NTMs in CGE models – Is reducing iceberg trade costs enough? An experiment of modelling EU DCFTAs in GTAP

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Abstract: to be added
1 Introduction

This paper presents an approach to modelling non-tariff measures (NTMs) by reflecting reduced trade costs and adjustment costs. We apply the approach to the case of the EU deep and comprehensive trade agreements (DCFTAs) with Eastern European countries, specifically the Ukraine as an example. The EU DCFTA context lends itself for analysing NTMs since one of the main goals of these agreements is to overcome obstacles caused by NTMs, working towards closer cooperation and deeper market integration of the EU and partner countries. With the EU DCFTAs, producers in the partner countries in general face fixed adjustment costs since investments are arguably necessary in order to follow the process of deeper market integration. This may be investment in technology, production methods and/or product quality. Due to the legal approximation that the DCFTA partners commit to all producers in the sector and not only exporters that wish to sell on the EU market are affected. In the Ukraine, the example of our experiment, one specific concern is the investment in the agri-food sector, and this sector will thus be the focus in our application in the GTAP model.

Computable general equilibrium (CGE) models, like GTAP, usually treat the removal of NTMs by an iceberg cost approach, which simulates changes in the productivity of products destined to foreign markets. In the context of DCFTAs, we propose to incorporate NTMs by accounting for investment costs but without getting into the heterogeneous firms realm. The ratification of the DCFTA between the Ukraine and the EU will lead to harmonisation of standards and procedures between the two entities, with the clear orientation towards EU norms. This has two effects in addition to the reduction of trade costs due to the removal of NTMs: Producers will have to invest (fixed costs) in order to meet the EU standards and norms but they will possibly also see an increase in their productivity, at least in the long run. We consider the fixed adjustment costs as investment in primary factors (labour, capital and land) and depict them by introducing a composite primary factor of value-added in the GTAP production structure.

In this paper, we first outline the standard iceberg cost approach to modelling the removal of NTMs and then elaborate on our proposed modification to include the adjustment costs associated with the removal of NTMs. Next we apply our modification in the GTAP model, investigating the case of the DCFTA between the Ukraine and the EU. Our model results show that modelling the removal of NTMs by the standard iceberg cost approach is not sufficient. The adjustment costs that partner countries like the Ukraine incur when committing and ratifying DCFTAs need to be taken into account since they crucially determine the model results. We conclude with some remarks and directions for further work on the NTM analysis in the DCFTA context.

1 NTMs take various forms such as sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBT). For the classification of NTMs commonly used see UNCTAD (2013).
2 NTMs in CGE models

2.1 Existing approach to modelling NTMs

Commonly, CGE models depict the removal of NTMs by an iceberg cost approach that depicts the NTM removal as a change in the productivity of products destined to foreign markets. This is the standard iceberg costs modelling approach of NTMs. NTMs are considered to impact real trade costs, using up resources of exporters. Due to NTMs, a fraction of the export value “melts away” on the way from the exporting to the importing country, hence the name iceberg costs, and this causes efficiency losses for the exporting country that is subject to the respective NTMs of the importing country. Reducing iceberg costs hence implies lower real trade costs, which boosts the efficiency of exporting. From the perspective of the importing country that reduces NTMs, this translates into a decrease of the price of the respective import products and thus an increase in imports.

In essence, the iceberg cost approach depicts the reduction of NTMs in terms of a positive technological change for producing export products for the importing country that removed its NTMs for the respective product. In GTAP, this is modelled by a shock of the “ams” variable that determines the reduced prices for exports (imports) and the increase in the quantity traded. For a stylised application in GTAP see Fugazza and Maur (2008).

Typically, the “ams” shock is obtained by a gravity estimation, which provides the quantity effect of distances and thus the effect of NTMs between countries. Here it is important to note that restrictions in the gravity estimations usually per definition result in a negative and hence trade-hampering effect of NTMs. Beghin et al (2014) release the restrictions, thereby allowing for the potentially positive trade effect of NTMs. Using import substitution elasticities, the quantity effect expressed by the coefficient estimated is translated into price effects of NTMs per country (average valorem equivalents, AVE) and the latter determine the size of the shocks for the simulation. The AVEs of NTMs calculated using the gravity estimates are used for the “ams” shock.

