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An EU-Canada bilateral trade agreement a DefraTAP application

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Abstract

The first round of negotiations held in Ottawa on the 19th October, 2009, heralded the opening of bilateral trade talks intent on reaching a Canadian-European Union (EU27) free trade area (FTA) agreement. A second round of negotiations were staged in Brussels in January, whilst further rounds are scheduled for 2010, with the longer term aim of ratifying an agreement within 24-30 months. Although stumbling blocs will be encountered, the divergent political interests of each region are compatible. In Canada, a FTA with its second largest trading partner offers a viable alternative to its current overdependence on the US. Similarly, the EU27 sees an opportunity to regain a competitive foothold in the North American market.

This paper re-examines the long run trade led gains from a Canada-EU27 FTA. Unlike previous studies, our assessment also accounts for the HS6 level sensitive product declarations submitted by both parties in the first round. We examine the extent to which these proposals afford protection to key strategic sectors and impact on trade led growth and real incomes. All estimates are compared with a realistic contemporary baseline scenario. The results suggest that non tariff barrier (NTB) reductions dominate real income gains, whilst sensitive product exceptions, principally affecting wheat, dairy, wearing apparel and leather sectors, reduce Canadian and EU27 real income gains by 20% and 24%, respectively. Trade diversion impacts are relatively marked for the US and EFTA, whilst China escapes largely unscathed due to the pattern of its trade specialisation.

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1. Introduction

Since its inception, the European Union (EU) has traditionally enjoyed warm relations with Canada. Notwithstanding, progress on economic integration has been sporadic, focusing on isolated sectors (e.g., science and technology, education, competition, wine and spirits, aviation etc.) and between specific geographical regions (e.g., Canada-UK, Canada-France, Quebec-France). Consequently, the annual Canada-EU27 summit in Berlin in July 2007 took on additional significance when the idea was first mooted to examine the potential for closer economic ties. At that time, the Doha Development Round (DDR) was still in full sway and neither side wished to undermine multilateral negotiations which promised 'first-best' economic gains to all parties concerned. Unfortunately, in the ensuing period multilateral talks have lingered, whilst the trade reform agenda has been engulfed by a proliferation of 'second-best' bilateral free trade areas (FTAs). Indeed, over the last two years, Canada has signed accords with Columbia, the European Free Trade Association (EFTA), Jordan and Peru, whilst the EU27 has ratified an FTA with Korea and is looking to finalise an agreement with India.

Against this background, the politically strategic importance of a Canada-EU27 FTA should not be underestimated. Canada has enjoyed significant growth as a member of the North American Free Trade Agreement (NAFTA) with Mexico and the United States (US), although as the recent economic crisis has shown, it has arguably become over-reliant on the US economy, subsequently lacking resistance to US business cycles. Moreover, recent calls from Capitol Hill to re-negotiate NAFTA as well as clauses in the fiscal stimulus package to 'buy US', have not gone unnoticed by Canada. From the EU's perspective, an FTA with Canada presents a unique opportunity to restore a degree of competitive parity with the US, which was lost under the NAFTA agreement.

Table 1 presents the top ten merchandise trade partners for Canada and the EU27 and highlights two main observations. Firstly, as postulated by the gravity model (Anderson and van Wincoop 2003), bilateral trade is positively related to mass (i.e., GDP) and negatively correlated with distance. Under these simple criteria, EU27 imports from Canada are perhaps under-represented. For example, due to its GDP the EU27 ranks second for Canada, whilst Canada, which has a considerably larger

economy than either of Switzerland, Turkey or South Korea, lies tenth.[1] Furthermore, time series data (Eurostat 2009) demonstrate that Canada's share of EU27 trade has fallen from 2.3% in 1999 to 1.7% in 2008. Secondly, the data show that the US and to a lesser extent China, play a key role for both regions, whilst specific EFTA members (i.e., Switzerland and Norway), have significant trade relations with the EU27.

The structure of trade protection in both trading partners is presented in Table 2. The underlying statistic for both regions is the relatively low average MFN applied tariff rates (4.7% and 5.6% in Canada and the EU27, respectively). In both regions, tariff protection is concentrated in the agricultural sectors, recorded at 11.5% (Canada) and 16.0% (EU27). The maximum applied tariff line in Canada is found within animal products (718%), although on average Canadian dairy produce is the most sensitive, with an applied protection rate of 126%.[2] By the same token, EU27 dairy (64.1%) and 'sugars and confectionary' (33.3%) regimes are the most trade prohibiting. In non-agricultural and fishing sectors, both Canadian and EU27 average applied tariffs are highest on clothing imports (16.9% and 11.5% respectively).

Reviewing the data above, it is expected that Canada would benefit considerably more than the EU27 from a hypothetical FTA, whilst trade diversion impacts are mainly expected in the US. Average applied tariffs on merchandise trade are relatively low which is likely to moderate Canada-EU27 trade gains, although Guerin and Napoli (2008) suggest that the EU27 exhibits a similar tariff structure to the US when it signed the CUSFTA (Canada-US FTA) in 1989, which resulted in notable trade gains to Canada. Further, it is anticipated that higher than average protection on agro-food imports would imply important resource shifts in these sectors under full liberalisation; a factor which underlies the debate on 'sensitive product' exceptions within the negotiations. Finally, the potential economic gains from the liberalisation of non-tariff barriers (NTB) relating to trade-inhibiting practices on merchandise (i.e., licensing, pre-shipment inspection, rules of origin, etc.) and services trade (i.e., application delays for visas; restrictions on ownership by, or participation of foreign firms, etc.) and the concomitant positive spill-over effects on investment are likely to be considerable.[3]

[1] Furthermore, other positive factors on trade postulated within the gravity model, such as cultural similarities and common language, suggest that Canada-EU trade ties should be even stronger.
[2] Note, that in Table 2, zero per cent of dairy tariff lines are duty free.
[3] EU-Canada services trade amounted to €20.5 billion in 2007 (Eurostat 2009), dominated by 'transport' and 'travel' services. The EU also offers notable exports to Canada of (€877 million) and insurance (€621 million) services.

A review of the relevant literature reveals only two studies which enumerate the economic gains from a Canada-EU27 FTA. One example by Cameron and Loukine (2001) employs the standard Global Trade Analysis Project (GTAP) computable general equilibrium (CGE) model and accompanying version 4 database, aggregated to 6 regions and 10 sectors (including aggregate 'primary agriculture' and 'food sectors'). The study develops two policy scenarios: tariff elimination on all merchandise trade except food and agriculture; and complete tariff elimination. As the study pre-dates EU-enlargement, the authors represent an 'enlarged' common agricultural policy (CAP) via trade preferences to accession members. The study estimates that trade creation exceeds trade diversion yielding real income or equivalent variation (EV) gains to Canada and the EU15 of up to $236 million (0.04% of GDP) and $772 million (0.01% of GDP), respectively. Interestingly, the US suffers a trade diversion loss of $562 million.

