Melitz Meets Milk: The Impact of Quota Abolition on EU Dairy Export Competitiveness

Melitz Meets Milk: The Impact of Quota Abolition on EU Dairy Export Competitiveness

1. Introduction

On the first of April 2015, over thirty years after its inception, the European Union (EU) dairy quota came to an end. This marked the latest chapter in a series of common agricultural policy (CAP) reforms, initiated more than a decade earlier, to bring EU dairy policy into line with other common market organization (CMO) schemes, with the aim of fostering a competitive export-oriented sector. The 2003 'Mid-Term Review' mapped out gradual reductions in price support, accompanied by the removal of 'coupled' Pillar 1 dairy payments in favour of a single payment scheme. Under the 2008 'Health Check', discrete annual increases in the quota were implemented in preparation for a 'soft landing' in 2015. Additionally, from 2009, the EU has effectively ceased the implementation of export refunds on dairy markets.

According to official data (Eurostat, 2015), the dairy sector accounts for 14% of EU28 agri-food production (2014 figure). However, this aggregate statistic conceals considerable heterogeneity in relative size and industrial structure across Member States (MS). On the former, the share of agri-food output committed to dairy is as low as seven per cent in Spain, whilst in the Czech Republic, Estonia, Germany, Ireland, Cyprus, Latvia, Luxembourg, Finland and Sweden, it exceeds 20% (Eurostat, 2015). Furthermore, milk production in many EU countries is largely located in disadvantaged regions (EC, 2014). Consequently, safety-nets remain in the form of import tariffs, public and private storage, voluntarily re-coupling of Pillar 1 support to dairy farmers ('article 68' provision) and rural development (Pillar 2) funds for farmers in marginal areas. On the latter, Jongeneel et al. (2011) show that firm concentration ratios and associated 'downstream' market power in milk processing vary dramatically. Indeed, as part of the 'milk-package' (EU regulation 1308) of 2012, the promotion of stable internal market conditions for 'upstream' farmers became a priority.

In preparation for eventual quota abolition, *ex-ante* studies emerged to predict the impact on the performance of EU dairy firms, mainly examining internal EU market developments. In contrast, this research focuses on the EU's global trade competitiveness as a motor of medium-term growth in the EU dairy sector. As a *de facto* tool of global trade analysis with a comprehensive coverage of 57 products (including raw milk and dairy) and 140 regions, a multi-region Computable General Equilibrium (CGE) framework is an attractive option. Moreover, with its macroeconomic and productivity growth drivers, the CGE model is well equipped to capture structural change through competing uses for scarce primary factors and their concomitant impacts on the real exchange rate, which offers a more complete treatment of potential export competitiveness.

With very few exceptions, standard modelling representations of producer behaviour assume perfect competition (PC) and constant returns to scale, which is broadly compatible with 'price-taking' agricultural markets selling homogeneous commodities. However, it is clearly less appropriate in the dairy industry which exhibits retailer market power and product variety driven utility effects. As well as capturing these pertinent demand-side (i.e., varietal preference) and supply-side (i.e., entry/exit, firm scale) mechanisms, the heterogeneous firm extension of Melitz (2003) explicitly considers the decision-making which drives individual domestic firms to export (or not) to specific foreign markets.

Consistent with previous studies, our PC model shows that falling raw milk prices resulting from quota removal bestow a competitive advantage to EU dairy exporters in the medium term. Furthermore, the IC model predicts a 'shakeout' in the EU dairy industry, with remaining firms exhibiting greater third-country export orientation. The resulting varietal proliferation on extra-EU trade routes generates even greater export market penetration and welfare gains to the EU.

The rest of this paper is as follows. Section 2 presents a review of the relevant literature. Section 3 discusses the methodology. Section 4 examines the results, whilst section 5 critically evaluates the overall performance of the Melitz model.

2. Literature Review

Focusing on the analysis of raw milk quota abolition, there are a number of *ex-ante* modelling assessments using both partial equilibrium (PE) and general equilibrium (CGE) models. Bartova et al. (2009) employ the AGMEMOD PE model, whilst Witzke and Tonini (2009a) use the CAPSIM PE model. With a comprehensive disaggregation of agricultural and food activities, both models provide considerable detail of dairy activities for all EU MS, although the coverage of non-EU regions and intra- and extra-EU trade flows is stylized (i.e. net trade only). Subsequent studies by Witzke et al. (2009b) and Kempen et al. (2011) use the CAPRI PE model, which has a superior treatment of trade over many other PE representations as it explicitly models gross bilateral trade flows employing an Armington treatment (see section 3.1).

Bouamra-Mechemache et al. (2002) developed a specialized EU dairy industry spatial equilibrium model (EDIM), with a highly detailed representation of the vertical chain. Subsequent work on quota abolition (Bouamra-Mechemache et al., 2008) extends the model to capture international trade between the EU and its major partners (Oceania and four net importing regions), favouring a treatment of highly disaggregated homogeneous product sub-categories over an Armington approach.

In all four studies, the results are consistent. Comparing with a baseline (no-quota abolition), raw milk output rises by between 3% (CAPSIM), 4% (AGMEMOD and CAPRI) and 5% (EDIM), whilst the average EU market price for milk falls by 7% (CAPSIM), 8% (AGMEMOD), 10% (CAPRI) and 13% (EDIM) with the lost capitalization of rents from quota elimination. Downstream dairy activities exhibit similar trends.