When modelling NTMs, it should be noted that the total removal of NTMs is unrealistic since NTMs are usually introduced for a reason, in particular when it comes to SPS and TBT measures. NTMs can hardly be negotiated away and in fact countries have the right and obligation to implement NTMs for human, plant and animal health reasons according to the WTO. Having said that, NTMs have been used with a protectionist intention and they have also been overly restricted, thereby unnecessarily creating costs and hampering trade. However, in the simulation of NTMs, it makes sense to depict the removal of certain NTMs to a certain extent, which has been referred to as “actionable” NTMs; see for example the CGE analysis of the sustainable investment and trade assessments of upcoming EU trade agreements commissioned by the EU Commission, DG Trade.

As elaborated above, the simulation depicts the NTM removal by reducing the price of import product, and the reduction is given by the tariff equivalent calculated with the result of the gravity estimation. The iceberg cost approach considers the removal of NTMs without taking
into account the possible rents or costs associated with reducing NTMs. While Fugazza and Maur (2008) mention the issue of rents in the CGE analysis of NTMs, the costs of removing NTMs are so far not specifically considered in the CGE literature, to our knowledge. We suggest incorporating them especially when investigating the effect of reducing NTMs in the context of DCFTAs, which tackle NTMs as behind the border measures and bring forward the market integration of the signing entities.

2.2 Proposed conceptual modifications to depict adjustment costs

We postulate that modelling NTMs in the context of DCFTAs should consider two distinct types of impacts:

- Reduction in trade costs due to NTM removal (iceberg cost approach, see 2.2)
- Increase of adjustment costs: In order to gain from the NTM removal, countries face costs, which we call adjustment costs. On the one hand, adjustment costs occur at the firm-level where business have to meet the requirements necessary and agreed upon in the agreements and thus undergo structural adjustments, like changes in production methods and upgrading. On the other hand, costs also occur at the country-level since administrative procedures have to be changed, information or services need to be provided and regulatory reforms usually have to be brought forward as well as implemented in order to ratify the agreements. Note that as a result of adjustment costs, the factor productivity may increase but we do not have any empirical evidence for the EU DCFTAs, yet.

As mentioned, studies covering NTMs in CGE models cover only the first impact, i.e. the removal of NTMs and the thereof resulting decrease of trade costs. That is, the second impact, i.e. the adjustment costs, is not depicted in the modelling and hence the removal of NTMs is assumed to be for free. This is however not the case; in fact the adjustment costs in the DCFTA context can be considered as being substantial rather than being negligible. With regard to the EU DCFTAs, there is a clear orientation towards EU standards and norms in addition to regulatory cooperation. The removal of NTMs hence does come at the cost of regulatory reform in the partner countries that have to achieve the EU orientation, as stipulated in these agreements. Although DCFTAs do not foresee EU membership and do not promote the full integration of partner countries in the EU common market, partner countries have agreed to the legal approximation of some parts of the EU acquis communautaire. Indeed, the deep but not full market integration implies removing NTMs between the EU and partner countries through harmonisation, mutual recognition or other ways of cooperation, and since the EU norms and standards are to be taken over, adjustment costs occur for the EU partner countries.

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2 Investigating the market integration of EU eastward enlargement, Rau and van Tongeren (2007) explicitly depict the fixed (through additional investments) and variable (through additional activities) compliance costs for exporting firms in a PE framework. As such, this present paper extends their reasoning about fixed adjustment costs to the EU DCFTAs (see 2.2).
In our experiment, we include adjustment costs in terms of sector investment in the GTAP model in order to investigate the importance of these costs for the model results. Further, we are interested to see if the cost effect cancels out the benefit of removing NTMs in the DCFTA context. In GTAP, we incorporate the adjustment costs in the production tree structure, as illustrated in figure 1.

*Figure 1: Modified GTAP production structure to account for adjustment costs*

![Diagram of modified GTAP production structure](source)

We use a composite primary factor of value-added, which we split into a variable cost (“qvav”) and a fixed cost (“qvaf”) component. The latter reflects the adjustment costs that are assumed to be sunk. Adjustment costs are not proportional to the level of economic activity in the sector and are thus modelled as a fixed proportion of total costs, irrespective of the level of output. Furthermore, the adjustment costs incur for the entire sector, i.e. all producers whether exporting or not face the adjustment costs of the regulatory reforms, as agreed upon in the DCFTA. All adjustment costs are related to primary production and not intermediate inputs of production. The split into the variable and fixed cost component is made according to the share of investment in output or rather value added in the sector. Note that the split preserves the structure of the comparative advantage as portrayed by the GTAP endowment mix of a country.
3 GTAP experiment: Modelling the reduction of NTM trade costs and adjustment costs

To present our conceptual modification of accounting for adjustment costs, we apply a straightforward and simple experiment to the example of the EU DCFTA with the Ukraine\(^3\). Like other DCFTAs, the agreement with the Ukraine contains specific chapters on the legal approximation with a clear orientation towards the EU in order to reduce NTMs between the two entities (see 2.2). Hence the Ukraine has committed itself to harmonizing a large number of rules, norms and standards in trade-related areas with those of the EU. In our experiment, we assume that the legal approximation particularly affects primary agricultural production with the tight EU regulations on SPS matters of animal, plant as well as human health (food safety). The shocks in the experiment are thus only applied to the agricultural sector in the Ukraine.