In a second study, commissioned by the European Union and Government of Canada (EU and GC, 2008), a 35 sector aggregation of the GTAP data (version 7) is employed.[4] The CGE model code is modified to capture imperfectly competitive 'scale effects', efficiency gains in manufacturing and services sectors from reductions in trade costs (i.e., NTB), and a long run closure to characterise capital accumulation from real income induced investment increases. Consequently, EV estimates from a Canadian-EU27 FTA scenario are significantly magnified compared with Cameron and Loukine (2001). Canada and the EU27 gain €8,161 billion (0.77% of GDP) and €11,594 billion (0.08% of GDP) respectively, whilst 66% and 75% of the total gains stem from NTB removal in Canada and the EU27, respectively.

The aim of this study is to reassess the economic impacts of a Canada-EU27 FTA employing the GTAP data and a modified long run variant of the accompanying CGE model. Unlike previous studies, more attention is given to the trade impacts in the agro-food sectors where a majority of tariff peaks occur, whilst we also shed more light on the trade diversion (and consequently global) impacts. A unique feature of the paper is to focus on the HS6 sensitive product declarations submitted by both parties in the first round of trade talks in October 2009. We examine the extent to which these proposals afford protection to the relevant sectors and affect trade led growth and real incomes. All results are compared with a realistic contemporary baseline scenario.

[4] The sector aggregation treats agricultural and food processing activities as single aggregate sectors. The regional aggregation employed is not stated and it is not clear if the authors refer to the EU25 or EU27. Moreover, the remit of the study does not contemplate the impacts of trade diversion on third countries.

The rest of this paper is structured as follows: Section 2 details the data, methodology and the scenario designs employed. In section 3, the results are discussed, whilst section 4 concludes.

2. Methodology

2.1 Modelling and Data

There is a burgeoning of CGE trade literature quantitatively analysing (*inter alia*) the impacts of multilateral (e.g., Francois et al. 2005), regional (e.g., De Bruijn et al. 2008) and bilateral trade agreements (e.g., Gouranga and Andriamananjara 2006). Underpinning these studies is the widely respected Global Trade Analysis Project (GTAP) database (Narayanan and Walmsley 2008), which in its latest incarnation (version 7), is benchmarked to 2004 and covers production and trade flows for 113 regions and 57 commodity groupings.

Accompanying the data, is a 'standard' comparative static GTAP model framework based on a system of neoclassical final, intermediate and primary demand functions. Assuming weak homothetic separability, optimisation is sub-divided into 'nests' to allow greater 'behavioural' flexibility through the incorporation of differing elasticities of substitution, whilst accounting identities and market clearing equations ensure a general equilibrium solution. Once the model is calibrated to the data and an appropriate endogenous/exogenous variable split is chosen (i.e., 'closure'), macroeconomic or trade policy 'shocks' can be imposed on key exogenous policy variables (i.e., tariff/subsidy rates, technical change variables etc.). Through the interaction of economic agents within each market, a 'solution' is characterised by a 'counterfactual' set of equilibrium conditions. The standard framework is modified in a number of ways, with additional discussion in the technical appendix.

As the analysis of Canada-EU27 protectionism reveals, sectoral impacts in agricultural sectors are likely to be larger due to the prevalence of tariff peaks. Consequently, to improve the analysis, significant additional model code is inserted to capture the rigidities inherent within agricultural factor and product markets. Firstly, following Keeney and Hertel (2005), constant elasticity of substitution (CES) substitution possibilities are modelled between intermediate inputs and primary factor demands, whilst in livestock sectors, intermediate feed inputs are also now CES

substitutable.[5] A constant elasticity of transformation (CET) controls the transfer of labour and capital factors between agricultural/non-agricultural sectors to capture observed differentials in wages and rents in each sub-sector.

Secondly, a three-stage weakly separable CET nest to capture land-use heterogeneity across different agricultural activities is employed. Thirdly, following the procedure of van Meijl et al. (2006), an econometric nonlinear land supply function is estimated for the 113 regions in version 7 database, complete with an aggregation program for the relevant land supply parameters. Fourthly, the study incorporates explicit modelling of the EU27 common agricultural policy (CAP) (*e.g.*, set aside, CAP budget, intervention prices, quotas etc.), whilst raw milk quotas are modelled in Canada.[6] Finally, Canadian and EU27 tariff-rate quotas (TRQs) are modelled (Elbehri and Pearson 2005), although the broad GTAP sectoral classification restricts TRQ representation to Canadian dairy imports and EU27 wheat and beef imports (see appendix).

To keep the model within computational limits and focus on those issues of interest the data is aggregated to 13 regions/countries and 32 sectors (Table 3). Owing to the addition of model coding for the agricultural sectors, it is necessary to disaggregate the EU27 into four separate regions, although results are only reported for the EU27. In addition to Canada, the choice of remaining regions is based on the trade data in Table 1, whilst a 'rest of the world' region captures residual production and trade flows. The detailed disaggregation of agro-food sectors permits a more detailed examination of the main gainers/losers at the sectoral level. Remaining non-food sectors are grouped into four manufacturing sectors and ten services sectors.

2.2 Experimental Design

Under the auspices of the Comprehensive Economic Trade Agreement (CETA), the first round of Canada-EU27 negotiations began on the 19th October, 2009, in Ottawa, whilst a full ratification of an agreement is unlikely before 2012. Under article XXIV:5(c) GATT, a FTA should be completed within, "a reasonable length of time",

[5] The standard GTAP employs a Leontief specification. This implies that, for example, the intensiveness of fertiliser application on land cannot alter, or competing feeds are not substitutable in livestock sectors. Substitution elasticities are calibrated to OECD central values of Allen partial elasticities (Keeney and Hertel 2005).

[6] Owing to the short term transitional nature of many of Canada's agricultural policies and the medium to long run time horizon considered, no attempt was made to further model its agricultural sector.

defined as ten years, although it is further stated that, "In cases where member parties…believe that 10 years would be insufficient they shall provide a full explanation…of the need for a longer period". As Bartels (2009) notes, "Practice indicates that it is relatively common for the implementation period to stretch to 12 years" (pp346). Accordingly, a long-run 'baseline' is carefully designed up to 2024 (Table 4), against which two Canada-EU27 FTA scenarios are compared.

The baseline incorporates trade protection shocks to accommodate European enlargement. Further Canada/EU27 tariff elimination shocks are implemented to characterise recently ratified FTA deals (post 2004), or FTAs which are scheduled to conclude post 2004. In this way, our reported trade creation and diversion effects from the EU-Canada FTA are more accurately isolated. Thirdly, the baseline employs the latest DDR modalities for agriculture (WTO 2008a) and non-agriculture (WTO, 2008b), differentiated between developed and developing countries, small vulnerable economies (SVEs), recently acceded members (RAMs) and less developed countries.

To enumerate the Doha tariff shocks, specialist software developed by Horridge and Laborde (2008) is employed, with data on 5113 disaggregated HS6 applied and bound tariff lines across 227 countries in 2004. By entering the relevant tariff reduction formulae, this facility calculates necessary applied tariff reductions (accounting for tariff binding overhangs) and aggregates to a GTAP concordance consistent with the user's chosen aggregation. Doha tariff reductions also include 'sensitive' concessions on four per cent (five and one third per cent) of HS6 product lines for developed (developing; small vulnerable economies (SVEs); recently acceding member (RAMs)) countries,[7] based on the criterion of tariff revenue forgone (Jean et al. 2005).[8] Fourthly, in accordance with the 'provisional' agreement reached at the Hong Kong summit in December 2005, all export subsidies are eliminated.

