the competitiveness of agriculture and forestry, improving the structural and environmental performance of agriculture and promoting local/rural development. Although pillar 1 expenditures are fully funded by the EU, pillar 2 expenditures are co-financed by EU Member States and the EU budget.

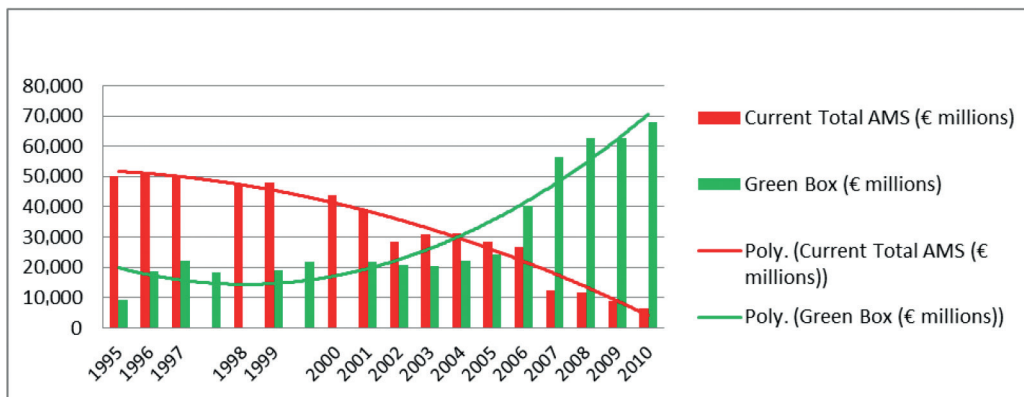
To make CAP expenditures more acceptable internationally, there have been considerable reforms, beginning with the Mac Sharry reforms of 1992, which reduced market price support and introduced direct support. The decoupling of direct payments from production (Single Farm Payment) was encouraged in 2003 reforms. However, it has been pointed out that the link with land input still remained, as payments go to farmers who keep their land in 'good agricultural condition', which is to say that it is ready to produce (EuroCare GmbH, 2010).

The new CAP (2014–20) maintains the two pillars, although in real terms the amounts of domestic support decline by 1.8 per cent for pillar 1 and 7.6 per cent for pillar 2 (in 2011 prices). The total amount allocated is €362.8 billion for the period 2014–20, of which €277.8 billion (76.5 per cent) will be spent on direct payments and market-related expenditures (pillar 1). To increase agricultural competitiveness, the new CAP reforms have removed all the existing restrictions on production volumes, in particular for sugar, dairy and the wine sector. It aims to facilitate producer co-operation, which will reduce costs of farming, improve access to credit and help in adding value to the primary sector. Support will be extended to set up producer groups and to encourage product differentiation and promote on-farm processing and adding value.

Although the payments are decoupled from products, the payments under the new CAP remain coupled with the producers of agricultural products, providing them with new risk insurance schemes, including insurance schemes for crops, animals and plants and responsive safety net measures. Start-up aid will be given to young farmers, expenditures on innovation and training will be increased and a new management toolkit will be introduced, which includes mutual funds and income stabilisation tool. 'Green direct payments' have been introduced, which account for 30 per cent of the national direct payment envelope and special packages of direct payments are offered to small farmers. Direct payments are no longer based on uneven historical references but are now based on converging per hectare payment at national or regional level.

The reforms in CAP in the EU have, over time, reduced the domestic support under the Amber Box but steadily increased the subsidies in GB. Figure 1 depicts the EU box-shifting.

Figure 1. Current total AMS and GB subsidies in the EU: 1995–2010



Source: based on WTO notifications: 1995–2010

Domestic support under the Amber Box declined from €50 billion in 1995 to €30.8 billion in 2003 and declined further to €6.5 billion in 2010. However, domestic support in GB increased from €9.2 billion in 1995 to €20.4 billion in 2003 and reached €68 billion in 2010. In 2010, the total domestic support provided under GB exceeded that provided under Amber Box in 1995. Most of the domestic support scheduled under the new CAP falls in the GB, with Amber Box support being only around 8 per cent of the total domestic support in the two boxes.

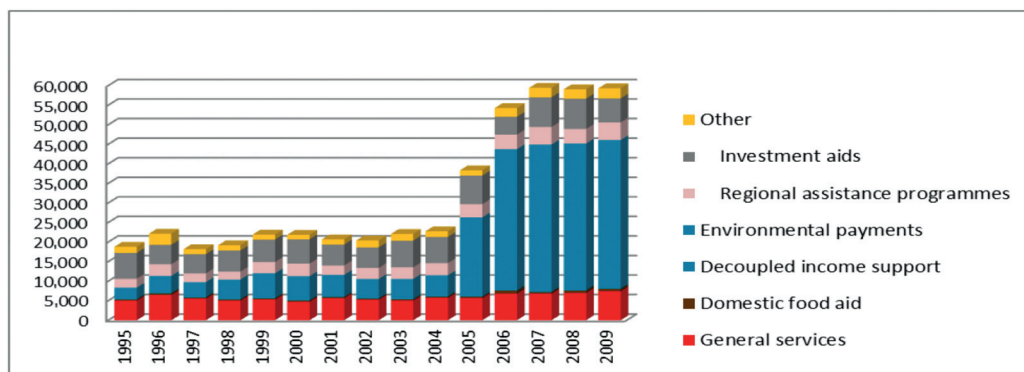
Figure 2 shows the change in composition of GB subsidies over time in the EU. There has been a drastic fall in the share of general services provided under GB subsidies in the EU. Their share fell from 27 per cent in 1995 to 23 per cent in 2003, and declined further to 12 per cent in 2009–10. The share of decoupled payments has increased substantially from 1 per cent in 1995 to 37 per cent in 2005 and 49 per cent in 2009–10. Shares of environmental

payments, regional assistance programmes and investment aids have declined from 15 per cent, 12 per cent and 35 per cent respectively in 1995 to 10 per cent, 7 per cent and 10 per cent respectively in 2009–10. The share of domestic food aid has remained at approximately 1–2% throughout the period.

2.2.2 'Box-shifting' by the USA

Similarly to the EU experience, the US Farm bills have also changed drastically over the past two decades. One of the major changes came in 1996, when it was decided that farm subsidies would be eliminated over the next seven years and that, alternatively, farmers would be offered direct payments based on the size of their land. The US Farm Act of 2002 included income support for growers of selected commodities, including wheat, feed grains, cotton, rice, oilseed, sugar and dairy products. The income support was given largely through direct payments, counter-cyclical payments and marketing loans. A total of

Figure 2. Composition of GB in the EU: 1995–2010



Source: based on WTO notifications: 1995–2010

27 per cent of total actual spending of US\$271 billion in 2002–7 was spent on commodity support, whereas 67 per cent was spent on food stamps. The US Farm Act 2008 budgeted for US\$288 billion in relief over five years, but in 2010 alone, around 80 per cent of the total spending from the Farm Bill went towards domestic food assistance programmes and 10 per cent went towards commodity programmes.

The US Farm Bill of 2014 has stopped direct and counter-cyclical payments to farmers and in turn offers expanded crop insurance programmes for risk-management. These include new programmes such as the Price Loss Coverage and the Agriculture Risk Coverage programmes. Farmers can choose between the two programmes. Price Loss Coverage pays out if crop prices fall too low or if farm revenue falls below certain benchmarks. The reference price for assessing falls in revenue has been raised in the new Farm Bill compared with the parameters in the 2008 Farm Bill. Agriculture Risk Coverage covers those losses that normally would not be covered by crop insurance. It is intended to maintain farm revenue and pays certain percentages of farm revenue if they fall below historic benchmarks, either for individual farm operations or for all the farms in a county. Payments are triggered when actual crop revenue drops below 86 per cent of historical or ‘benchmark’ revenue. However, these farm programmes are separate from a producer’s decision to purchase crop insurance. Nevertheless, farmers selecting the Price Loss Coverage (but not Agriculture Risk Coverage) are also eligible to purchase an additional subsidised crop insurance policy to protect against ‘shallow losses’.