Soregaroli et al. (2011) observe that whilst market model studies (particularly those with a European focus) capture well the sectoral detail and agricultural policy regimes, the role of market power remains largely neglected. Thus, building on the EDIM model, Soregaroli et al., (2011) examine imperfect competition in the Italian dairy industry. The authors estimate conjectural elasticity market power parameters which are then incorporated into the model equations for five dairy activities. As expected, the pattern of prices and quantities in raw milk and dairy are consistent with prior studies. Comparing with 2005 levels, the authors conclude that relative to imperfect competition, perfectly competitive Italian raw milk prices fall more, whilst production rises slightly less.

Jensen and Nielsen (2004) employ a global CGE model to simulate an abolition of the EU's export refunds and the removal of the tariff rate quota regime for dairy products. Incorporating a novel modelling treatment of the quota rent, Lips and Rieder (2005) use a global CGE model to examine quota and dairy export refund elimination with associated compensatory coupled payments to milk producers. Despite different base years and simulation design, the reported rise in EU milk output (3%) is comparable with that found in PE studies, though the magnitude of the market price fall for milk is at the upper end of the spectrum (22%).

To summarise, with one exception, modelling treatments typically assume perfectly competitive constant returns to scale technologies. Moreover, there is a clear consensus that EU milk and dairy production is expected to expand under quota abolition. Importantly, all studies concur that the measure of relative competitiveness, dictated by the assumed size of the quota rent, is key to determining the spread of supply responses across MS.

3. Methodology

3.1 Model Framework

Employing 'well-behaved' linearly homogeneous mathematical functional forms, neoclassical CGE models enumerate the theoretical tenets of constrained optimization (i.e., cost-minimization, utility-maximization). Under conditions of consistent aggregation and weak separability, optimization is compartmentalized into 'nests' to add flexibility to decision-making behaviour by agents (i.e., consumers, producers, investors). These behavioural equations are calibrated to the underlying input-output data to recreate the benchmark year under consideration. Additional market clearing and accounting equations enforce an equilibrium in all markets. Within a model characterized by 'm' variables and 'n' equations (m > n), 'm-n' variables are exogenous ('model closure') to ensure a mathematical solution. A 'neoclassical' closure rule for each economy ensures that changes in the balance of payments sum to zero.

The current study employs the Modular Agricultural GeNeral Equilibrium Tool (MAGNET -- Woltjer and Kuiper, 2014) calibrated to version 9 (2007 benchmark year) of the Global Trade Analysis Project (GTAP) database (Narayanan et al., 2012), covering 57 sectors, 140 regions and five primary factors. With the focus on agri-food markets, the MAGNET agricultural variant in Boulanger and Philippidis (2015) is employed.

Gross bilateral trade demands follow Armington (1969) where buyers in import region 's' exogenously differentiate domestic and imported varieties of the same good by a CES substitution elasticity σ_{dm}. The price of one unit of the Armington aggregate of good *i* (PA_i) is given by:

$$PA_i = \left[\vartheta_i \cdot PD_i^{1-\sigma_{dm}^i} + \left(1-\vartheta_i\right) \cdot PM_i^{1-\sigma_{dm}^i} \right]^{\frac{1}{1-\sigma_{dm}^i}} \quad [1]$$

where ϑ_i is the share of domestically-produced *i* in a country/region's use of *i* and PD_i and PM_i are the unit prices of the domestic good and the composite import good, respectively. Imports are further disaggregated by country/region, so the import price index PM_i is a CES aggregate of imports from different regions. In the PC model variant, substitution elasticities are taken from the GTAP9 dataset (Narayanan et al., 2012).

3.2 Imperfect competition

To better understand issues of structural change, product diversity and export competitiveness, this study extends the MAGNET model to include IC behaviour. In the IC model variant, only 'downstream' dairy activity is characterized by heterogeneous firms producing differentiated products under conditions of industry-wide increasing returns to scale.[1] Under the traditional 'love-of-variety' monopolistic competition model (Spence 1976; Dixit and Stiglitz, 1977; Krugman, 1979), consumer utility across a continuum of dairy varieties of *i* in region *s* ($Q_{i,s}$) is a CES aggregate of available dairy varieties sourced from all regions *r*:

$$Q_{i,s} = \left[\sum_r N_{i,r,s} \tilde{Q}_{i,r,s}^{\frac{\sigma_i - 1}{\sigma_i}} \right]^{\frac{\sigma_i}{\sigma_i - 1}} \quad [2]$$

where $N_{i,r,s}$ is the number of varieties or firms in the dairy industry in exporting region *r* selling into importing region *s*, and $\tilde{Q}_{i,r,s}$ is output of the average dairy firm sourced from *r*.