In addition to the above trade shocks, a 'likely' EU27 CAP reform scenario is inserted. Following Oskam et al. (2004), a digression rate of 2 per cent per annum in

[7] Owing to complexity of the model code, TRQs are only modelled between Canada and the EU27. It is therefore assumed that 68% (instead of 66% - see WTO 2008) of the corresponding Doha tariff reduction is applied to sensitive product lines to account for the absence of additional market access from TRQ expansion.

[8] This criterion has become an accepted hypothesis for identifying sensitive products, although it is hampered by assuming invariant tariff quantities, whilst cases of prohibitive tariff barriers have a zero weighting. Nevertheless, it still 'largely' accounts for the (political) importance of the commodity (i.e., size of the tariff revenue), the height of the applied tariff compared with the c.i.f. import price, and the distance between the binding and applied tariff rates (i.e. the revenue fall under each formula is a function of this 'distance').

nominal euros is applied to the EU27 single farm payment (SFP) (pillar I) from the 2013 ceiling limits[9] and modulation rates are raised to 20 per cent from the current 5 per cent limit. With complete decoupling, all price support and quantitative constraints are eliminated, whilst the Canadian milk quota is maintained.[10] A final feature of the baseline is the model closure. Given the importance of investment flows on potential trade led gains, a long run closure swap permits an endogenous treatment of the interaction between changes in investment and the capital stock. Thus, it is assumed that investment moves in tandem with fixed savings rates, respecting the long run empirical observation that domestic saving finances domestic investment (Francois et al. 1996).

In addition to the baseline shocks, the first 'policy' scenario implements a full Canada-EU27 FTA characterised by bilateral tariff eliminations.[11] Whilst the standard GTAP database lacks bilateral estimates of NTBs, EU and GC (2008) provide econometric estimates of NTB costs between Canada and the EU27 for the ten aggregate service sectors included in this study. Following EU and GC (2008), Canada-EU27 NTB liberalisation is only partial, although as suggested by the trade data and literature, even small NTB cost reductions will bestow important trade creation gains to both parties.[12] In non-commodity goods sectors (i.e., food processing and manufacturing), the assumption in EU and GC (2008) of a two percent NTB cost saving is implemented. In the model code, the (partial) removal of trade restraining NTB measures is imposed by shocking a bilateral hicks-neutral technical change variable in the import (Armington) demand function (Hertel et al. 2001). This has the effect of increasing the 'effective quantity' imported at a lower 'effective price'.

The second scenario examines the impact of 'sensitive' product exemptions on trade creation and diversion. Unfortunately, GATT article XXIV employs a nebulous definition of a preferential trading agreement (e.g., FTA), as the removal of restrictions 'on substantially all the trade', which grants a degree of flexibility at the negotiating

[9] Since a full FTA is assumed by 2024, the 2% per annum reductions on the SFP ceiling limits in 2013 to EU27 members are calculated over 11 years.

[10] Referring to the Canada-EU talks, Canadian Trade Minister Stockwell Day maintained that "..supply side sectors are not things we negotiate...We have established many bilateral and multilateral agreements with that understanding, and that is how we are proceeding with this one."
http://www.bilaterals.org/article.php3?id_article=16156&lang=en

[11] Although this scenario is politically overambitious, it still serves as an upper limit estimate on the gain to both parties.

[12] EU and GC (2008) estimate additional NTB services trade costs into Canada ranging between 24-52%, whilst those for the EU are between 18-42%. The authors have extrapolated from the increase in services trade under EU's single market in order to estimate the magnitude of NTB services trade cost reductions from Canada-EU bilateral liberalisation. Consequently, NTB cost reductions in the order of between 2%-10% (depending on the service sector) are derived, which in turn, are employed in this study.

table. Examining Canada's initial tariff offer from the October 2009 negotiations (EC, 2009), exceptions are proposed on 8.1% of tariff lines, divided between agrifood (3.7%) and non-agrifood (4.4%) commodities respectively. The EU27 proposes exceptions on 10% of tariff lines apportioned as 3.9% and 6.1% between agrifood and non-agrifood tariff lines respectively. These tariff reduction exemptions are implemented at the HS6 level and aggregated to the GTAP sector concordance employing the TASTE program.

3. Results

The size and complexity of the model framework makes a discussion of all the results unwieldy. Instead, the focus is on Canada and the EU27 aggregate region, whilst some commentary is reserved for the trade diversion impacts on third countries.

3.1 Scenario 1 vs. Baseline

3.1.1 Macro Welfare

Macroeconomic (welfare) impacts are presented in Table 5 compared with the baseline and calculated as money metric changes in real income (equivalent variation) measured in millions of euro at 2004 prices. Table 5 also provides a decomposition of equivalent variation (EV) between allocative efficiency (AE), terms of trade (ToT) impacts, endowment effects (EE) and efficiency gains from partial removal of non tariff barriers (NTBs). Compared with the baseline, both the EU27 and Canada realise trade led gains of €4,336 million and €3,157 million respectively, which equates to a corresponding per capita real income gain of 0.05% and 0.45%. Not surprisingly, Canada's trade led gains are larger given the EU27's trade weighting.

Interestingly, the proportion of EV gains owing to trade facilitation from NTB eliminations is 67% (Canada) and 57% (EU27) (not shown). Indeed, despite the fact that NTB removal is only partial, it still dominates since it applies to the majority of trade flows (except primary agriculture), whilst in many sectors (i.e., non-food manufacturing) tariff barriers are typically low, or zero (i.e., services) in these sectors.

AE measures the change in resource or product usage from policy shocks imposed on a given market distortion (i.e., tax/tariff or subsidy). For example, a tax discourages resource usage compared with free (undistorted) markets, whilst a subsidy has the

opposite effect. Consequently, taxed (subsidised) activities have a positive (negative) marginal social value, whilst an increase (decrease) in the level of a relatively highly taxed (subsidized) activity results in an AE gain (loss) (Huff and Hertel, 2000). Tariff abolition implies increases in imports for both regions, whilst there is a contraction in subsidised agricultural activity in the EU27 (-0.05% (not shown)). Accordingly, Canada and the EU27 realise AE gains of €889 million and €973 million, respectively.

The ToT effects for both regions are also positive, estimated at €434 million (Canada) and €1,040 million (EU27). Owing to tariff eliminations, trade induced increases in economic activity bid up factor prices (i.e., real exchange rate) in both regions. Consequently, domestic (and consequently export) prices are increased. Examining the EE, the endowment of land falls (rises) slightly in the EU27 (Canada) owing to a contraction (expansion) in the primary agricultural sector.[13] The single largest source of EV gain is the EE for net capital investment. Owing to trade induced economic growth, EE is estimated at €928 million and €1,504 million in Canada and the EU27, respectively.