Interestingly, to compensate cotton producers, a new crop insurance policy, called the Stacked Income Protection Plan (STAX), has been introduced, which is similar to Area Revenue Protection. It covers revenue losses of not less than 10 per cent and not more than 30 per cent of expected county revenue. Producers receive a premium discount equal to 80 per cent of the STAX premium, and, on behalf of the producers, an administrative and operative expense of 12 per cent of premium is paid to the crop insurance companies. Furthermore, the Farm Bill 2014 reauthorises many of the larger conservation programmes and makes available subsidised crop insurance to producers, who purchase a policy to protect against

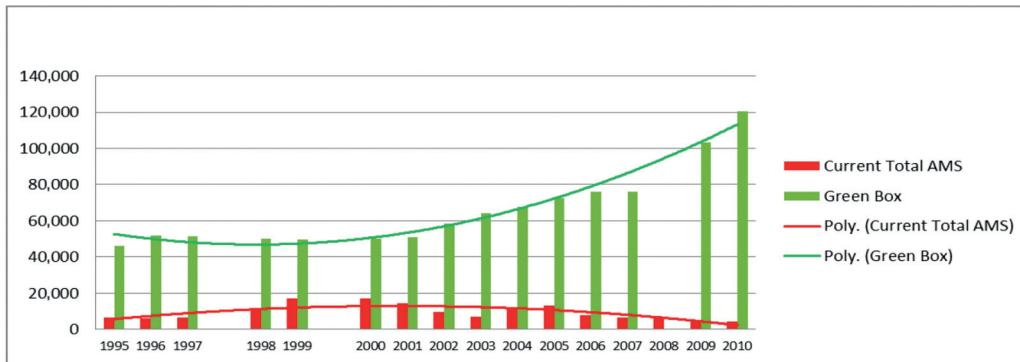
losses in yield, crop revenue or whole farm revenue.

The Farm Bill 2014 envisages spending US\$956 billion over next 10 years, of which US\$756 billion is for nutrition assistance and US\$200 billion is for the agriculture portion. Within the agriculture portion, US\$90 billion is budgeted for crop insurance programmes over the next 10 years, US\$58 billion for conservation, and US\$44 billion for farm commodity programmes. The budget of the Farm Bill 2014 (US\$478 for 5 years) is much higher than that of the Farm Bill 2008 (US\$288 billion), with the budget for food stamps (*Supplemental Nutrition Assistance Program* (SNAP)) doubling in every Farm Bill and growing from US\$17 billion in 2000 to US\$38 billion in 2008 and US\$80 billion in 2014. According to SNAP, any household with one person (without disability or senior person) with a maximum gross monthly income of US\$1,245 per month (around US\$40 per day) is eligible for food stamps. These can be used to buy fruit and vegetables and organic agricultural products. The growing demand is anticipated to lead to higher investments in local and regional food systems and organic agriculture, thereby providing greater opportunities for small and medium-sized farms, especially crop farms, to diversify. The food stamps, which attract a large share of Farm Bill expenditures, therefore help to boost demand for agricultural products.

Figure 3 depicts the shifting of domestic support from Amber Box to GB in the period 1995–2010. Amber Box domestic support increased from US\$6.2 billion in 1995 to US\$9.6 billion in 2002, but declined to US\$6.2 billion in 2008 and US\$4.1 billion in 2010, whereas GB subsidies increased from US\$46 billion in 1995 to US\$58.3 billion in 2002 before reaching US\$120 billion in 2010.

Along with the box-shifting of domestic support, the composition of GB subsidies has also changed over time in the USA, evolving from one Farm Bill to the other. Although environment payments have remained between 3 per cent and 4 per cent of total GB domestic support from 1995 to 2010, food aid has increased from 65 per cent in 2002 to around 79 per cent of total GB subsidies in 2010. Expenditure on general services and decoupled payments has declined from 17 per cent and 9 per cent respectively of total GB subsidies in 2002 to 12 per cent and 5 per cent in 2010 (Figure 4).

Figure 3. Current total AMS and GB subsidies in the USA: 1995–2010



Source: based on WTO notifications: 1995–2010

Although it can be argued that food aid simply allows poor US citizens to feed themselves cheaply with food stamps, a number of studies have argued that this creates an artificial domestic demand, leading to a rise in agricultural production. Berthelot (2005) points out that, although the shops selling this food also import, a large part of the food comes from agri-food surpluses collected by the Commodity Credit Corporation and has the effect, therefore, of creating domestic demand and supporting the prices of the corresponding products. Here, the food aid is clearly coupled.

Furthermore, Debar and Blogowski (1999) estimated ‘the net equivalent aid to agricultural production’ of the US domestic food aid for 1996 on the following bases:

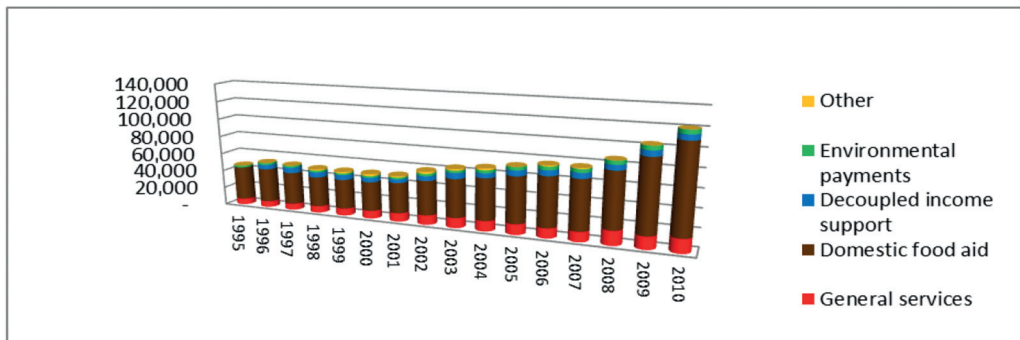
- (i) 88.4 per cent of US consumers’ food purchases were of a US origin in 1996;
- (ii) the share of those purchases at the retail prices going to farmers was 25 per cent;
- (iii) every dollar granted in food stamps induces a net additional consumption of food between 20 and 45 cents.

The results show that ‘the net equivalent aid to agricultural production’ was US\$2.6 billion in 1996, which was around 6.9 per cent of the domestic food aid value, a percentage that can be extrapolated to other years. In 2010, this equivalent aid to agricultural production was US\$6.6 billion, which is more than the Amber Box subsidies in 2010.