Maximizing [2] subject to a budget constraint, the aggregate demand for the average variety of *i* in *s* from region *r* is:

[1] With a focus on the vertical supply chain in the dairy industry, a number of remaining activities are aggregated (see section 3.3). Given the parametric demands in calibrating Melitz monopolistic dairy sectors with 'plausible' values (see discussion below) and the use of aggregate sectors (i.e., manufacturing, services) to complete the macro-economy, only the downstream dairy industry is characterized with a 'Melitz' market structure.

$$\tilde{Q}_{i,r,s} = N_{i,r,s} Q_{i,s} \left[\frac{P_{i,s}}{\tilde{P}_{i,r,s}} \right]^{\sigma_i} \qquad [3]$$

where prices $P_{i,s}$ and $\tilde{P}_{i,r,s}$ correspond to the quantities $Q_{i,s}$ and $\tilde{Q}_{i,r,s}$ in equation (2). The average firm in region *r* exercises market power over sales of their variety of dairy output in region *s*, by charging an optimal mark-up σ_i / (σ_i -1) over their marginal cost of production $C_{i,r,s}$:

$$\tilde{P}_{i,r,s} = \frac{C_{i,r,s}}{\tilde{\psi}_{i,r,s}} \frac{\sigma_i}{\sigma_i - 1} \qquad [4]$$

This mark-up expression from the monopolistic competition literature is augmented with the productivity of the average firm ($\tilde{\psi}_{i,r,s}$) in region *r* selling *i* in region *s* (Melitz, 2003). This representation of Melitz type IC uses the concept of a 'representative' firm (Akgul et al., 2016; Balistreri and Rutherford, 2012; Dixon et al., 2016), which charges the average industry price ($\tilde{P}_{i,r,s}$) and produces the average industry output ($\tilde{Q}_{i,r,s}$). In the IC sector, variable costs exhibit constant returns to scale (i.e., marginal cost equals average variable cost), whilst internal scale economies by firms occur as fixed costs are spread over a larger number of units of production. In the Melitz model, there are two types of fixed costs. As in the monopolistic competition model, fixed setup costs consist of industry-wide research and development and marketing costs which allow firms to operate in their 'home' region *r*. These costs equal the per unit fixed input cost ($W_{i,r,r}$) multiplied by the number of units of fixed setup costs ($H_{i,r}$). Thus, industry profit ($\Pi_{i,r}$) is:

$$\Pi_{i,r} = \sum_{s} N_{i,r,s} \tilde{\Pi}_{i,r,s} - N_{i,r}^{p} W_{i,r,r} H_{i,r} \qquad [5]$$

where $\tilde{\Pi}_{i,r,s}$ represents profits of the average firm in *r* operating in destination market *s*, and $N^{p}_{i,r}$ is the number of potential firms that operate in industry *i* in region *r*.

The second type of fixed costs is destination-specific fixed trading costs associated with entry of firms in *r* to any bilateral sales route *s*. These costs equal the per unit fixed input cost ($W_{i,r,s}$)

multiplied by the number of units of fixed trading costs ($F_{i,r,s}$). The profit condition for the average firm in source market *r* operating in destination market *s* is:

$$\tilde{\Pi}_{i,r,s}\left(\tilde{\psi}_{i,r,s}\right)=\frac{P_{i,r,s}\left(\tilde{\psi}_{i,r,s}\right)}{T_{i,r,s}}Q_{i,r,s}\left(\tilde{\psi}_{i,r,s}\right)-\frac{C_{i,r,s}}{\tilde{\psi}_{i,r,s}}Q_{i,r,s}\left(\tilde{\psi}_{i,r,s}\right)-W_{i,r,s}F_{i,r,s} \qquad [6]$$

where the fixed costs associated with research and development activities, marketing and distribution (i.e., shipping, packaging, product labelling) relating to product differentiation, are drawn from the use of labour and capital (Akgul et al., 2016, pp.123).

The firm's productivity $\psi_{r,s}$ in serving any of the *s* markets is drawn from a Pareto distribution whose cumulative distribution is $G(\psi) = 1 - (b_i/\psi)^{a_i}$, where b_i is the minimum productivity (associated with the least productive dairy producer in each country/region) and a_i is the Pareto shape parameter. There will be a firm in *r* with productivity $\psi^*_{i,r,s} > b_i$ for which operating profits in serving market *s* are exactly equal to fixed costs. Any firm with productivity below $\psi^*_{i,r,s}$ will not sell its variety of dairy output in destination market *s*.

As shown in Akgul et al. (2016) and Balistreri and Rutherford (2012), average firm productivity thresholds move in proportion to minimum productivity thresholds:

$$\tilde{\psi}_{i,r,s}=\psi^{*}_{i,r,s}\left[\frac{a_i}{a_i-(\sigma_i-1)}\right]^{\frac{1}{\sigma_i-1}} \qquad a_i>(\sigma_i-1) \qquad [7]$$

Solving equation [6] to derive the minimum threshold productivity ($\psi^*_{i,r,s}$) and substituting [7], it is possible to define changes in $\psi^*_{i,r,s}$ for the minimum productivity firm as:

$$\psi^{*}_{i,r,s}=\frac{\sigma_i^{\frac{\sigma_i}{\sigma_i-1}}}{\sigma_i-1}\frac{C_{i,r}}{\tilde{P}_{i,r,s}}\left[\frac{\tilde{P}_{i,r,s}}{T_{i,r,s}W_{i,r,s}}\frac{\tilde{Q}_{i,r,s}}{F_{i,r,s}}\right]^{\frac{1}{1-\sigma_i}} \qquad [8]$$

Given the mark-up equation [4], the industry profit equation [5] and the restriction that industry output be equal to average firm output multiplied by the number of firms in the industry ($N_{i,r}$), it is possible to determine changes in the number of potential firms. Finally, of the potential firms in the industry, only those whose productivity threshold satisfies