The employment of NTBs represent an additional usage of resources to (*inter alia*) meet regulatory stipulations, modify products for different markets and comply with import procedures. Liberalisation of NTBs therefore represents an unambiguous efficiency gain to both regions, which is a function of the size of the trade flow and the trade elasticity in each region. Given Canada's greater trade relative dependency on EU27 markets, efficiency gains in Canada (€897 million) exceed those of the EU27 (€820 million), both in relative and absolute terms.

Examining third countries, the trade diversionary impacts of the Canada-EU27 FTA are mostly felt in the US and EFTA regions, which show per capita real income losses of 0.02% (€1,626m) and 0.05% (€212 million) respectively. As a result of the relative contraction in economic output in both regions, the majority of EV losses stem from relative contractions in net capital investment and ToT losses due to real exchange rate deteriorations. Despite its importance in EU27 and Canadian trade (Table 1), the loss to China is mitigated owing to the fact that unlike Canada and the EU27, it specialises in lower value added goods (vis-à-vis services trade).

[13] In the GTAP model data, the land factor is specific to the agricultural sectors only.

3.1.2 Sectoral Output, market prices and trade balances

Table 6 presents changes in sectoral output, market prices and trade balances compared with the baseline. Output changes are a function of the relative trade competitiveness between the EU27 and Canada, the associated arming ton (trade) elasticities, the magnitude of the bilateral trade flows, as well as the pattern of each region's trade with third countries (trade diversion). The majority of agro-food trade is through processed food sectors, which impacts on upstream sectors through purchases of intermediate inputs. With the exception of 'vegetables, fruits and nuts', dairy and the 'other food' processing,[14] Canada is more trade competitive in these sectors.

Examining the results for scenario 1 (Table 6), Canada witnesses large percentage increases in rice (185.1% - calculated from a small base) and wheat (14.8%).[15] From the EU27 perspective, the elimination of its wheat TRQ results in a production fall of 1.9%. Canadian 'oilseeds' and 'other grains' production falls due to the reallocation of land into the wheat activity, whilst the contraction in Canadian oilseeds impacts on the downstream 'vegetable oils and fats' sector.[16] Furthermore, Canada's 'vegetables, fruits and nuts' sector (14% of total agricultural output) contracts 0.5%, whilst the removal of its dairy TRQs leads to 7.9% and 9.3% reductions in Canadian raw milk and dairy sectors respectively.[17] The EU27 makes concurrent gains of 0.3% and 0.8% in raw milk and dairy, respectively. Examining meat production, the Canadian meat and livestock industry benefits at the (slight) expense of EU27's corresponding sectors.

Overall, aggregate agro-food production[18] in Canada falls by 0.3%, with a 0.6% gain in primary agriculture partially mitigated by contractions in food processing (-0.7%) due to large contractions in dairy activities. In the EU27, agricultural production falls 0.1% due to output losses in the wheat sector, whilst overall agro-food production improves (0.1%), due to trade led gains in dairy.

In manufacturing sectors, where the majority of bilateral intra-industry trade occurs, partial removal of bilateral NTBs in both regions has (*ceteris paribus*) an unambiguous positive impact on sectoral output. The exception is 'light' manufacturing

[14] This is typically a large sector covering (*inter alia*) processed fish, vegetable, fruit and cereal products.
[15] Wheat constitutes approximately 10% of primary agricultural production in Canada.
[16] In this paper, land usage is modelled as heterogeneous between competing agricultural sectors – see appendix. Moreover, 'other grains' is not traded in significant quantities between the two regions, whilst the GTAP protection data records near negligible tariffs on bilateral oilseeds trade.
[17] In the GTAP database, raw milk is non-tradable and almost entirely purchased by the downstream dairy sector.
[18] In the interests of saving space, aggregate agro-food statistics are not reported in Table 6.

in Canada, which suffers due to its relatively higher tariff protection. In the absence of tariff protection for services trade, the partial NTB elimination results in output increases in both regions, where the smaller percentage rises in the EU27 reflect changes on a larger base and the reduced relative importance of Canadian trade in the EU27. With sectoral rises in manufacturing and services, Canadian and EU27 real GDP grows 0.4% and 0.04% compared with the baseline (Table 6). Macro growth is accompanied by rises in net capital investment (Table 7), although with the decline in EU27 primary agriculture, land usage falls slightly accompanied by corresponding land use increases in Canada (Table 7).

Turning to the changes in factor prices (Table 7), economic growth in both regions bids up relative labour, capital and natural resource returns. Aggregate agricultural land rents fall slightly in the EU27 owing to minor land idling, whilst in Canada land rents increase 2.1% from the expansion in primary agricultural output. With increases in factor costs, there are general rises in domestic sectoral market prices (Table 6) in both regions, with the notable exception of Canadian dairy prices, which fall owing to an influx of cheaper EU27 imports. The retail price index rises 0.2% and 0.1% in Canada and the EU27, respectively.

Turning to the trade balances (Table 6), the Canadian (EU27) 'agricultural and fishing' trade balance improves €363 million (deteriorates €440 million) largely due to the reported impacts in the wheat sector. On the other hand, the Canadian (EU27) processed food balance deteriorates €377 million (improves €1,126 million) as a result of FTA induced changes in the dairy sector. Indeed, with reduced Canadian dairy production, EFTA and the US switch to EU27 dairy exports resulting in dairy trade balance deteriorations of €200 million and €426 million, respectively.[19]

In the non-food sectors, Canadian protection on light manufacturing trade (including textiles and wearing apparel) is more prohibitive resulting in sectoral trade balance deteriorations (to the EU27's concurrent trade balance gains). In the remaining cases, Canadian sectoral trade balances generally improve at the expense of the EU27, since the trade weight of the EU27 grants Canada with greater scope for trade creation. Aggregating over all sectors, the trade balances in both regions deteriorate €50 million and €215 million in Canada and the EU27, respectively.

[19] Trade balance statistics for the remaining regions are not reported in the tables.

3.2 Scenario 2 vs. Baseline

3.2.1 Macro Welfare

In scenario 2, a number of sensitive product exceptions have been introduced into the FTA based on the initial tariff offers from both Canada and the EU27. Accordingly, this reduction in market access results in smaller EV gains (see Table 5) for both Canada and the EU27 of €2,519 million (0.36% per capita utility) and €3,295 million (0.04% per capita utility), respectively. Since the NTB percentage reductions remain unchanged compared with scenario 1, the proportion of the EV gains due to NTB trade facilitation increases to 81% and 74% for Canada and the EU27 respectively. A cursory glance at third countries' welfare shows that EV impacts are mitigated (except for Mexico) due to reduced trade diversion effects. Comparing between scenarios 1 and 2, the largest per capita utility improvement occurs in the EFTA region (0.02%), whilst in euro terms, the US's EV loss is reduced by €536 million.

3.2.2 Sectoral Output, market prices and trade balances

As expected, estimates in Table 6 quantify the extent to which stifling market access impacts on macro growth, particularly in Canada which has greater trade dependence on the EU27. Accordingly, as a general rule, output falls compared with scenario 1, although more noticeable impacts are apparent in sectors containing sensitive tariff line exceptions on commodities trade. Examining scenario 2 model shocks on trade protection, reductions in Canadian tariff cuts are strongest in 'vegetables, fruits and nuts', 'pigs and poultry', white meat, dairy products, processed sugar, textiles and clothing. For the EU27, similarly affected sectors are wheat, 'other grains', red and white meats, 'other processed food', textiles, clothing and heavy manufacturing.[20] Furthermore, TRQs on Canadian dairy and EU27 wheat and red meat imports, are maintained.