For our application, we use the standard GTAP model with 3 sectors (ag, mnf and svc) and 3 regions (Ukr, EU28 and ROW), based on the GTAP data 2007. The focus is on the agricultural sector, as explained, and the shocks reflect both the NTM removal for Ukrainian exporters as well as the adjustment costs in the entire sector that are necessary for the NTM removal. In order to gauge the distinct effect of the two impacts, we compare the contribution of reducing the iceberg trade costs, which come down as a result of the NTM removal, and the contribution of increased adjustment costs, which represent the sunk investment of the EU orientation, to the model results.

**Shock for the iceberg cost approach of removing NTMs:** Estimates of AVEs for NTMs have been made available by Kee et al. (2009). They provide AVEs for NTMs in agriculture and manufacturing separately, and we simply use the estimates of market access for Ukrainian agriculture in 2009. Note that the AVEs for NTMs are not bilaterally defined. The estimates hence reflect the difficulty of Ukrainian exporters when supplying foreign markets, including the EU market. The AVE for the Ukrainian agricultural sector is 10%, i.e. that the trade costs due to NTMs are 10% of the value of Ukrainian agri-food exports. Given the tight requirements in the EU, the AVE estimate by Kee et al. can be considered to be at the lower end of the actual trade costs.

**Shock for adjustment costs:** Information on the adjustment costs is not available, and obtaining cost estimates bears considerable challenges, like determining compliance costs. We approximate the adjustment costs necessary to implement the EU requirements by looking at the funds that the EU has made available to support the ratification of the DCFTAs. As a partner country, the Ukraine has prepared a national plan to ratify its DCFTA with the EU, in particular achieving the legal approximation (implementation and enforcement). Based on the actions necessary, the EU has been providing funds to support the endeavour. The EU funds

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\(^3\) The EU and Ukraine signed a DCFTA on 27 June 2014 as part of their broader association agreement. In response to the political and economic challenges that the Ukraine has faced and the war in Crimea with Russia, the ratification of the DCFTA was postponed to the 1\(^{st}\) January 2016. For more information on the DCFTA between the EU and Ukraine see http://ec.europa.eu/trade/policy/countries-and-regions/countries/ukraine/.
have started before the DCFTAs within support programmes under the EU neighbourhood policy (ENP), some of which are targeted towards specific priorities in the context of EU orientation and/or are specifically reserved for the agricultural sector. Table 1 summarises the funds that we identified as being relevant for the DCFTA ratification with an emphasis on funds for agriculture. Using the funds spent between 2007 (the base year of our analysis) and 2015, we calculate a 50% increase of the adjustment costs in the DCFTA context. Note that this is a very crude approximation, which we expect to be at the lower end of the actual costs for the sector. In table 1, we also provide the figures of the investment in the Ukraine agricultural sector, as given in the statistical year books. The EU funds reserved for regulatory reform associated with an orientation towards the EU make up for less than 3% of the total investment in the sector. Unfortunately, we do not know if the investment spent contains adjustment costs. First-hand information by exports of the Ukrainian agricultural sector and the state of adjustment has not been available.

*Table 1: Approximation of adjustment costs (million Euro)*

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</thead>
<tbody>
<tr>
<td>EU funds for regulatory reform/legislative approximation in Ukraine</td>
<td>21.9</td>
<td>51.8</td>
<td>42.4</td>
<td>50.9</td>
<td>33.2</td>
<td>25.6</td>
<td>48.9</td>
<td>39.4</td>
<td>66.3</td>
</tr>
<tr>
<td>Total EU funds for other priorities</td>
<td>52.1</td>
<td>123.3</td>
<td>100.9</td>
<td>121.3</td>
<td>103.7</td>
<td>79.9</td>
<td>152.8</td>
<td>123</td>
<td>207</td>
</tr>
<tr>
<td>Total investment in agriculture primary in Ukraine</td>
<td>1383.8</td>
<td>2226.0</td>
<td>839.7</td>
<td>1098.6</td>
<td>1534.2</td>
<td>1869.4</td>
<td>1761.1</td>
<td></td>
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</tr>
<tr>
<td>Share in total EU funds for other priorities</td>
<td>42%</td>
<td>42%</td>
<td>42%</td>
<td>42%</td>
<td>32%</td>
<td>32%</td>
<td>32%</td>
<td>32%</td>
<td>32%</td>
</tr>
<tr>
<td>Share of funds in total investment in agriculture primary</td>
<td>2%</td>
<td>2%</td>
<td>5%</td>
<td>5%</td>
<td>2%</td>
<td>1%</td>
<td>3%</td>
<td></td>
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</tr>
</tbody>
</table>