2.2.3 Rising Green Box subsidies in other developed countries

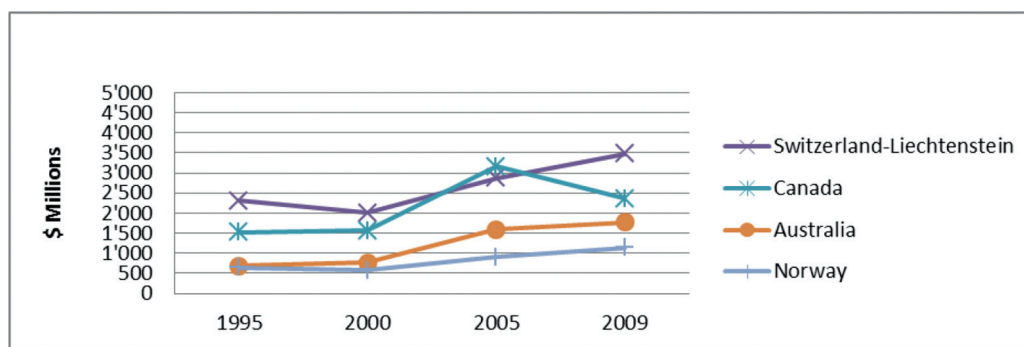
The rising trend in domestic support measures in GB subsidies is not just limited to the USA and the EU. Other developed countries have also increased their GB subsidies. The domestic support under GB has increased by more than 150 per cent in Australia, by around 75 per cent in Norway and by more than 50 per cent in both Switzerland and Canada. These spurts in growth occurred post-2000 and continue to grow. Figure 5 depicts the rise in GB subsidies in Australia, Canada, Norway and Switzerland–Liechtenstein. Although Canada has also increased its GB support post-2000, it declined

Figure 4. Changing composition of GB in the USA: 1995–2010



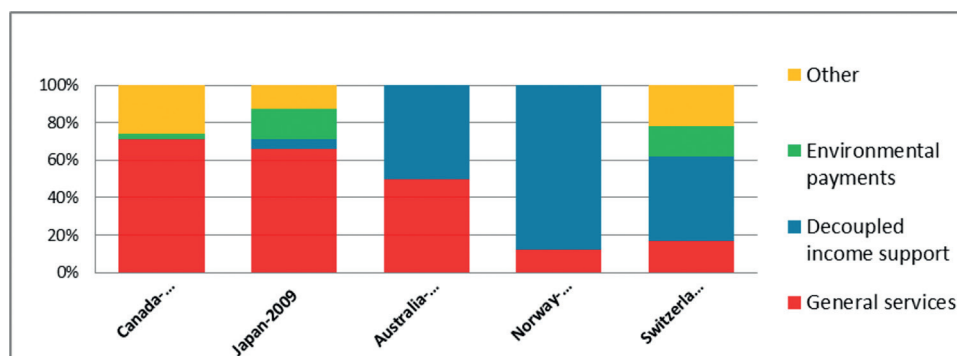
Source: based on WTO notifications: 1995–2010

Figure 5. Rise in domestic support under GB: 1995–2010



Source: based on WTO notifications: 1995–2010

Figure 6. Composition of GB in selected developed countries: latest available year



Source: based on WTO notifications: 1995–2010

in 2009 but still remains much higher than the 1995 level in absolute terms.

Figure 6 illustrates the distribution of domestic support within GB for the latest available year in the abovementioned countries. General services have more than a 60 per cent

share of GB subsidies in Canada and Japan and around a 50 per cent share in Australia. Decoupled payments comprise around 88 per cent of total domestic support under GB in Norway and around 45 per cent in Switzerland–Liechtenstein.

3. Existing theoretical and empirical evidence of the production- and trade-distorting impact of Green Box subsidies

Although it has been accepted by WTO members under the AoA that domestic support measures under GB are permitted as they do not, or at most minimally, distort production and trade, the growing trend towards ‘box-shifting’ has led to a stream of theoretical and empirical literature that provides evidence to the contrary. This

section provides a brief review of theoretical literature, which is increasingly supported by empirical evidence, showing that production decisions are not decoupled from domestic support measures permitted under GB. There is also growing evidence that these domestic support measures are trade-distorting.

It is well established in the theoretical literature that the channels through which the decoupled payments under GB are made can affect production. These channels are: (i) risk effects; (ii) land price effects; (iii) credit effects; (iv) labour participation effects; and (v) expectations effect.

(i) Risk effects were first articulated prominently by Hennesy (1998), when he argued that decoupled payments can reduce the risks faced by farmers by increasing their wealth (wealth effect) and making them less risk-averse and, therefore, more productive. Risk effect can also work through insurance effect, which reduces the price risk faced by domestic producers and therefore leads to increased production. It has also been argued that risk effect can distort international trade by reducing the degree of adjustment in domestic markets, increasing world price variability and forcing greater adjustments in other countries. This can, therefore, lead to negative insurance effects on other countries' production and promote production and net trade in the country with decoupled payment support.

Empirical evidence of the risk effects of decoupled payments has been presented in many studies including Chavas and Holt (1990), Young and Westcott (2000), Anton and Le Mouel (2004), Sckokai and Moro (2006) Serra et al. (2006), Serra et al. (2011) and Just (2011). Brady et al. (2009) found that decoupled payments increase land rental prices and this, in turn, affects future farm income and production decisions. Although most of the studies found that decoupled payments impact production by making farmers less risk-averse and affecting relative land prices, many argue that this effect may not be very large and can be termed as minimal. However, very few studies have actually estimated the elasticity of decoupled payments with respect to production.

(ii) Land price effects operate when the decoupled payments are capitalised into land values. Many studies have modelled this effect and its related implication for production and investments in agriculture, including Roe et al. (2003), Roberts et al. (2003), Goodwin et al. (2003), Kirwan (2009), Dewbre et al. (2001) and Gohin (2006).

Empirical evidence of land price effects is steadily rising. Goodwin et al. (2003) found that decoupled payments have increased land

values to an extent of between 2 and 6 per cent in the Northern Great Plains and Corn Belt regions. Barnard et al. (2001) found that the gap between aggregate land values with and without government payments was about 13 per cent in the period 1990–97, increasing to about 25 per cent during 1998–2001 when payments included market loss assistance and marketing loan benefits in addition to production flexibility contract payments in the USA. Studies have emphasised the heterogeneity of this impact across regions and forms of payments. For Northern Ireland, Patton et al. (2008) estimated that the capitalisation rate of coupled subsidies varied between 20 per cent and 100 per cent, whereas the capitalisation rate of decoupled subsidies varied between 20 per cent and 80 per cent.

Woodard et al. (2010), using data from the Illinois Farm Bureau Farm Management for 1996 to 2008, found capitalisation of 27 cents per dollar, but when the sample was divided into pre- and post-2002 cohorts, capitalisation was found to be only 8 cents in the pre-2002 period and 47 cents in the post-2002 period. Hendricks et al. (2012) used a panel dataset of Kansas farmers from 1990 that the long-run capitalisation increased to 37 cents per dollar of subsidies.

Using data from the German federal state of Lower Saxony in 2001, Breustedt and Habermann (2011) explored the incidence of EU per-hectare payments for eligible arable crop land and found that an additional euro of premium payments increased rents by 38 cents.

Ciaian and Kancs (2012) explored the capitalisation of Single Area Payment Scheme (SAPS) payments into land rents in the new EU Member States for 2004 and 2005. A first-difference estimator was used to remove the effects of time invariant omitted variables and selection bias was controlled for by including the Inverse Mills Ratio based on a probit model for whether or not the farm rents land. They found that between 18 and 20 cents per euro of SAPS payments are bid into land rents.

(iii) Credit effects operate when domestic support measures under GB lower the cost of access to debt. Studies have argued that in the presence of imperfect capital markets, including significant gaps between borrowing and lending rates, any agricultural policy relating to credit availability will affect farmers'

willingness to invest in generating additional production in future and will also potentially raise farmers' credit worthiness and liquidity (Rude 2000; Phimister 1995).