In Canada, processed sugar, 'vegetables, fruits and nuts', and in particular, dairy activities expand compared with the baseline, due to reductions in market access, but also from reallocations in primary resources from other contracting sectors. Canadian TRQs on dairy remain over quota despite small falls in imports from the EU27 (not

[20] Due to confidentiality reasons, the authors are not at liberty to specify specific HS6 tariff line exceptions, given that we are still at an initial stage in the negotiations.

shown), whilst EU27 raw milk and dairy production remains static compared with the baseline. Despite reduced market access in Canadian 'pigs and poultry' and white meat sectors, output in both cases contract compared with the baseline. This is due to a greater abundance of EU27 sensitive product declarations for (red and) white meat, which impacts negatively on Canadian producers.

A further key area is EU27 wheat production which remains protected (TRQ remains in-quota), whilst also drawing in land from other EU27 cereals and oilseeds sectors. Accordingly, an important source of competitive trade gain to Canada in scenario 1 is now curtailed. Indeed, these trends in the wheat sector largely explain why Canadian (EU27) 'agriculture and fishing' production worsens (improves) compared with scenario 1. In addition, the increase (reduction) in aggregate land usage in Canada (EU27) is duly moderated (Table 7). Similarly, Canadian (EU27) food production now benefits (suffers) compared with scenario 1, since Canadian dairy market access remains restrictive. In 'light' manufacturing, both regions issued numerous tariff exceptions, principally on textiles and wearing apparel trade, which impacts negatively on sectoral output in both regions, compared with scenario 1. In 'heavy' manufacturing, tariff line exceptions issued by the EU27 significantly reduce Canadian output gains compared with the baseline, whilst concurrently benefiting the EU27.

Examining the price trends, reduced economic activity reduces inflationary pressure on factor returns, although relative output increases in EU27 agricultural output bid up land rents compared with the baseline (and scenario 1). On the other hand, smaller tariff cuts by both regions, imply higher import prices. Overall, the former exerts more influence on market prices (when compared with scenario 1), although notable exceptions are dairy, processed sugar and light manufacturing in Canada, as well as wheat prices in the EU27. Compared with scenario 1, the retail price index falls in the EU27, whilst dairy, processed sugar and light manufacturing price rises contribute to a slight retail price index rise in Canada.

Turning to the trade balances, the main differences from scenario 1 occur in the wheat sector where the EU27 trade balance improves (€345 million) at the expense of Canada (-€404 million). In dairy trade, the opposite is the case, whilst notable trade balance improvements occur in the US (€438 million) and EFTA €204 million) dairy sectors from eliminated trade diversion effects. Similarly, in heavy manufacturing, the incorporation of sensitive product exceptions on EU27 import protection improves the trade balance €1,188 million compared with scenario 1, where most of the formerly

diverted trade is taken from the US (-€708 million (not shown)). Finally, in 'light manufacturing' sectors a number of sensitive product exceptions where issued on both sides in the initial tariff offers data, where trade balance improvements compared with scenario 1 reflect relatively greater restrictions on market access by one partner. Accordingly, in Canada trade balances improve for 'wearing apparel and leather' and other light manufacturing, whilst in the EU27, the 'textiles' trade balance improves.

4. Conclusions

In October 2009, Canada and the European Union (EU) held the first of five rounds of trade talks with a view to establishing a Comprehensive Economic Trade Agreement (CETA). From an economic perspective, the promise of unfettered access for Canadian producers to its second largest trading partner presents an attractive proposition, whilst simultaneously offering the EU27 a foothold in the North American market. This paper quantitatively assesses the trade led impacts from a Canada-EU27 free trade area (FTA) agreement. In particular, the paper focuses on the role of the sensitive product declarations submitted by both partners at the first round of talks, with special attention on how such exemptions protect 'key' sectors and consequently, affect real income gains. As a final aim, the study attempts to shed light on the likely third country effects from the deal.[21]

Importantly, the results are consistent with two previous studies on Canada-EU27 free trade showing that trade creation exceeds trade diversion and that Canadian gains are relatively larger given the importance of the EU27 in its trade portfolio. A deeper comparison of the results reveals that our real income estimates exceed Cameron and Loukine (2001), but are below those of EU and GC (2008). In the former case, this is because Cameron and Loukine (2001) do not incorporate non tariff barrier (NTB) liberalisation or capital accumulation effects; which in this study are found to be two significant sources of welfare gain.

In the latter case, there are several explanatory factors. Firstly, this study incorporates numerous rigidities in factor, input and output markets, both between primary agricultural sectors and agricultural/non-agricultural sectors. This inhibits the

[21] One important caveat of this study is that the comparative static framework and assumption of market clearing does not adequately account for the structural adjustment costs required between equilibria, particularly frictional unemployment costs.

flow of resources in response to policy shocks which moderates trade led gains. Secondly, there is the dampening role of sensitive product exemptions on welfare gains. Thirdly, the baseline incorporates existing (and probable) FTAs for both Canada and the EU27, which reduces the trade creation benefits from the EU27-Canada FTA. Finally, to maintain the model at a manageable level of complexity, our study precludes monopolistic competition, with its associated 'scale' and 'variety' effects. Interestingly, comparing our tariff barrier abolition estimates (scenario 1) with that of EU and GC (2008), the decomposition of gains between TBs and NTB liberalisation for Canada are remarkably similar, whilst for the EU27, NTB market access in this study has a lesser importance. The authors speculate that this may be related to differences in the baseline scenario design.

Based on the initial tariff offers presented at the first round of talks in October 2009, it is estimated that sensitive product exemptions reduce Canadian and EU27 real income gains by 20% and 24%, respectively. The sectors which stand out the most are 'wheat', 'dairy' and 'wearing apparel and leather'.[22] Without sensitive product exceptions, Canada's raw milk and dairy sector faces an aggregate production loss of approximately €985 million (2004 prices), whilst wheat in the EU27 would record a production value loss of €334 million (2004 prices). Finally, as expected trade diversion impacts most seriously on the USA and EFTA, although it is important to note that China escapes relatively unscathed due to the pattern of its trade specialisation (i.e., lower value added goods).

To summarise, the economic rationale for free trade is clear (but moderate), although political expediency stemming from ostensible lobby groups professing to protect national interests, tempers such gains. This paper deals with one such political hurdle (i.e., sensitive products), although others also remain (e.g., EU27 restrictions on hormone treated beef and seal products; Canadian ownership restrictions on service utilities; vetoing rights granted to the European Parliament under the Lisbon treaty) before a FTA agreement between the EU27 and Canada is to be achieved. Notwithstanding, as noted in the introduction to this paper, whilst divergent, the political motives for granting freer market access on both sides are entirely compatible, thereby presenting a firm foundation upon which a trade deal can be ratified.