Source: Ukraine National Plan, Ukraine statistical year books.

**Model results:** In the model, we approximate the reduced trade costs by means of an “ams” shock and the increased adjustment costs by a shock of the “qvaf” variable, which we created in the production composite. Table 2 presents the results of the following shocks: ams (ag,Ukr,EU) = 10 and qvaf (ag, Ukr) = 50, i.e. a 50 percent increase in fixed costs in the Ukrainian agricultural sector. The latter implies that fixed costs go up from existing 15% of total costs to about 22% of total costs in the agricultural sector, as a result of taking over EU standards and norms. With the DCFTA, agricultural production in the Ukraine is hence modelled as becoming more costly with the share of fixed costs increasing between 2007 and 2015.
Adjustment costs in the agricultural sector (column 2) make the agricultural products in Ukraine more expensive as seen from the increased market price (a result of zero profits condition). They also make agricultural production in Ukraine less lucrative in comparison to the other sectors that do not face such increases in costs of production. Thus, as expected, agricultural output in the Ukraine, falls as a result of increased adjustment costs only. Note how different this result is if we were to only model the beneficial part of the NTM removal (harmonisation with the EU), as done in the standard iceberg cost approach to reflect trade costs (column 3). The impact of a standalone reduction in trade costs tells us that agricultural output in Ukraine should increase as a result of increased import demand from EU. The net impact of the two together, depends on which one is the dominant impact. Similarly if we were to take only the impact of reduced transaction costs from DCFTA we would expect the Ukrainian Agricultural exports to EU to increase by 35%, which is a lot bigger in comparison to the case when we account for both transaction and adjustment costs. In the latter case we see the exports to rise only by 20%.

Table 2: Total and specific impacts of modelling NTMs in the context of the EU DCFTA with Ukraine (all numbers represent % change)

<table>
<thead>
<tr>
<th></th>
<th>Total Impact (1)</th>
<th>Impact from higher adjustment costs (2)</th>
<th>Impact from lower trade costs (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market price of agricultural goods in Ukraine (pm)</td>
<td>4.1</td>
<td>3.16</td>
<td>0.94</td>
</tr>
<tr>
<td>Market price of agricultural goods in EU (pm)</td>
<td>-0.01</td>
<td>0.01</td>
<td>-0.02</td>
</tr>
<tr>
<td>Price of agricultural goods imported in EU from Ukraine (pms)</td>
<td>3.73</td>
<td>2.87</td>
<td>0.86</td>
</tr>
<tr>
<td>Agricultural production in Ukraine (qo)</td>
<td>-3.14</td>
<td>-4.01</td>
<td>0.87</td>
</tr>
<tr>
<td>Agricultural production in EU (qo)</td>
<td>-0.01</td>
<td>0.02</td>
<td>-0.03</td>
</tr>
<tr>
<td>Exports of agricultural from Ukraine to EU (qxs)</td>
<td>20.88</td>
<td>-14.97</td>
<td>35.85</td>
</tr>
<tr>
<td>Price of composite prim. Factors in the agricultural sector in Ukraine (pva)</td>
<td>6.35</td>
<td>4.9</td>
<td>1.45</td>
</tr>
</tbody>
</table>

Source: Simulation results.