Empirical evidence on credit effects of GB subsidies is difficult to estimate in terms of elasticities. Nevertheless, many studies show that investment is sensitive to cash flows and lower cost of credit can increase investments by farmers. These studies include those by Bierlen and Featherstone (1998), Bierlen et al. (1998), Gilchrist and Himmelberg (1995), Whited (1992), Hubbard et al. (1995), Rude (2000), Benjamin and Phimister (2002) and Vercaemmen (2003). Westcott and Price (2000) estimated the effects of the marketing loan programme on soybean production. They used the US Department of Agriculture 1999 baseline and simulated an econometric model for the US agricultural sector. The results show that soybean acreage increased as a result of marketing loans, resulting in higher production and lower prices. As a result of the acreage effects, exports of soybean oil were found to increase by 1 to 2 per cent.

(iv) Labour participation effects occur and can affect production when farm households receiving decoupled payments accordingly allocate their labour between farm and non-farm activities. Studies such as those by Ahearn et al. (2006), El-Osta et al. (2004) and Key and Roberts (2009) show that decoupled payments induce farm households to spend more time on the farm and increase production.

(v) Expectations effect of subsidies under GB can affect production as farmers may alter their production decisions to maximise their future payments from expected policy changes (Lagerkvist 2005; Sumner 2003; McIntosh, et al. 2007). Some studies, such as the one by Coble et al. (2008), have pointed out that the 2002 US Farm Act, which extended the fixed decoupled payments of the 1996 Act, gave producers an opportunity to update their base acreage and yields, and allowed them to include acreage in common oilseeds such as soybeans and rapeseed in their base. Prior to 2002, farmers may have altered planting decisions in anticipation of the base updating, even though current payments were decoupled from current

production. Decoupled payments can therefore affect farmers' expectations by linking current decisions to future payments (Lagerkvist 2005; McIntosh et al. 2007; Coble et al. 2008).

Empirical evidence of the production- and trade-distorting effects of GB subsidies as a package has also been estimated in a number of studies. Bakhshi and Kerr (2009) estimate the impact of the Net Income Stabilization Account (NISA) and the Canadian Agricultural Income Stabilization (CAIS) programs in Canada under GB subsidies on production and trade. The estimated results show significant coefficients of expected total wealth and variance of total wealth, which implies that the whole-farm programmes are production- and, therefore, trade-distorting and are not actually decoupled. The estimated statistically significant coefficients (for expected total wealth and variance of total wealth variables) are then used to simulate the impact of the NISA and CAIS programs. The results show that NISA and CAIS programmes increased the acreage allocated to spring wheat, rye and peas in the Prairie Provinces. During the period 1991–2002, spring wheat acres increased, mostly through the insurance effect, on average by 9.25 per cent in Manitoba, 5.34 per cent in Saskatchewan and 11.12 per cent in Alberta under the NISA. Under the CAIS, spring wheat acres expanded during the period 2003–2006, on average by 14 per cent in Manitoba, 10.67 per cent in Saskatchewan and 8.90 per cent in Alberta. In the NISA period, pea acreage increased, through insurance effect, on average by 15.18 per cent in Manitoba, 3.22 per cent in Saskatchewan and 11.02 per cent in Alberta. Based on the results, under CAIS, pea acreage increased by 23.82 per cent in Manitoba.

Key et al. (2006) found that participation in government schemes, including the 1996 Federal Agriculture Improvement and Reform Act actually increased production levels among participants in the programme. The study compared programme participants with non-participants who were otherwise similar in their observed characteristics and found that participants increased plantings of programme crops by 38 to 59 percentage points more than non-participants.

4. The impact of Green Box subsidies on agricultural productivity and efficiency

Although theoretical and empirical literature has emphasised the implications of GB subsidies on production and trade via wealth effects, insurance effects, land price effects, etc., there is another stream of literature that has emerged on estimating the impact of subsidies on agricultural production via its impact on productivity and efficiency. The main objective of categorising selected domestic support measures under GB was that these measures do not or at most only minimally distort production, and post-1995 efforts were made to decouple the payments from production under GB. However, emerging empirical literature suggests that even the decoupled payments have led to substantive increases in farm output via increases in productivity and efficiency. This positive impact stems from investment-induced productivity gains caused by the interaction of credit and risk attitudes with subsidies, especially in credit-starved farms (Rizov et al. 2013). Mary (2013) estimated the impact of various types of CAP subsidies on the productivity and efficiency of French crop farms for the period 1996–2003 and found that the Agenda 2000 reform (i.e. partial decoupling) had a positive impact on aggregate productivity and led to increased production.

This section estimates the impact of GB subsidies on agriculture productivity and technical efficiency in 26 countries for the period 1995–2007.¹ The WTO notifications of each country are used for arriving at the extent of total domestic GB support measures in each year for each country. DEA is used to estimate the impact of GB subsidies on total factor productivity (TFP) and cost efficiency.

DEA is a widely used technique for estimating the impact of subsidies on output. Using DEA methodology, a comparison of TFP across countries with and without GB subsidies is undertaken. DEA also allows comparisons of the sources of

productivity improvements across countries. It not only provides comparable percentage changes in productivity attributable to subsidies but also decomposes changes in TFP into changes attributable to scale, changes attributable to technical improvements and changes attributable to improvements in technical efficiency.

4.1 Methodology and data

The paper uses DEA for estimating the impact of GB subsidies of TFP and technical efficiency. DEA is a linear programming methodology, which uses data on the input and output quantities of a group of countries to construct a piece-wise linear surface over the data points. A frontier surface is then constructed by the solution of a sequence of linear programming problems – one for each country in the sample. The degree of technical change of each country (the distance between the observed data point and the frontier) arrived at is a by-product of the frontier construction method.

DEA can be either input-oriented or output-oriented. In the input-oriented analysis, the DEA method defines the frontier by seeking the maximum possible proportional reduction in input usage, with output levels held constant, for each country. In the output-oriented analysis, the DEA method seeks the maximum proportional increase in output production, with input levels held constant. The two measures provide the same technical efficiency scores when a constant returns to scale technology applies, but are unequal when variable returns to scale (VRS) are assumed.² This paper assumes VRS technology and selects the output-oriented approach for calculating production efficiency, as it is fair to assume that, in agriculture, one usually attempts to maximise output from a given set of inputs, rather than the converse.³ TFP is then calculated using a Malmquist TFP

1 GB subsidies were available for all countries until 2007, after which many countries still had not notified their domestic support under GB.

2 Agricultural production is generally assumed to have variable returns to scale.

3 This has also been argued by Coelli and Prasada Rao (2005).

index, which is derived from a sequence of DEA frontiers that are fitted to the sample data in each of the years. For calculating cost efficiencies, however, this paper uses an input-oriented approach. One advantage of using DEA is that it does not require a parametric specification of a functional form to define the frontier. This is critical to the analysis of impact of subsidies on productivity. Furthermore, DEA allows multiple outputs and multiple inputs to be considered and permits the relationship between all inputs and outputs simultaneously.

There is a large volume of literature on the impact of subsidies on output, with the traditional approach being that subsidies reduce productivity and efficiency of agricultural production, as their availability provides less motivation for improving efficiency. However, more recent studies show that subsidies can increase productivity by reducing risk-aversion and costs of borrowing. Studies have argued that subsidies can increase productivity and technical efficiency if they provide incentives, financial or otherwise, to switch to new technologies (Harris and Trainor 2005).

Three different modelling approaches have been used by the studies for estimating the impact of subsidies on TFP. The first set of studies use subsidies as one of the traditional inputs in the production function (e.g. Zhengfei and Oude Lansink 2006); the second set of studies use a two-step method where productivity is estimated and then regressed on factors affecting productivity, with subsidies as being one of the factors (e.g. Stefanos et al. 2012); the third set of studies compare productivity growth in pre- and post-subsidies periods (e.g. Olson and Vu 2009). The first two approaches have limitations. Using subsidies as an input is limited by the fact that subsidies are treated as a traditional input, like land and labour, but unlike traditional inputs they may not be able to produce any output by themselves. Furthermore, they are not necessary for the production of outputs. In the second approach, account is not taken of the impact of subsidies on output via its impacts on input productivity, technical efficiency and technical change (see McCloud and Khumbhakar 2008). The third approach has a high probability of omitted variable bias.