$\psi_{i,r,s} > \psi^{*}_{i,r,s}$ may operate in market *s*. More formally, if 1 - *G*($\psi^*_{i,r,s}$) is the proportion of firms that are active in market *s*, it can be shown that:

$$N_{i,r,s} = N_{i,r}\left[\psi^{*}_{i,r,s}\right]^{-a_i} \quad [9]$$

In parameterizing the Melitz model, the two crucial parameters are (i) the elasticity of substitution in the Armington function between competing varieties sourced from *r* (σ_i) and (ii) the shape parameter (a_i). To ensure that calibrated industry fixed costs from the mark-up expression do not exceed value added costs in the dairy sector in any of the regions, we choose a dairy Armington elasticity of 4.5 (vis-à-vis a value of 7.3 in the standard GTAP database). To satisfy the restriction that $a_i > (\sigma_i - 1)$ (see equation [7]), a shape parameter value of 3.6 is employed, which yields the result that fixed trading costs ($W_{i,r,s}.F_{i,r,s}$) are approximately five percent of total dairy industry fixed costs.[2]

3.3. Data aggregation and scenario design

From the GTAP data, the sectoral aggregation retains separate raw milk and dairy sectors. While the upstream raw milk is always modelled as perfectly competitive, the downstream dairy sector is modelled as either perfectly competitive or imperfectly competitive. Remaining agricultural activities are 'arable', 'other livestock', and a non-dairy composite food sector. Non agrifood activities are aggregated into 'resources', 'utilities', 'manufacturing' and 'services'. To represent the EU, key dairy net-exporters (Belgium, Netherlands, France, Germany) and importers (Italy) are disaggregated, with remaining EU regions aggregated into a 'rest of EU28' composite. For non-EU regions, dairy net-exporters (Argentina, Australia, New Zealand, Switzerland, United States) and importers (China, Japan, Mexico, Russia) are identified, with remaining regions aggregated into two additional composite regions, for a total of 17 regions.

To take full advantage of the detailed CAP payments baseline data in Boulanger and Philippidis (2015), version 9 2007 GTAP data is employed as a starting point. To capture global structural developments over the time horizon of our experiment, additional real macro growth,

[2] See also the supplementary information document.

population and land productivity shocks are compounded over three discrete time periods (2007-2013; 2013-2020; 2020-2030).[3]

As identified in section 2, MS raw milk quota rents are an influential driver of model results. In the baseline, raw milk quota rents are calibrated into the GTAP dataset as output tax rates based on CAPRI estimates for the periods 2007, 2013 and 2020 (no quota elimination).[4] For the year 2030, the quota rent rate in the baseline is assumed to be the same as the 2020 quota rent rate. To simulate quota elimination in the 2013-2020 period (the milk quota was eliminated in 2015), the 'tax' power of the quota rent is exogenously set to zero and maintained at zero in the 2020-2030 period.

4. Results

In sections 4.1 and 4.2, all markets are assumed perfectly competitive with symmetric firms producing a homogeneous good, to explain the market drivers from quota abolition. Then in sections 4.3 and 4.4, results from baseline and quota abolition experiments are presented assuming the dairy sector operates under conditions of IC. Since the first period of the baseline is independent of divergent policy shocks and is primarily employed to 'update' the database, the results are presented from the starting point of 2013.

4.1 Prices and Output (perfect competition)

The left hand side of Table 1 shows perfectly competitive changes in milk and dairy output volumes and nominal market prices relative to 2013 over the simulation period. With EU raw milk production under quota, the baseline results reveal that the quota is binding for all EU MS across the three periods. As a result, EU28 downstream dairy production also remains static, rising to 100.7 by 2030. In non-EU regions (results not shown), there is continued growth compared with 2013 production volumes in 'large' dairy net exporters such as New Zealand (52.0 points), 'other dairy exporters' (42.0 points), Australia (40.5 points) and the USA (25.2 points). In the baseline, EU28 average raw milk market prices increase 31.9 index points by

[3] Further details on the baseline implementation are in the supplementary information document.
[4] See the supplementary data document

2030 (Table 1 - approximately 1.64% compound growth per annum). Thus, with an EU average raw milk price in 2013 of €36.5 per 100kg (EC, 2017), this is the equivalent of a price rise to €48.1 per 100kg. Furthermore, there is a concomitant price transmission effect on dairy market prices of 11.5 index points (approximately 0.64% compound growth per annum). In the non-EU regions (results not shown), raw milk and dairy prices are held down by anticipated increases in land productivities, macro growth and endowment rises. These results are consistent with other studies of agri-food markets (e.g., Baldos and Hertel, 2014; OECD-FAO, 2015).

Table 1 here

Turning to market price falls under quota abolition (bottom left hand side of Table 1), by 2030, EU28 raw milk prices fall 39.1 index point compared with the baseline (or to €29.3 per 100kg). Similarly, dairy prices fall by 10.9 index points compared with the baseline. On a MS basis, the removal of milk quotas and the ensuing decrease in raw milk prices translates into the largest decrease in costs and market price in the downstream dairy sectors in Belgium (-13.3), France (-14.1) and the Netherlands (-13.8). These are also the regions which by 2030 exhibit the largest relative raw milk output volume increases. For the EU28, relative raw milk output volume rises by 8.1 points (approximately 0.45% annual compound growth). The output volume trends for dairy are very similar, with the result that EU28 output volume rises 7.5 points compared with the baseline (approximately 0.43% annual compound growth). It is worth noting that the French dairy sector expands strongly while the German dairy sector does not (see Table 1), even though the quota rents in France and Germany are similar (see supplementary information document). This apparently counter-intuitive result is explained by three other features of the dataset and baseline: (i) demand driven changes in baseline population growth (taken from SSP2) in France is 14% while it is -1.5% in Germany, (ii) relative baseline productivity growth in raw milk production (again taken from SSP2) is stronger in France than in Germany, and (iii) 29.5% of French dairy exports are destined for non-EU markets, whilst in Germany this share is only 14.3%. As we argue in section 4.4, the potential competitive gain to EU dairy firms is greater the larger their share of exports to non-EU markets.