While for exports and production, these two work in opposite directions, the story is different for prices: Introducing adjustment costs in the experiment, strengthens the effect of the trade costs and does not counteract those. In most cases the impact of fixed adjustment costs can be expected to be higher than those of lower trade costs. One reason is that the fixed cost shocks are bigger but in addition, the fixed cost variable directly affects most economic variables (except exports) in the model, while ams has an indirect effect.
In the long-run, the adjustment in Ukraine agriculture could raise the productivity in the sector. This should contribute to increased output and lower prices and increased exports. We assume that productivity for all primary and intermediate factors in the agricultural production in the Ukraine rises by 5% (a hypothetical number). In the table 3, we report the total and the individual component impacts of these changes. For ease of comparison we also reproduce the total impact column from table 2 (see table 3, column 1) and gauge how the accounting for increased productivity affects the model results. The results indicate that a 5% increase in productivity in the agricultural sector considerable boosts Ukrainian agricultural exports to EU; the impact is almost as pronounced as the one of the reduced trade cost. Furthermore if gains in agricultural productivity are accounted for, then the Ukrainian agricultural output actually increases and price of agricultural commodities in the Ukraine, and therefore import price of agricultural products from the Ukraine to EU also drops.

*Table 3: Total and individual impacts of higher adjustment costs, reduced trade costs and increased productivity in the Ukrainian agricultural sector (all numbers represent % change in the variable)*

<table>
<thead>
<tr>
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<th>Total* (without pdty increase)</th>
<th>Total (with pdty increase)</th>
<th>Adjustment costs (50%)</th>
<th>Trade costs (-10%)</th>
<th>Increase in agricultural productivity in Ukraine (5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market price of Agricultural goods in Ukraine (pm)</td>
<td>4.1</td>
<td>-0.95</td>
<td>3.03</td>
<td>0.98</td>
<td>-4.96</td>
</tr>
<tr>
<td>Market price of Agricultural goods in EU (pm)</td>
<td>-0.01</td>
<td>-0.03</td>
<td>0.01</td>
<td>-0.02</td>
<td>-0.02</td>
</tr>
<tr>
<td>Price of Agricultural products goods imported in EU from Ukraine (pms)</td>
<td>3.73</td>
<td>-0.87</td>
<td>2.76</td>
<td>0.89</td>
<td>-4.52</td>
</tr>
<tr>
<td>Agricultural production in Ukraine (qo)</td>
<td>-3.14</td>
<td>2.32</td>
<td>-4.2</td>
<td>0.93</td>
<td>5.59</td>
</tr>
<tr>
<td>Agricultural production in EU (qo)</td>
<td>-0.01</td>
<td>-0.05</td>
<td>0.03</td>
<td>-0.03</td>
<td>-0.04</td>
</tr>
<tr>
<td>Exports of agricultural goods from Ukraine to EU (qx)</td>
<td>20.88</td>
<td>50.5</td>
<td>-16.39</td>
<td>39.86</td>
<td>27.03</td>
</tr>
<tr>
<td>Price of composite prim. Factors in the agricultural sector in Ukraine (pva)</td>
<td>6.35</td>
<td>8.19</td>
<td>4.84</td>
<td>1.55</td>
<td>1.8</td>
</tr>
</tbody>
</table>

* Numbers reproduced from Table 1, column 1.
Source: Simulation results.
4 Conclusions and future directions

The main goal of this paper is to draw attention to the importance of the costs of DCFTAs or agreements of a similar scope. In our experiment of the EU DCFTA with the Ukraine, we show that modelling the decrease in trade costs due to the removal of NTMs by the standard iceberg cost approach is not sufficient. The adjustment costs that partner countries like the Ukraine incur when committing and ratifying DCFTAs need to be taken into account.

Accounting for both the reduced trade costs and the increased (fixed) adjustment costs, our simulation results indicate that the net impact on production and exports for the Ukraine crucially depends on whether the effect of adjustment costs dominates the effect of lower trade costs, or vice versa. The magnitude of both the level of fixed costs and the level of the resulting productivity gains determines the impact. Hence it is important to get the size of the shocks correct, taking them from literature or specifically estimating them for the simulation exercise.

Building upon this improvement of the NTM analysis, our experiment revealing the importance of accounting for fixed adjustment costs in the simulation, a natural direction of further progression would be to refine the methodology by incorporating productivity changes, which should be related to the investments, and by including a better representation of market structure, both domestically and for exporters. This points toward approaches to depicting firm heterogeneity in CGE models.

Going further, we would also like to look into the impact on individual factors of production and how their demand is affected by the restructuring of production process. In addition, the DCFTAs and similar agreements come with technical and financial assistance for their implementation, as described in the case of the EU DCFTAs, and these transfers could be included. In the current model, the EU funds to support the DCFTA ratification in the Ukraine are used to approximate the adjustment costs since no other information on adjustment costs is available for the Ukraine (and other partner countries). This highlights the considerable data issue when depicting NTMs in CGE models in a more sophisticated and thus more realistic manner than the nowadays standard iceberg costs approach.

5 References