The approach adopted in this analysis is to consider subsidies as an additional output

along with the total agricultural output produced. Given that these subsidies are decoupled from production, they are like additional incomes or wealth in the hands of the farmers in the form of decoupled payments, concessional loans, general services provided or risk covered, which may be linked to the ability to invest more. Comparison of TFP and technical efficiencies in agriculture is made with and without subsidies. Using subsidies as an additional output in DEA to estimate its impact on productivity and efficiency has been used in recent studies (e.g. Silva and Marote 2013).

The analyses undertaken can be divided into two parts. First, TFP growth for 26 countries for the period 1995–2007 is estimated using Malmquist indices, which are defined by distance functions in DEA. One output (total agricultural output) and three inputs (land, labour and capital) are used to construct these indices. This constitutes a baseline frontier. Second, the same exercise is undertaken with GB subsidies as an additional output alongside total agricultural output with three inputs (land, labour and capital). TFP is estimated using distance functions with and without GB as an output. TFP is further decomposed into technical efficiency (TE) and technical change, which is represented by a shift in the production frontier. However, given that the two TFP estimates have been obtained using two different frontiers, the relative distances from the frontier are estimated for each country. The difference in the relative TFP scores gives the change in TFP on account of GB.

Two outputs and three inputs are used for DEA. Outputs considered are agriculture; value added at constant 2005 prices (US\$) (source: Food and Agriculture Organization of the United Nations (FAO)); and GB subsidies (source: WTO notifications). Inputs considered are arable land area in 1,000 Ha (source: FAO); total economically active population in agriculture (source: FAO); and gross capital stock in constant 2005 prices (source: FAO).

4.2 Average Green Box subsidies and total factor productivity growth: 1995–2010

In the period 1995–2007, total GB subsidies for 26 countries were recorded as US\$2.6 trillion,

Table 1. Average GB subsidies in selected countries: 1995–2007 (based on WTO notifications)

Serial No.	GB status	Country	Average GB subsidies (US\$ million)	GB subsidies in 1995 (US\$ million)	GB subsidies in 2007 (US \$ Million)
1	High GB	USA	67,107	46,041	76,162
2	High GB	EU countries	44,493	25,022	85,795
3	High GB	China	23,626		36,785
4	High GB	Japan	20,739	33,908	15,999
5	Medium GB	Korea, Republic of	4,974	5,187	5,742
6	Medium GB	Switzerland–Liechtenstein	2,667	2,304	3,000
7	Medium GB	Canada	1,982	1,529	2,977
8	Medium GB	Brazil	1,525	5,061	1,207
9	Medium GB	Australia	1,245	690	2,325
10	Medium GB	Thailand	1,119	1,352	1,081
11	Low GB	Norway	762	648	1,149
12	Low GB	Mexico	570	791	627
13	Low GB	Indonesia	567	160	902
14	Low GB	Cuba	556	908	118
15	Low GB	Morocco	343	292	733
16	Low GB	Malaysia	216	243	222
17	Low GB	New Zealand	169	133	253
18	Low GB	Chile	160	307	198
19	Low GB	Israel	78	97	77
20	Low GB	Tunisia	46	29	50
21	Low GB	Dominican Republic	43	6	54
22	Low GB	Namibia	21	50	27
23	Low GB	South Africa	0.8	0.8	1.3
24	Low GB	Costa Rica	0.2	0.4	0.1
25	Low GB	Colombia	0.1	0.3	0.1
26	Low GB	Paraguay	0.0	0.0	0.0
		Grand average	6,414		

of which 41 per cent (US\$1.07 trillion) were given by the USA and 27 per cent (US\$711.8 billion) by the EU. On average, US\$6.4 billion of subsidies were provided under GB every year. The USA has provided US\$67.1 billion every year, whereas the EU has provided GB subsidies worth US\$44.4 billion per annum in the period 1995–2010. High GB countries (with subsidies greater than average) include the USA, EU countries, China and Japan. Medium GB countries (with subsidies greater than US\$1 billion average per annum) include the Republic of Korea, Switzerland–Liechtenstein, Canada, Brazil, Australia and Thailand. The

remaining countries can be categorised as low GB countries (Table 1). Although GB subsidies increased substantially in the USA and the EU in 2007 compared with 1995, they have declined in Japan and in many developing countries including Brazil, Thailand, Mexico, Cuba, Malaysia, Chile, Israel and Namibia.

4.3 Impact of Green Box subsidies on total factor productivity: results

Table 2 reports the results of DEA estimating the impact of GB subsidies on TFP growth in

Table 2. Change in TFP and TE in agriculture as a result of GB subsidies

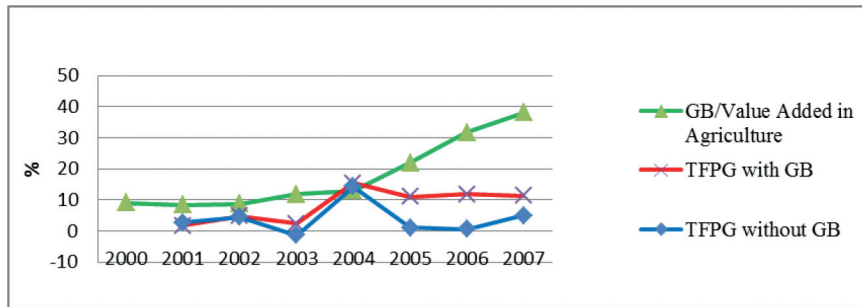
Country	Change in GB in US\$ million (1995–2007)	TFP without GB subsidies	TFP with GB subsidies	Average per annum change in TFP as a result of GB subsidies (%)	Average per annum change in TE as a result of GB subsidies (%)
Australia	1,635	1.031	1.029	−0.2	−0.2
Brazil	−3,854	1.037	1.037	0	0
Canada	1,448	1.029	1.048	1.9	1
Chile	−109	1.061	1.061	0	0
China	23,605	1.042	1.045	0.3	0.1
Colombia	0	1.104	1.104	0	0
Costa Rica	0	1.129	1.129	0	0
Cuba	−790	1.008	0.875	−13.3	−15.8
Dominican Republic	47	1.071	1.061	−1	0
EU	60,772	1.037	1.083	4.6	4.8
Indonesia	741	1.019	1.019	0	0
Israel	−20	1.042	1.042	0	0
Japan	−17,910	1.003	0.985	−1.8	−2.3
Korea, Republic of	555	0.998	1.002	0.4	0
Malaysia	−21	1.228	1.228	0	0
Mexico	−164	1.051	1.051	0	0
Morocco	441	1.565	1.578	1.3	0.03
Namibia	−23	1.003	1.003	0	0
New Zealand	121	1.081	1.081	0	0
Norway	501	1.175	1.191	1.6	−1.8
Paraguay	0	1.055	1.055	0	0
South Africa	1	1.004	1.004	0	0
Switzerland–Liechtenstein	696	1.004	1.038	3.4	0
Thailand	−271	1.021	1.016	−0.5	0
Tunisia	21	1.016	1.016	0	0
USA	30,121	1.023	1.062	3.9	2.5

agriculture and improvements in TE. As discussed above, even subsidies that are decoupled from production (which is the underlying principle in categorising subsidies under GB) may affect production through many channels such as creation of wealth effect, lowering risk-aversion, lowering the cost of credit and inducing investments, for example. This comes out clearly in the results, as countries that experienced a rise in their GB subsidies in the period 1995–2007 also experienced a rise in their TFP and TE scores. Change in the scores with and without GB subsidies show the extent to which productivity and efficiency in agriculture has increased as a result of GB subsidies.