4.2 Trade (perfect competition)

The left hand side of Table 2 shows the perfectly competitive changes in intra- and extra-EU28 real dairy imports and exports.[5] By 2030, the volume of extra-EU28 dairy exports increases 6.1 index points in the baseline, motivated by export rises to the 'other dairy importers' region (23.1 index points), due to the FTA shocks between the EU and Korea, Peru, Columbia and Canada. To other export destinations, extra-EU exports fall between 13 and 25 index points in the baseline (except Argentina and the USA where falls are higher). At the same time, there is a strong rise in extra-EU imports (60.7 points).[6] Intra-EU trade, which constitutes the majority of EU dairy trade, rises by a modest 1.3 index points by 2030.

Table 2 here

Under quota abolition, the competitive gain to all non-EU export routes from the drop in the milk price increases aggregate extra-EU dairy exports 30.4 index points by 2030 compared to the baseline. The EU28 becomes more self-sufficient in dairy as extra-EU dairy imports witness a relative fall of 38.1 index points by 2030. As different MS experience different supply response effects from quota abolition, intra-EU trade in 2030 also rises by 6.9 index points compared with the baseline. In terms of the trade balances (left hand side of Table 3), by 2030 the EU28 increases its dairy trade surplus by €3,257 million compared with the 2030 baseline. This increase in EU trade competitiveness is accompanied by deteriorating trade balances in the traditionally competitive dairy exporting regions, such as the United States (-€805 million), New Zealand (-€758 million), Australia (-€406 million) and Argentina (-€211 million).

Table 3 here

4.3 Baseline (imperfect competition)

With the same model drivers, the reported baseline trends in the imperfectly competitive model variant are very similar to those discussed in the perfectly competitive (PC) model. On the other hand, there is a richness of detail on the structure of industry costs, per firm output

[5] Raw milk is non-tradable in the GTAP database.

[6] The reader should be mindful that the extra-EU export base is considerably larger than the extra-EU import base.

(Table 4), dairy firm entry/exit (Table 5), and endogenous productivity changes (Table 6) which the PC model does not capture.

Tables 4, 5, and 6 here

As internal EU domestic demand conditions (income elasticities) are relatively more stable than the more price-sensitive purchasing decisions (trade elasticities) of foreign importers, intra-EU trade (right hand side of Table 2) and 'home' market minimum market productivity thresholds (Table 6, upper panel) hold steadier, whilst by 2030, the number of firms in the EU dairy industry rises by 5.3 index points (Table 5, upper panel). Examining the dairy trade balance (right hand side of Table 3), the EU trade surplus rises to €9.290 billion in 2030 (compared with €9.111 billion in the perfect competition baseline). EU28 dairy production rises by only 0.3 points by 2030 (right hand side of Table 1), whilst the 5.3 point proliferation in the number of EU dairy firms mentioned previously implies that the scale of per firm output falls by five points (Table 4). Firms move back up their average cost curves with associated increases in average fixed costs per firm, consistent with the baseline increases in dairy market prices/average costs presented in Table 1 (right hand side).

As with the PC model baseline, EU dairy penetration in non-EU markets falls everywhere except for the 'other dairy importers' region (right hand side of Table 2). With this loss of market access in many non-EU regions (falling $Q_{i,r,s}$ in equation 8), by 2030 there are rises in threshold productivities for the average EU firms operating in foreign markets (Table 6, lower panel), which is consistent with a decrease in the number of EU dairy firms operating in those same non-EU markets (see Table 5, lower panel).

In addition to the 'traditional' terms of trade, allocative efficiency, technical change, endowment and population growth decomposition of equivalent variation (EV) (see Huff and Hertel, 2001), the Melitz model introduces additional sources of welfare, owing to the existence of endogenous changes in minimum productivity thresholds, fixed trading cost effects resulting from endogenous changes in the number of firms by sales route, output per firm scale effects, and variety effects from firm/varietal changes in domestic and foreign markets (see Table 7). Under assumed conditions of sustained economic growth, EU EV rises between 2013-2030 (approximately 11 index points in per capita utility – not shown). A variety effect gain (€2,964 million) arises from greater varietal dairy choice to EU consumers in the 'home' market, although this is largely offset by negative scale effects (-€2,363 million) as dairy firms move up their average cost curve. The general rise in productivity thresholds by EU firms operating in 'home' and 'foreign' markets generates an EV gain of €255 million (not shown), whilst the small real income increase associated with changes in fixed trading costs arises because of a slight rise in the (weighted) proportion of potential firms that pay setup costs to operate in different markets.[7]

Table 7 here

4.4 Quota elimination (imperfect competition)

There is a fall in the EU28 average raw milk price of 29.4 points compared with the baseline (Table 1), which in absolute price terms is equivalent to a price fall from €44.7 per 100kg in 2030 to €31.5 per 100kg. Furthermore, average variable costs in the dairy industry fall by 10.9 points compared with the baseline (Table 1), whilst the matching fall in dairy market prices implies that firms are moving down their average cost curves. As a result, by 2030 the scale of EU28 firm output increases by 11.8 points over the baseline (Table 4), whilst the slower corresponding rise in EU28 dairy industry output (9.0 index points - Table 1) implies a 'shakeout' in the dairy sector as the aggregate number of EU firms falls 2.9 points compared with the baseline (Table 5, upper panel).