[22] Given the pervasiveness of sensitive tariff declarations for 'wearing apparel and leather' by both negotiating parties, coupled to similar levels of tariff protection, the impacts in this sector are muted.

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	Canadian Trade relations				
	GDP (2009)	X (f.o.b.) (2008)	M (c.i.f.) (2008)	Balance	Total Trade
US	10241.5	240.5	145.6	94.9	386.1
EU27	10678.0	23.3	34.6	-11.4	57.9
China	3469.9	6.7	27.3	-20.6	34.0
Japan	3584.7	7.1	9.8	-2.7	16.9
Mexico	593.9	3.7	11.5	-7.7	15.2
Korea	522.0	2.5	3.8	-1.4	6.3
Norway	244.6	1.8	4.0	-2.2	5.8
Algeria	92.3	0.6	4.9	-4.4	5.5
Taiwan	239.7	1.0	2.5	-1.5	3.5
Brazil	910.7	1.7	1.7	-0.1	3.4
	EU27 Trade relations				
	GDP (2009)	X (f.o.b.) (2008)	M (c.i.f.) (2008)	Balance	Total Trade
US	10241.5	250.0	186.9	63.1	436.9
China	3469.9	78.4	247.9	-169.5	326.4
Russia	835.5	105.0	177.9	-72.9	282.9
Switzerland	324.5	98.1	80.3	17.7	178.4
Japan	3584.7	42.2	75.2	-32.9	117.4
Norway	244.6	43.8	95.8	-52.1	139.6
Turkey	396.5	54.1	46.0	8.1	100.1
S. Korea	522.0	25.6	39.6	-14.0	65.1
India	851.3	31.6	29.5	2.1	61.1
Canada	882.7	26.1	23.9	2.2	50.0

Table 1: Top ten merchandise trade partners (€ billions)
Source: Government of Canada (2009); Eurostat (2009).

	Canada 2008 MFN applied duties (%)			EU27 2008 MFN applied duties (%)		
	Average	Duty free	Max.	Average	Dutyfree	Max.
Animal products	20.7	68.0	718.0	27.6	23.8	236.0
Dairy products	126.2	0.0	314.0	64.1	0.0	205.0
Fruit, vegetables, plants	3.5	58.6	19.0	12.4	18.6	233.0
Coffee, tea	7.7	76.0	265.0	7.2	27.1	99.0
Cereals and preps	13.3	31.2	277.0	22.3	7.2	123.0
Oilseeds, fats & oils	4.5	53.3	218.0	6.4	43.4	180.0
Sugars & confectionary	4.9	28.1	24.0	33.3	0.0	143.0
Beverages & Tobacco	9.0	34.4	256.0	20.7	19.8	203.0
Cotton	0.5	90.0	5.0	0.0	100.0	0.0
Other agricultural prod	4.0	79.0	532.0	5.8	65.5	133.0
Agricultural average	11.5	-	-	16.0	-	-
Fish & fish products	0.9	81.1	11.0	11.8	9.0	26.0
Minerals & metals	1.7	68.7	16.0	2.0	49.2	12.0
Petroleum	2.7	58.7	8.0	3.1	20.0	5.0
Chemicals	2.8	50.5	16.0	4.6	21.4	7.0
Wood, paper, etc.	1.1	83.1	16.0	0.9	81.2	10.0
Textiles	6.6	47.2	18.0	6.6	2.1	12.0
Clothing	16.9	3.0	18.0	11.5	0.0	12.0
Leather, footwear, etc.	5.3	40.9	20.0	4.2	22.7	17.0
Non-electrical machinery	1.5	74.6	10.0	1.9	21.0	10.0
Electrical machinery	2.5	53.8	11.0	2.8	20.1	14.0
Transport equipment	5.8	41.1	25.0	4.3	12.5	22.0
Manufacturers	3.0	52.2	18.0	2.7	20.6	14.0
Non agricultural average	3.7	-	-	4.0	-	-
Average	4.7	-	-	5.6	-	-

Table 2: Applied tariff protectionism by product groups.
Source: WTO (2009)

I. Chosen Sectoral Aggregation (32 GTAP sectors in bold)

Rice (rice) – Husked and not husked; **Wheat** – soft and durum wheat; **Other grains** – rye, sorghum, barley, oats, maize, millet, other cereals; **Vegetables, fruits nuts** – all vegetables, fruits and nuts; **Oilseeds** – oilseeds and oleaginous fruits; **Raw Sugar** – sugar cane/beet; **Cattle and sheep** – live bovine cattle, sheep and goats for fattening, horses, asses, mules; **Pigs and poultry** – live swine and poultry for fattening, other animals; eggs, honey, snails and frogs legs; **Raw milk** – dairy and other cows; **Other agriculture** - raw sugar, raw vegetable materials used in textiles; seeds, live plants, flowers, beverage and spice crops, unmanufactured tobacco, plants used in perfumery, pharmacy, insecticidal, fungicidal or similar purposes; cereal straw and husks, fodder and forage crops; other raw vegetable materials; animal materials used in textiles; **Fishing** – All fishing activities including fish farms and hatcheries; **Red meat** – red meat products (bovine, sheep and goat); edible offals and animal oils and fats; **White meat** – white meat products, edible offals and animal oils and fats; **Vegetable oils and fats** – Oils of: Coconuts, cottonseeds, groundnuts, oilseeds, olives, palmkernels, rice brans, rape and mustard, soyabeans, sunflower seeds; and fats; **Dairy** – all dairy products; **Processed sugar** – Refined sugar, sweeteners; **Other Food Processing** – milled rice; prepared and preserved sea food products, vegetables and fruits, bakery and confectionary products, pastas and flours; **Beverages and Tobacco** – Cigarettes, Cigars etc., Wines and Spirits, Beer; **Textiles goods**; **Wearing apparel & leather goods**; **Other light manufacturing** –wood and paper products and publishing; Other metal products; motor vehicles and parts; transport equipment; **Heavy manufacturing** – Petroleum, chemical, rubber and plastic products; mineral products and ferrous metals; electronic equipment; machinery and equipment; **Utilities** - Gas, water, electricity; **Construction services**; **Trade services**; **Transport services** - air, sea, road; **Communications**; **Financial services**; **Insurance**; **Other business services**; **Consumer services**; **Public services** public administration/defence/health/education.

II. Chosen Regional Aggregation (13 GTAP Regions in bold)

Canada; **UK**; **EU4** (Austria, Germany, Netherlands, Sweden); **RoEU25** (Belgium, Czech Republic, Cyprus, Denmark, Estonia, Finland, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden); **AC2** (Bulgaria, Romania); **US**; **Mexico**; **EFTA** (Iceland, Liechtenstein, Norway, Switzerland); **China**; **Japan**; **Korea**; **Russian Federation**; **Rest of the World**.