Maximum increase in GB subsidies has been experienced by the EU countries, as the results

show that TFP growth in agriculture is 3.7 per cent per annum without GB subsidies but 8.3 per cent per annum as a result of GB subsidies. A rise of, on average, 4.6 percentage points per annum in agriculture productivity can be attributed to GB subsidies in the EU in the period 1995–2007. In the USA, the increase in GB subsidies was US\$30 billion in this period, which increased TFP from 2.6 per cent per annum to 6.8 per cent per annum, an increase of, on average, 3.9 percentage points per annum. This implies that over 13 years, agricultural productivity has increased around 60 per cent in the EU and 51 per cent in the USA on account of GB subsidies. This corroborates the results of a survey carried out by the German Federal Agricultural Research Centre in 2005 on a

Figure 7. Total factor productivity growth in agriculture production with and without GB in the EU: 2000–7



Source: based on WTO notifications: 1995–2010

sample of farms in Germany, which showed that investment aids increased the productivity of the farms by 40–73 per cent.

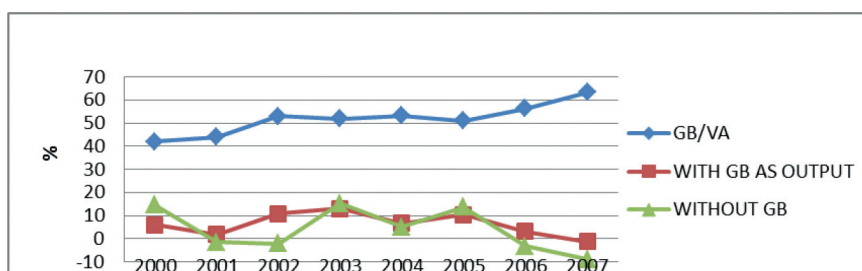
Similar increases in agricultural productivity are seen in case of Canada, Norway and Switzerland, although TE has not increased substantially in these countries. However, productivity may not rise for all countries as a result of an increase in GB subsidies. In Australia, although there is a rise in GB subsidies, TFP has actually declined. In the EU, decoupled income support is a large part of direct payments (almost 50 per cent), whereas in Australia it is a small fraction of direct payments.

In estimating year-to-year agricultural productivity change in the EU using the DEA, we find that GB as a proportion of total value added in agriculture increased from less than 10 per cent in 2000 to 38 per cent in 2007, thereby pulling up TFP growth from 2.7 per cent in 2001 to 11.4 per cent in 2007, which

would otherwise have been at 5 per cent in 2007 (Figure 7). Following the 2003 reforms, GB has contributed more to agriculture productivity than earlier CAP programmes. In 2014–20, planned GB subsidies are much higher and, therefore, will have greater impact on productivity and thereby agricultural production.

Similar analyses of year-on-year growth in agricultural productivity shows that in the USA GB subsidies as a ratio of total value added in agriculture increased from 42 per cent in 2000 to 63 per cent in 2007. Although this ratio remained between 53 per cent and 51 per cent in the period 2002–5, TFP growth increased from –2.1 per cent in 2002 without GB support to 10.7 per cent with GB support. In 2007, productivity growth without GB would have been –8.9 per cent but with the support it was –1.3 per cent. The spurt in GB subsidies post 2005 helped in sustaining productivity growth in the USA post 2005 (Figure 8).

Figure 8. Total factor productivity growth in agriculture production with and without GB in the USA: 2000–7



Source: based on WTO notifications and FAO

5. Impact of Green Box subsidies on production and international trade: simulation results

5.1 Results for aggregate regions

The impact of GB subsidies on production, export and import volumes, export revenues and import costs is estimated using the ATPSM model, which is a trade policy simulation model for quantifying the economic effects of trade policy changes at the global and regional levels. Although this model was developed to estimate trade policy changes with respect to tariff cuts, Amber Box subsidy reduction and other trade policy simulations, the model has been suitably modified to estimate the impact of reduction in GB subsidies on aggregate agricultural production and trade. ATPSM version 3.1 (January 2006)⁴ has been used and the data for aggregate production and trade have been updated using an average for 2005–7, from FAO statistics. The model covers 176 countries, and other countries are included in the Rest of World category. The economy of each country is represented individually, with the exception of the 15 EU countries, which are represented as a single country group.

To undertake simulations of the removal of GB subsidies, the cuts are applied to an aggregate category comprising all commodities, and impact on total production and total trade is estimated. Two kinds of simulations have been undertaken to quantify the impact of cuts in GB subsidies by the EU and the USA, as they contribute the bulk share of GB subsidies.

In 2007, the GB subsidies of the USA were US\$76 billion, of which around 70 per cent were food stamps. Removing food stamps from GB subsidies, a 30 per cent cut to total GB subsidies can be applied. However, using the estimates of ‘net equivalent support of food stamps to agricultural production’ (as discussed above; see Debar and Blogowski 1999), which is approximately 10 per cent, a cut of 40 per cent to US GB subsidies is applied. For the EU, decoupled payments amounted to 50 per cent

of total GB subsidies in 2007; therefore, a cut of 50 per cent is applied to GB subsidies. The first simulation results show the impact of a 40 per cent cut in the GB subsidies of USA and a 50 per cent cut in the GB subsidies of the EU. The second simulation has been carried out using a capping of US and EU GB subsidies to their 2001 level, after which there was a surge in box-shifting.

The results of first simulation – cutting GB subsidies by 40 per cent in the USA and 50 per cent in the EU – on agricultural production and trade at regional level are reported in Table 3. The results show that these cuts could lead to major restructuring of agricultural production and trade where production and exports shift towards more competitive producers in developing countries. Imports would rise in developed countries by 22 per cent, whereas production would fall by 5 per cent; in contrast, exports of developing countries would rise by 12 per cent and export revenue would increase by 17 per cent. There would be a fall in import cost and import volumes in developing regions.

LDCs would not experience a rise in their import costs, as has been argued many times in support of GB subsidies. In fact, export volumes would increase from LDCs by 9 per cent and export revenue would increase by 8 per cent, while imports would fall by 4 per cent. NFICs would also not be unfavourably affected, as their import costs would fall and export revenue rise, as non-food agricultural exports form these countries’ increases. Import volumes of agricultural products would rise substantially in the EU (35 per cent) and the USA (67 per cent) along with import costs. North Africa and the Middle East appear to gain most in terms of percentage change in volume of exports, but this may be because of their lower base. There would be a rise of 6 per cent in export volumes and export revenue in Sub-Saharan Africa.

4 ATPSM is a deterministic, partial equilibrium, comparative static model. It analyses the effects of price and trade policy changes on supply and demand using a system of simultaneous equations that are characterised by a number of data and behavioural relationships designed to simulate the real world. The model solution gives estimates of the changes in trade volumes, prices and welfare indicators associated with changes in the trade policy environment.