Interestingly, although there are now fewer firms/varieties in the EU28 dairy industry compared with the baseline, a proportionally larger share of remaining incumbents is export-oriented (see Table 5, lower panel) along all extra-EU export routes. This generates an additional impetus on demand, with the result that variety-loving dairy consumers now purchase more EU products than in the PC model. Examining the right side of Table 2, by 2030, extra-EU exports increase 43.5 index points compared with the baseline (compared with 30.4 index points in the PC

[7] The difference between potential firms and firms that operate is governed by the shape parameter and the minimum productivity threshold by sales route.

experiment), whilst intra-EU trade rises by approximately the same magnitude as in the PC experiment.

The EU's share of global dairy exports (by c.i.f. values) rises from 28.1% in the baseline (compared to 29.7% in the PC experiment), to 35.3% with quota abolition (compared to 36.8% in the PC experiment). Extra-EU dairy imports fall by 43.3 index points by 2030 compared with the baseline (Table 2), causing the EU's share of global dairy imports to fall from 4.8% in the baseline (compared to 5.5% in the PC experiment) to 3.4% under quota abolition (compared to 4.0% in the PC experiment). Examining the dairy trade balance figures (right hand side of Table 3), by 2030 the EU generates a surplus of €13,328 million, an improvement of €4,038 million compared with the baseline (compared with €3,257 million in the PC experiment).

With simultaneous quota removal in all EU regions, the home market minimum productivity threshold changes are very similar to the baseline. On the other hand, in non-EU destination markets where no quota exists and where import demands are more price elastic, the potential competitive gain to EU dairy firms is greater. As a result, this translates into a reduction in minimum productivities (Table 6, lower panel) by export routes, consistent with the observation of greater extra-EU export orientation by EU28 dairy firms.

Finally, the EU28 welfare gain from quota abolition increases from €1,923 million in the PC experiment (not shown) to €5,380 million in the imperfectly competitive experiment (Table 7). This difference is explained largely by the additional scale and variety effects. While there is a reduction in EU consumer choice for dairy products which costs the EU28 economy -€1,825 million compared with the baseline, the consolidation of the EU28 dairy industry into fewer larger firms generates a scale effect gain of €5,236 million compared with the baseline. This is consistent with results in Dixon *et al.* (2016). With a larger proportion of potential EU firms operating, there is an additional welfare gain of €359 million, compared with the baseline.

5. Discussion and Conclusions

Examining EU dairy sector export performance, commonly assumed perfectly competitive structures cannot capture the importance of either endogenous varietal preference patterns or industrial structural change (i.e., scale effects, firm exit/entry) features. The firm heterogeneity extension (Melitz, 2003) enriches the analysis, since it offers insight on the proportion of 'home-market' firms which take the export-oriented step of engaging in trade by specific bilateral sales destinations. Furthermore, with its complete macro-economic and global trade coverage coupled with its internalisation of economy-wide structural change, the CGE model provides a complete framework for assessing EU trade competitiveness.

Under EU milk quota abolition, the perfectly competitive (PC) model reports per annum compound milk output growth of approximately 0.5% per annum (slightly below the 0.8% reported in the European Commission's market outlook (EC, 2015)), whilst dairy price falls are a little stronger than previous studies. This may be attributed to CGE model assumptions of factor market rigidities in the upstream milk sector or structural differences between PE and CGE representations of (downstream) dairy industry cost shares. Our PC model variant predicts an EU global dairy trade share of 37% by 2030 which, despite the five year time gap compared with the EC's (2015) corresponding trade share statistic of 28% by 2025, is perhaps optimistic. This divergence is conditioned by differences in the representation of the quota and structural differences in both the model behavioural equations of trade and underlying global trade datasets. Moreover, according to official data (Eurostat, 2016a) the EU dairy trade surplus has risen steadily from €5,396 million in 2007 to €8,951 million in 2015, suggesting that our PC experiment estimate of €12,368 million by 2030 (Table 3) is plausible.

Secondly, we find that PC and imperfect competition (IC) model variants exhibit broadly similar price, output and bilateral trade trends. This result is supported by Soregaroli et al. (2011) who report that deviations between their two model variants of the Italian dairy sector never exceed 10%. Furthermore, as with their study, we also observe that for most EU regions, market power reduces the degree of direct price transmission such that raw milk price falls under quota abolition are stronger in the PC model variant. Whilst the difference may not be large, Soregaroli et al. (2011) note that even small price differences may have important effects on farmers operating at the margin. This is particularly pertinent at a time when EU dairy farmers are struggling with low milk prices, prompting a €350 million aid package from the

European Commission in exchange for voluntary short-term milk production cuts (Euractiv, 2016).