Table 3: GTAP Data Aggregation

Baseline Scenario Assumptions
EU Enlargement
Elimination of all border protection (i.e., import tariffs, export subsidies) between incumbent EU25 and the new member states (Romania and Bulgaria - 2007 accession)
Impose common external tariff on 'third' country trade for the two new EU member states.
Trade Policy Shocks
Import tariff reductions for developed and developing countries under a 'stylised' Doha Round.
Export subsidy eliminations on all products and countries.
Canadian FTAs: Chile (1997); Columbia (2008); Costa Rica (2002); EFTA (2009); Israel (1997); Jordan (2009); Peru (2009)
EU FTAs: Mexico (2000); Korea (2009); ACP Cotonou Agreement (2000)
NAFTA full implementation
Agricultural policy
Elimination of all EU raw sugar and raw milk quotas. Canadian milk quota is maintained.
Elimination of all EU intervention prices
Elimination of EU set aside
Decoupling of all EU agricultural domestic support
'Reduced' pillar I single farm payment totals

Table 4: Assumptions shaping the long-run baseline

Scenario 1 vs. Baseline	Canada	EU27	US	Mexico	EFTA	China	Japan	Korea	Russia	ROW
Equivalent Variation	3157	4336	-1626	9	-212	-157	-6	-2	-70	-762
Per Capita Utility	0.45	0.05	-0.02	0.00	-0.05	-0.01	0.00	0.00	-0.02	-0.02
Decomposition										
Allocative Efficiency	889	973	-170	2	-10	-25	-7	2	-11	-145
Terms of Trade	434	1040	-1019	9	-115	-59	-6	-1	-29	-263
Land Endowment	9	-1	-4	0	-3	-3	1	0	-3	-12
Capital Accumulation	928	1504	-433	-2	-84	-70	6	-3	-27	-342
NTB efficiency gains	897	820	0	0	0	0	0	0	0	0
Scenario 2 vs. Baseline	Canada	EU27	US	Mexico	EFTA	China	Japan	Korea	Russia	ROW
Equivalent Variation	2519	3295	-1090	3	-102	-50	1	1	-48	-467
Per Capita Utility	0.36	0.04	-0.01	0.00	-0.02	0.00	0.00	0.00	-0.01	-0.01
Decomposition:										
Allocative Efficiency	487	821	-131	-4	-8	-10	-2	1	-7	-87
Terms of Trade	389	608	-702	7	-63	-20	-6	0	-26	-193
Land Endowment	1	0	4	0	-1	-1	0	0	0	-3
Capital Accumulation	770	1054	-261	-1	-31	-20	9	1	-15	-187
NTB efficiency gains	872	812	0	0	0	0	0	0	0	0

Table 5: Macro **welfare impacts under free trade area scenarios (€ millions, 2004 prices)**

	Output vs. baseline (%)				Market prices vs. baseline (%)				Trade balances (€ millions, 2004 prices)			
	Canada		EU27		Canada		EU27		Canada		EU27	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Rice	185.06	187.42	-0.32	0.00	3.48	3.44	0.01	0.01	14	14	-10	-7
Wheat	14.76	-0.38	-1.92	-0.02	1.13	0.06	-0.12	0.02	395	-9	-350	-5
Other grains	-0.44	0.13	0.04	0.01	0.43	0.08	0.02	0.03	0	-1	-4	-1
Vegetables, fruits, nuts	-0.54	0.06	0.00	-0.01	0.37	0.09	0.04	0.02	-22	-5	-17	-12
Oilseeds	-1.64	-0.19	0.02	-0.02	0.50	0.06	0.05	0.03	-22	-3	-6	-3
Cattle & sheep	0.39	-0.06	0.04	0.01	0.37	0.15	0.02	0.02	-1	0	-1	-1
Pigs & poultry	0.55	-0.22	0.03	0.00	0.33	0.16	0.03	0.02	-3	3	-5	-5
Milk	-7.90	1.14	0.31	0.01	0.11	0.14	0.03	0.02	0	0	0	0
Fishing	0.20	0.18	0.02	0.00	0.61	0.56	0.09	0.03	2	4	-11	-6
Red meat	0.61	-0.16	-0.10	-0.01	0.30	0.21	0.04	0.03	29	-21	-56	-11
White meat	1.66	-0.98	-0.16	-0.01	0.25	0.21	0.04	0.03	58	-36	-116	-16
Vegetable oils, fats	-0.53	-0.06	-0.01	0.00	0.20	0.12	0.05	0.03	-9	-5	-21	-9
Dairy	-9.27	1.28	0.82	-0.02	-0.91	0.17	0.05	0.03	-472	61	1106	-62
Processed sugar	-0.02	0.16	0.01	0.00	-0.05	0.12	0.04	0.03	1	-2	-11	-5
Other processed food	0.52	0.29	0.11	0.00	-0.03	0.20	0.04	0.03	53	25	185	-127
Beverages, tobacco	0.03	-0.03	0.06	0.05	0.14	0.17	0.05	0.03	-37	-34	37	41
Textiles	0.18	-0.55	0.09	0.05	0.03	0.06	0.05	0.03	-12	-32	14	54
Wearing apparel, leather	0.21	-0.05	0.15	-0.02	0.00	0.10	0.06	0.03	-79	-19	264	-148
Other light manufacturing	-0.12	-0.18	0.03	0.02	0.08	0.11	0.05	0.03	-418	-396	2	-156
Heavy manufacturing	0.25	0.02	0.00	0.04	0.09	0.08	0.05	0.02	40	-106	-709	479
Utilities	0.18	0.12	0.03	0.03	0.18	0.17	0.05	0.03	-6	-5	-8	3
Construction	0.58	0.48	0.06	0.04	0.26	0.24	0.06	0.03	0	0	-20	-9
Trade	0.33	0.25	0.04	0.02	0.35	0.34	0.06	0.04	23	26	-89	-38
Transport	0.69	0.69	0.01	0.01	0.23	0.20	0.06	0.03	334	340	81	112
Communications	0.36	0.33	0.02	0.02	0.27	0.25	0.06	0.04	38	41	-23	-9
Other financial services	0.24	0.21	0.03	0.03	0.35	0.31	0.06	0.03	8	12	-12	18
Insurance	0.16	0.13	0.03	0.04	0.33	0.30	0.06	0.03	5	12	33	57
Oth. business services	0.23	0.22	0.03	0.02	0.34	0.31	0.06	0.03	8	31	-269	-144
Consumer Services	0.63	0.60	0.03	0.02	0.29	0.27	0.06	0.04	88	93	-25	2
Public Services	0.24	0.22	0.02	0.02	0.37	0.34	0.08	0.05	-36	-29	-104	-57
Macro change	0.41	0.32	0.04	0.03	0.19	0.23	0.06	0.03	-50	-4	-215	-138

Table 6: Canadian and EU27 output, market prices and trade balances.