Table 3. Simulation results of capping of GB subsidies in 2007: 50 per cent cut in the EU and 40 per cent cut in the US GB subsidies

Region	Change in production (%)	Change in export volumes (%)	Change in import volumes (%)	Change in export revenue (%)	Change in import cost (%)
Central America	1	3	-5	3	-4
Caribbean	1	5	-3	8	-0.5
Central Asia	2	18	-8	21	-3
Central and Eastern Europe	2	14	-13	18	-4
Developed Countries	-5	-1	22	2	22
Developing Countries	1	12	-5	17	-4
LDCs	1	10	-4	10	-1
NFICs ⁵	1	19	-4	24	-3
North Africa and Middle East	2	29	-3	47	-0.1
North America	-4	-2	42	0	33
Oceania	2	6	-4	9	5
South America	1	7	-8	13	-7
Sub-Saharan Africa	1	6	-2	6	-0.3
Western Europe	-8	-3	33	-2	34
EU	-8	-4	35	-3	36
USA	-5	-4	67	-2	43
Rest of the World	-1	5	5	8	8

Source: author's estimations based on ATPSM

The results show that production- and trade-distorting impact of GB subsidies is not minimal, as even a cut of 40–50 per cent in just two countries leads to an increase in global trade volume of 5 per cent and trade revenues of 8 per cent, with an average increase in export revenues of more than 15 per cent for developing countries. The results for LDCs are starker, as this can lead to an increase in their trade revenues of between 10–17 per cent without a corresponding increase in their import costs.

The results of the second simulation, that is capping the GB subsidies of the USA and the EU to 2007 level, are reported in Table 4. This simulation estimates the extent of distortions caused by GB subsidies in global agricultural production and agricultural trade post 2001. The GB subsidies in the USA increased from US\$50 billion in 2001 to US\$120 billion in 2010, whereas those of the EU rose from €18 billion to €90 billion.

The results show that such a capping would result in substantial gains to developing

countries as well as to LDCs and NFICs in terms of agriculture production and trade. Agriculture production would shift towards more competitive producers and would increase by 3 to 5 per cent in developing regions, whereas export revenues would increase by 55 per cent in developing countries and 32 per cent in LDCs. NFICs would increase production of agricultural products (not necessarily food) by 4 per cent and their export revenues would increase by 81 per cent (probably because of their lower base), whereas import costs would decline by 4 per cent. Global agriculture production would increase by 3 per cent, whereas export volume would increase by 17 per cent and export revenue by 25 per cent. All developing regions would experience a fall in their import costs as production shifts to more competitive and lower cost producers, whereas the imports of developed regions would rise substantially. This indicates the extent of artificial competitiveness created as a result of subsidies in developed countries. Agricultural production in the USA would fall by 15 per cent and in

5 As per the list of the Committee on Agriculture, WTO-G/AG/5/Rev.10.

Table 4. Simulations results of capping of GB subsidies at 2001 levels in the EU and the USA

Region	Percentage change in production (%)	Percentage change in export volumes (%)	Percentage change in import volumes (%)	Percentage change in export revenue (%)	Percentage change in import cost (%)
Central America	4	10	-14	11	-10
Caribbean	1	17	-8	25	0
Central Asia	5	53	-17	65	-5
Central and Eastern Europe	6	69	-22	76	-8
Developed Countries	-14	3	64	5	65
Developing Countries	3	41	-10	55	-6
LDCs	3	33	-8	32	-1
NFICs	4	67	-10	81	-4
North Africa and Middle East	5	90	-8	145	1
North America	-13	5	158	-1	114
Oceania	5	17	-9	27	14
South America	4	23	-13	42	-9
Sub-Saharan Africa	3	23	-5	19	0
Western Europe	-19	8	80	-5	85
EU	-19	-10	85	-8	91
USA	-15	-10	226	-8	149
Rest of the World	3	17	17	25	25

the EU by 19 per cent, while their agricultural imports would rise by 200 per cent and 85 per cent respectively. Rises in import costs are lower than rises in import volumes, which can be taken as indicative of cheaper imports in these countries.

5.2 Results for Net Food Importing Countries

Country-wise results for capping of GB subsidies to 2001 levels (Table 5) show that that most of the NFICs would experience a rise in their agricultural production and exports. Although these countries are net food importing, they are also exporters of agricultural products, in particular Egypt, Morocco, Pakistan and Peru. It is found that their imports rise but import costs fall owing to exports being provided by more

efficient producers of food at a lower cost. Ten countries in the group are Commonwealth member countries. Most of these countries would experience a rise in their imports and a fall in their import costs.

5.3 Results for CAIRNS group countries

The results for agricultural exporters (CAIRNS group countries) are reported in Table 6, along with the change in export and import revenues. The results show that all the countries in the group gain in terms of net exports. The highest gains in terms of net exports apply to Brazil, followed by Australia. All Commonwealth member countries are net gainers in terms of net exports, with increases in agricultural production in almost all countries.

Table 5. Simulation results of capping GB subsidies at 2001 levels in the EU and the USA for NFICs

Country	Percentage change in production (%)	Percentage change in export volumes (%)	Percentage change in import volumes (%)	Change in import cost (US\$ thousands)
<i>Commonwealth member countries</i>				
Barbados	1	5	-7	-1,163
Botswana	1	4	-2	-1,941
Dominican Republic	2	44	1	364
Jamaica	1	5	8	-9,258
Kenya	3	28	13	-22,976
Mauritius	0	2	4	17,247
Pakistan	2	138	16	-113,444
Sri Lanka	1	5	6	2,247
St Lucia	0	0	3	845
Trinidad and Tobago	2	5	7	-3,158
<i>Others</i>				
Egypt	4	134	6	-5,858
Honduras	2	8	17	-4,730
Morocco	4	28	5	19,193
Peru	2	38	9	28,507
Senegal	1	13	4	2,225
Tunisia	4	56	3	30,965
Venezuela	2	61	11	-73,127

Table 6. Simulation results of capping GB subsidies at 2001 levels in the EU and the USA for CAIRNS countries

Country	Percentage change in production (%)	Percentage change in exports (%)	Percentage change in imports (%)	Change in export revenue (US\$)	Change in import cost (US\$)
<i>Commonwealth member countries</i>					
Australia	4	12	-13	2,678,083	-147,988
Canada	5	9	15	1,454,504	-306,138
Malaysia	0	0	3	29,795	4,236
New Zealand	4	6	4	795,982	541,223
Pakistan	2	138	16	431,443	-113,444
South Africa	3	13	10	454,326	107,555
<i>Others</i>					
Argentina	3	13	-12	1,733,800	-94,737
Bolivia	2	42	13	71,385	-15,973
Brazil	2	20	12	4,167,607	-295,311
Chile	4	45	50	434,543	1,821
Colombia	2	19	7	318,788	-27,060
Costa Rica	1	2	3	36,922	-2,948
Guatemala	1	8	10	108,981	-20,839
Indonesia	1	7	21	289,079	-209,400
Paraguay	2	5	18	119,853	-10,754
Peru	2	38	9	115,323	28,507
Philippines	1	10	9	163,428	60,509
Thailand	1	5	5	453,217	38,303

6. Stronger international disciplines on Green Box subsidies are needed

GB subsidies as they stand in the AoA must have no, or at most minimal, trade- or production-distorting effects. Although developed countries have over the years attempted to decouple their domestic support in GB from production, they have increasingly coupled them with producers' behaviour. Box shifting in developed countries has substantially increased the amount of GB subsidies. The sheer volume and nature of subsidies provided by some of the developed countries, in particular the EU countries and the USA, have led to significant production and trade distortions. These subsidies operate by influencing producers' decisions with respect to current production volumes and sales by lowering their costs of production, increasing their wealth, lowering their risks of investments and creating domestic demand for their products. Growing theoretical as well as empirical literature on production- and trade-distorting impacts of GB subsidies has been largely ignored to date.