Thirdly, the IC barometers of scale and firm entry/exit shed further light on the viability of many dairy businesses, with the expectation that a 'shakeout' in the EU dairy industry could occur as production is concentrated into fewer larger scale firms. Examining Eurostat (2016b) data on the structure of the dairy industry by activity and EU MS, there is empirical evidence to support this finding. Comparing 2006 (latest year prior to the Mid-Term Review milk quota increases) and 2015 (latest available year), the number of dairy firms across all activities has fallen in Germany, Italy, the rest of the EU28 (except cheese) and the EU28 aggregate. Moreover, in Belgium and the Netherlands where firm numbers are expected to rise, this has indeed been the case for fresh dairy products, butter (Netherlands only) and the key export product, cheese.[8]

Fourthly, a key strength of the Melitz representation is the explicit role of product variety on export competitiveness. Successive annual reports by FoodDrinkEurope (2016) show the EU dairy industry is consistently amongst the highest in terms of research and development expenditure, which according to Tacken *et al.* (2009), is principally in product innovation. With specialist dairy products targeted at key foreign markets, it is entirely consistent with our result that PC models (and by extension IC models with no explicit product variety utility effects) understate the potential EU dairy trade gains arising from the demand for new product varieties. Moreover, it also strongly motivates our finding that a larger share of remaining EU dairy firms will engage in third country exports.

In terms of future research, further development of Spearot's (2016) econometric estimation of the shape parameter of the Pareto distribution of heterogeneous firms could be extended to regions as well as industries. On the other hand, recent trade research (Head et al., 2014; Freund and Pierola, 2015) even suggests the exploration of alternative distributions, arguing that Pareto may be an inadequate fit to real world business data, particularly in cases where a

[8] According to Eurostat data, between 60-70% of dairy enterprises in Belgium are engaged in cheese and fresh dairy products, whilst between 60-70% of Dutch dairy firms participate in fresh dairy, butter and cheese production.

large number of firms account for a small proportion of sales. By cross referencing data on EU dairy exports with EU dairy industry structure,[9] for the main EU exports of cheese and powdered dairy products (47% and 15% of EU dairy export revenues, respectively), the firm size distribution in both industries is broadly uniform across size categories. On the other hand, for fresh dairy products and butter, with more cases of a skewed distribution toward smaller firms in the main EU exporting countries, evidence supporting the use of the Pareto distribution is more contentious.

6. References

Akgul, Z., Villoria, N. and Hertel, T.W. `GTAP-HET: Introducing Firm Heterogeneity into the GTAP Model', *Journal of Global Economic Analysis*, Vol. 1(1), (2016) pp. 111-180. Available at: https://jgea.org/resources/jgea/ojs/index.php/jgea (open access).

Armington, P. `A Theory of Demand for Products Distinguished by Place of Production', *IMF Staff Papers,* Vol. 16(1), (1969) pp. 159-77.

Baldos, U.L. and Hertel, T.W. *Bursting the Bubble: A Long Run Perspective on Crop Commodity Prices*, Working Paper 80, (Center for Global Trade Analysis, 2014). Available at: https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=4574 (last accessed February 2016).

Balistreri, E. J. and Rutherford, T. F. `Computing General Equilibrium Theories of Monopolistic Competition and Heterogeneous Firms', in Dixon, P. B. and D. W. Jorgenson eds., *Handbook of Computable General Equilibrium Modeling* (Elsevier, 2012).

Bartova, L., Fellman, T. and M'barek, R., (eds.) *Modelling and Analysis of the European Milk and Dairy Market* (JRC, Institute for Prospective Technological Studies (IPTS), European Commission, 2009). Available at: http://ftp.jrc.es/EURdoc/JRC50915.pdf (last accessed March 2016).

[9] See the additional information document.

Bouamra-Mechemache Z., Chavas, J.P., Cox, T. and Réquillart, V. `EU dairy policy reform and future WTO negotiations: a spatial equilibrium analysis’, *Journal of Agricultural Economics,* Vol. 53(2), (2002) pp. 4-29.

Bouamra-Mechemache Z., Jongeneel, R. and Réquillart, V. `Impact of a gradual increase in milk quotas on the EU dairy sector’, *European Review of Agricultural Economics*, Vol. 35(4), (2008) pp. 461-491.

Boulanger, P. and Philippidis, G. `The EU Budget Battle: Assessing the Trade and Welfare Impacts of CAP Budgetary Reform’, *Food Pol*icy, Vol. 51, (2015) pp. 119-130. Available at: http://www.sciencedirect.com/science/article/pii/S0306919215000056 (open access).

Dixit, A.K. and Stiglitz, J.E. `Monopolistic Competition and Optimum Product Diversity’, *American Economic Rev*iew, Vol. 67, (1977) pp. 297-308.

Dixon, P., Jerie M. and Rimmer M. `Modern Trade Theory for CGE Modelling: The Armington, Krugman and Melitz Models’, *Journal of Global Economic Analysis*, Vol. 1(1), (2016) pp. 1-110.

EC. *EU Agricultural Outlook: Prospects for EU Agricultural markets and Income 2015-2025* (Brussels: DG Agri, December 2015). Available at: http://ec.europa.eu/agriculture/markets-and-prices/medium-term-outlook/index_en.htm (last accessed March 2015).

EC, 2016. European Commission Press Release Database. Available at: http://europa.eu/rapid/search.htm (last accessed March 2016).

EC, 2017. Milk Market Observatory, DG AGRI, European Commission, https://ec.europa.eu/agriculture/market-observatory/milk_en (last accessed November 2017).

Euractiv, 2016. EU throws fresh cash at struggling dairy farmers. Available at: https://www.euractiv.com/section/agriculture-food/news/eu-throws-fresh-cash-at-struggling-farmers/ (last accessed July 2016).

Eurostat, 2015. Economic Accounts for Agriculture. Available at: http://ec.europa.eu/eurostat/web/agriculture/data/database (last accessed May 2016).