	Canada		EU27	
	S1	S2	S1	S2
Factor employment vs. baseline (%)				
Land	0.48	0.03	-0.01	0.00
Unskilled labour	0.00	0.00	0.00	0.00
Skilled labour	0.00	0.00	0.00	0.00
Capital	0.64	0.53	0.07	0.05
Natural resources	0.00	0.00	0.00	0.00
Factor prices vs. baseline (%)				
Land	2.07	0.27	-0.02	0.01
Unskilled labour	0.69	0.59	0.11	0.07
Skilled labour	0.67	0.59	0.11	0.07
Capital	0.09	0.07	0.04	0.02
Natural resources	0.22	0.10	0.02	0.01

Table 7: Canadian and EU27 factor employment and returns

6. Technical Appendix

Land supply estimation

In estimating land supply functions for each of the 113 member countries/regions of the GTAP database, we follow a non linear functional form:

$$Accumulated\ Area = a - \frac{b}{C_0 + \mathrm{Re}nt^{\rho}} \quad (1)$$

where 'a' is the asymptote of the function representing the maximum potential available land for agricultural purposes; 'b_0', 'C_0' and 'p' are estimable parameters. For the econometric estimation, data on potential agricultural areas and yields developed by the International Institute for Applied System Analysis (IIASA, 2007) are employed. More specifically, yields and area data for 4 different levels of land suitability (4 types) across 23 crop types are available for each region (92 observations).

In an initial step, data observations are sorted in descending order of yields and the corresponding potential area is accumulated. Assuming that the most productive land is employed initially, the marginal cost of land increases (i.e., (1/yield)), which reflects the increased conversion cost of additional units of marginal land. All rents (yields) are normalised by dividing by the minimum rent (maximum yield) in each sample, which leads to rents above 1 and yields between 0 and 1. This scaling helps to infer the relative suitability of each country for each crop, while from an econometric standpoint it accelerates convergence to a solution.

The empirical land supply equation becomes:

$$R\_Area_j = 1 - \frac{b}{C_0 + R\_\mathrm{Re}nt_j^{p}} + \varepsilon_j \quad (2)$$

where the sub-index j refers to each of the 92 observations available for each country/region; R_Area is the relative accumulated area for observation j; R_Rent is the relative land rent for observation j; b, C0 and p are parameters to estimate, with $b = b_0/a$; and finally, ε_j is the error term, which is assumed to be normally distributed, $N(0,\sigma)$. Equation (2) is estimated by Weighted Maximum Likelihood (a suitable method for non-linear models). To improve the fit of the estimated function to the original data, we assign higher weights to those observations with greater R_Rent_j.

The location of each country/region on its land supply curve is the use ratio (R_Area_C) of agricultural land use in 2003/2004 to maximum available land area measure discussed above. Substituting calculated land use ratio estimates (R_Area_C) into equation (2) and re-arranging, the 'current relative rent' (R_Rent_C) is obtained. The point elasticity of the land supply function at these coordinates can then be expressed as:

$$E^S = \frac{\partial R\_Area}{\partial R\_\mathrm{Re}nt} \bullet \frac{R\_\mathrm{Re}nt_C}{R\_Area_C} = \frac{\hat{b} \cdot \hat{p} \cdot R\_\mathrm{Re}nt_C^{\hat{p}}}{(\hat{C}_0 + R\_\mathrm{Re}nt_C^{\hat{p}})\left(\hat{C}_0 + R\_\mathrm{Re}nt_C^{\hat{p}} - \hat{b}^*\right)} \quad (3)$$

where the circumflex over the parameters indicates the estimated coefficients. A full list of parameter estimates, standard errors, mean log-likelihood values, land use ratios and point elasticities for each of the 113 regions of the GTAP version six data is available from the authors on request.

In the model framework, equation (2) is inserted directly into the model code, where rents in the 2004 benchmark data can be calibrated given knowledge of the remaining parameters and land use ratio. To validate the correct implementation of the land supply function, we check that calculated land supply elasticities from a simple shock are sufficiently close to the point elasticities calculated in equation (3).

Other CAP modelling issues

Sugar and milk quotas are characterised employing complementarity equations in GEMPACK to allow binding/non-binding status of the quota. Estimates of milk and sugar quota rents for the EU25 in the benchmark are based on an array of literature sources and expert opinion within Defra (UK Government). Consistent with micro theory, the shadow price is only affected by changes in factor costs.

To characterise set aside an exogenous Hicks neutral productivity variable is employed. For example, a negative shock of 10 per cent implies that of every hectare used only 0.9 is productive. Since the value of land in the GTAP database only reflects 'productive' land, it is assumed that 2004 set aside levels are implicitly included in the benchmark data. Changes in set aside are based on projections from the European Commission.

Intervention prices are explicitly modelled employing changes in border protection, whilst complementarity equations are employed for triggering stock purchases when the support price falls to the exogenous intervention price. Since stocks are not the result of constrained optimisation, but rather are triggered, they must be subtracted from the regional income equation such that income remains equal to expenditure. Also, stock purchases are inserted into the relevant market clearing equations such that the accumulation of stocks supports the lower intervention price.

The decoupling of EU27 agricultural support is modelled by the removal of all output, intermediate input, capital and land subsidies in the GTAP database in 2004 (at different agenda 2000 rates) and replacing these with a single farm payment (SFP) characterised as a homogeneous land payment (i.e., decoupled) to all agricultural sectors.

The calculation of total modulation savings and allocations to each EU27 region follows in detail the Commission's proposals, whilst ensuring that all regions receive at least 80 per cent of their initial modulation contributions (except Germany which should receive 90 per cent). Modulation flows are incorporated within the common budget mechanism.

In the 2004 benchmark, the CAP budget only applies to the EU25 regions, whilst accession member participation is activated by an exogenous dummy variable. Thus, each EU region contributes to Brussels via 75 per cent of agricultural tariff revenues and modulation, and receives funding for domestic support policies. The difference between total receipts and total contributions by each member gives a net resource cost which is met by uniform percentage GDP contributions by each member state. Thus, at the member state level, a region may be a net loser (regional income < regional expenditure) or a net gainer (regional income > regional expenditure) from the budget. To ensure that regional expenditures and incomes balance, regional savings are altered in the benchmark, whilst at the EU level, savings remain unchanged.

In terms of the three nested CET land allocation structure, the top nest elasticity is 0.25 (based on the OECD model), which is increased by a factor of two as we move down the nest. Consequently, the mobility of land usage between agricultural sectors is reduced in comparison with the standard GTAP model (which also reduces agricultural supply responsiveness).

In the standard GTAP model, labour and capital are perfectly mobile, whilst in this model variant; the transference of these factors is controlled by a CET elasticity. Consequently, the supply responsiveness of agricultural/non-agricultural sub sectors in response to a removal of direct support in primary agriculture will be dampened compared with standard GTAP.

In the model, tariff rate quotas (TRQs) on EU-Canadian bilateral trade are modelled employing a conditional complementary slack statement pioneered by Elbehri and Pearson (2005). This modelling is supported by additional data (WTO, 2005; EC, 2007; USDA, 2007) on tariff fill rates (i.e., in-quota, on-quota, or over-quota) and the tariff rate (in-quota and over-quota tariffs). A degree of judgement is employed when selecting TRQ routes. Given the broad sectoral definitions in the GTAP sectors, Canadian and EU declared TRQ tariff lines are compared with the HS6 lines within the GTAP concordance. In the case of Canada, GTAP wheat and dairy sectors could include TRQ modelling, although Canadian wheat was later dropped owing to the small trade flows which lead to potentially large percentage changes which are incompatible with the TRQ model code. In a similar fashion, there was sufficient tariff line coverage to model EU TRQs on rice, wheat, cattle meat and sugar, although again, only wheat and cattle meat was finally employed owing to computational constraints.