There have been many unsuccessful efforts in the past to reopen and redefine the criteria on GB subsidies in order to make the subsidies listed in Annex 2 of the AoA meet the criteria of the Annex's first paragraph. The Chair's overview paper in 2002 (TN/AG/6, 18 December 2006) based on proposals received on possible changes in the GB provisions and comments of G-20 (JOB (06)/145, 16 May 2006) on the review paper reports the proposed changes. Subsidies debated under GB include direct payments to the producers (paragraph 5), including decoupled income support (paragraph 6) and government financial support for income insurance and income safety-net programmes (paragraph 7). It has also been pointed out by the G-33 proposal that price support for small resource-poor farmers for public food stockholding programmes should be shifted to GB subsidies that are allowed without limits. Furthermore, a new GB category has been suggested for developing countries to cater for their programmes on poverty alleviation, rural development, food security, agriculture diversification and the provision of employment opportunities.

In the Bali Ministerial meeting in December 2013, WTO members have agreed to prepare a work programme for concluding Doha Round. A group of issues that have been identified as 'easier to settle' for building the momentum include issues in export competition, tariff quotas, developing countries' food stockholding for food security, and a proposed list of general services of particular interest to developing countries that would be added to the GB. There is a need to bring 'revision of the provisions in green box' into the post-Bali work programme. The new CAP in the EU (2014–20) and in the US Farm Bill 2014 has substantially increased EU and US domestic support measures in direct payments and other categories of GB. This can lead to significant distortions in world production and international trade in agriculture, adversely impacting the more efficient and small producers in developing countries. In 2007, around 70 per cent of total GB subsidies were provided by the EU and the USA.

It has been argued that GB subsidies in developed countries should be limited to low-income farmers; however, given the way in which these subsidies are now being designed, it may not be possible to distinguish between those subsidies under GB that reach low-income farmers and those that benefit high-income farmers.

Based on the empirical evidence and arguments on the production- and trade-distorting impact of GB subsidies, which are by no means minimal, the provisions under GB need to be revisited. GB subsidies need to be disciplined.

Some of the broad principles that can be followed include:

- Capping the total GB expenditures of developed countries. There is a need to identify an upper bound for the extent of subsidies that can be provided by developed countries under the GB. This is important for avoiding any further box-shifting.
- Limit or completely eliminate subsidies provided under decoupled payments, as

- these payments will necessarily be coupled, either directly or indirectly, and will support production that may not otherwise be economically viable.
- Allow direct payments only in cases of natural disasters and/or where production loss has otherwise been above a threshold level.
- Structural adjustments programmes have to be time-limited or they may lead to cumulative production- and trade-distorting impacts.
- Strengthen the review mechanism to ensure that expenditures categorised under GB satisfy the basic principle of Annex 2 of the AoA.

7. Summary and conclusions

Agricultural subsidies and their impact on the production, trade and international competitiveness of developed countries has been a contentious issue in multilateral negotiations since the early 1980s. An important step was taken during the Uruguay Round to bring these subsidies under the ambit of international rules in the AoA. The idea of exempting production and trade-neutral subsidies from WTO commitments was first proposed by the USA in 1987 and subsequently endorsed by the EU. These subsidies were categorised under the GB.

Following the AoA, there has been a significant reduction in subsidies under the Amber Box and Blue Box in the developed countries. However, this decline has been more than compensated for by substantial increases in GB domestic subsidies following extensive 'box-shifting' of subsidies. The USA increased its GB subsidies from US\$46 billion in 1995 to US\$120 billion in 2010, whereas the EU's GB subsidies increased from €9.2 billion to €68 billion in the same period. GB subsidies have increased by more than 150 per cent in Australia, by around 75 per cent in Norway and by more than 50 per cent in Switzerland and Canada in the period 1995–2010. The spurt in the growth of GB subsidies has occurred post 2000 and continues to grow.

Literature provides sufficient evidence on the favourable impact of GB subsidies on the production and competitiveness of the developed countries. This paper adds to the existing literature by estimating the impact of GB subsidies on agricultural productivity and technical efficiency in 26 countries in the period 1995–2010. DEA results show that in the EU, TFP growth in agriculture would have been 3.7 per cent per annum in this period without GB

subsidies, but it increased to 8.3 per cent per annum as a result of GB subsidies. For the USA, TFP growth increased from 2.6 per cent per annum to 6.8 per cent per annum, an increase of, on average, 3.9 percentage points per annum as a result of GB subsidies. This implies that over 13 years, agricultural productivity has increased around 60 per cent in the EU and 51 per cent in USA on account of GB subsidies.

Estimating year-to-year agricultural productivity change in the EU, DEA results show that GB subsidies as a proportion of total value added in agriculture increased from less than 10 per cent in 2000 to 38 per cent in 2007, which raised TFP growth from 5 per cent to 11.4 per cent in 2007. A similar analysis shows that in the USA, GB subsidies as a ratio of total value added in agriculture increased from 42 per cent in 2000 to 63 per cent in 2007. TFP growth increased from –2.1 per cent in 2002 without GB support to 10.7 per cent with GB support. In 2007, productivity growth without GB would have been –8.9 per cent but with GB support it was –1.3 per cent. The spurt in GB subsidies post 2005 helped in sustaining productivity growth in the USA.

The impact of GB subsidies on production, export and import volumes, export revenues and import costs is estimated using the ATPSM (version 3.1, January 2006). The data for aggregate production and trade have been updated using averages taken from 2005–7 FAO statistics. The results of the first simulation, that is cutting GB subsidies by 40 per cent in the USA (excluding food stamps) and 50 per cent in the EU (decoupled payments), show that these cuts could lead to major restructuring of agricultural production and trade, whereby production and exports shift towards more competitive

producers in developing countries. Following the cuts, imports rose in developed countries by 22 per cent, whereas production fell by 5 per cent; in contrast to this, the exports of developing countries rose by 12 per cent and export revenue increased by 17 per cent. LDCs did not experience any rise in their import costs; in fact, export volume and export revenue increased in LDCs by 9 per cent and 8 per cent respectively, whereas imports fell by 4 per cent. NFICs were also not unfavourably affected, as their import costs fell.

Results of the second simulation, that is capping US and EU GB subsidies to the 2001 level, show that such a capping will result in substantial gains to developing countries as well as to LDCs and NFICs in terms of agriculture production and trade. Agriculture production increases by 3–5 per cent in developing regions, while export revenues increase by 55 per cent in developing countries and 32 per cent in LDCs. NFICs increase production of agricultural products (not necessary food) by 4 per cent, whereas import costs decline by 4 per cent. Global agriculture production increases by 3 per cent, whereas export volume and revenues increase by 17 per cent and 25 per cent respectively. These results indicate the extent of artificial competitiveness created because of subsidies in

developed countries. Agricultural production in the USA fell by 15 per cent, and in the EU fell by 19 per cent, whereas agricultural imports rose by 200 per cent and 85 per cent respectively. Rises in import costs are lower than rises in import volumes, which can also be taken as indicative of cheaper imports in these countries.

In view of the growing literature and empirical evidence on the production- and trade-distorting impact of GB subsidies of developed countries, which are substantial in volume, it is important to bring GB subsidies under international disciplines and to cap them in order to avoid further box-shifting. There is a strong case for giving priority to disciplining GB subsidies in the post-Bali work programme. Some of the broad principles suggested by this paper for disciplining GB subsidies include capping total GB expenditures of developed countries; limiting or completely eliminating subsidies provided under decoupled payments; allowing direct payments only in the case of natural disasters and/or where production loss has otherwise been above a threshold level; making structural adjustment programmes time-bound; and strengthening the review mechanism to ensure that expenditures categorised under the GB satisfy the basic principle of being minimally production- and trade-distorting.

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