Eurostat, 2016a. Extra-EU28 trade of food, drinks and tobacco (SITC 0+1), by Member State. Available at: http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tet00063 (last accessed May, 2016).

Eurostat, 2016b. Agricultural accounts data. Accessed December, 2016, available at: http://ec.europa.eu/eurostat/web/agriculture/data/database

FoodDrinkEurope 2016 Available at: http://www.fooddrinkeurope.eu/uploads/publications_documents/Data_and_trends_Interactive_PDF_NEW.pdf (last accessed December 2016).

Freund, C. and Pierola, M. D. `Export superstars', *Review of Economics and Statistics*, Vol. 97(5), (2015) pp. 1023-1032.

Head, K., Mayer, T. and Thoenig, M. `Welfare and Trade without Pareto', *American Economic Review*, Vol. 104(5), (2014) pp. 310-16.

Huff, K. and Hertel, T.W. *Decomposing Welfare Changes in GTAP*, GTAP Technical Paper 5, (Purdue University, USA, 2001). Available at: https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=308 (last accessed April 2016).

Jensen, H. and Nielsen, C. *EU dairy policy analysis. Assessing the importance of quota rent estimates*, (Washington, D.C.: Seventh Annual Conference on Global Economic Analysis, June 17-19, 2004).

Jongeneel, R., Burrell, A. and Kavallari, A. *Evaluation of CAP measures applied to the dairy sector*, final deliverable, (University of Wageningen, 2011). Available at: http://ec.europa.eu/agriculture/eval/reports/dairy/fulltext_en.pdf (last accessed March 2016).

Kempen, M., Witzke, H.P., Pérez Domínguez, I., Jansson, T. and Sckokai, P. `Economic and environmental impacts of milk quota reform in Europe', *Journal of Policy Modelling*, Vol. 33(1), (2011) pp. 29-52.

Krugman, P. `Increasing Returns, Monopolistic Competition and International Trade', *Journal of International Economics*, Vol. 9, (1979) pp. 469-479.

Lips, M. and Rieder, P. `Abolition of Raw Milk Quota in the European Union: A CGE Analysis at the Member Country Level', *Journal of Agricultural Economics*, Vol. 56(1), (2005) pp. 1-17.

Melitz, M. J. `The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity', *Econometrica*, Vol. 71(6), (2003) pp. 1695-1725.

Narayanan, B., Aguiar, A. and McDougall, R. *Global Trade, Assistance, and Production: The GTAP 8 Data Base* (Purdue University: Center for Global Trade Analysis, 2012).

OECD-FAO. *Agricultural Outlook 2015-2024*, (Paris: OECD Publishing, 2015). Available at: http://www.fao.org/3/a-i4738e.pdf (last accessed March 2016).

Soregaroli, C., Sckokai, P. and Moro, D. `Agricultural Policy Modelling under imperfect competition', *Journal of Policy Modelling*, Vol. 33, (2011) pp. 195-212.

Spearot, A. `Unpacking the Long Run Effects of Tariff Shocks: New Structural Implications from Firm Heterogeneity Models', *American Economic Journal: Microeconomics*, Vol. 8(2), (2016) pp. 128-167.

Spence, A.M. `Product Selection, Fixed Costs and Monopolistic Competition', *Review of Economic Studies*, Vol. 43, (1976) pp. 217-235.

Tacken, G.M.L., Batowska, A., Gardebroek, C., Nesha Turi, K., Banse, M., Wijnands J.H.M. and Poppe K.J. *Competitiveness of the EU dairy industry*, Report 2009-011, Project code 20964 (The Hague: LEI Wageningen UR, 2009).

Witzke, H. P. and Tonini, A. `Milk quota expiry impacts and sensitivity analyses using the CAPSIM model', *German Journal of Agricultural Economics*, Vol. 58(5/6), (2009a) pp. 228-237.

Witzke, H.P., Kempen, M., Pérez Domínguez, I., Jansson, T., Sckokai, P., Helming, J., Heckelei, T., Moro, D., Tonini, A. and Fellmann, T. *Regional Economic Analysis of Milk Quota Reform in the*

EU (JRC, IPTS, European Commission, 2009b). Available at: http://ftp.jrc.es/EURdoc/JRC53116.pdf (last accessed March 2015).

Woltjer, G., and Kuiper M., (eds) *The MAGNET model - Module description* UR Report 4-057 (The Hague: LEI Wageningen, 2014). Available at: http://www.magnet-model.org/MagnetModuleDescription.pdf (last accessed April 2016).

7. Tables

Table 1: Change in EU raw milk and dairy markets (2013=100)

	Perfect competition			Imperfect competition		
	Baseline		Quota elim. vs.baseline	Baseline		Quota elim. vs.baseline
Output volume						
Raw Milk	**2020**	**2030**	**2030**	**2020**	**2030**	**2030**
Belgium	100.0	100.0	15.6	100.0	100.0	19.2
France	100.0	100.0	13.7	100.0	100.0	16.0
Germany	100.0	100.0	3.0	99.9	99.4	3.1
Italy	100.0	100.0	5.5	100.0	100.0	6.0
Netherlands	100.0	100.0	16.4	100.0	100.0	22.7
Rest of EU28	100.0	100.0	5.9	100.0	100.0	5.9
EU28	100.0	100.0	8.1	100.0	99.9	8.9
Dairy	**2020**	**2030**	**2030**	**2020**	**2030**	**2030**
Belgium	99.2	98.1	18.0	99.4	97.5	24.2
France	99.8	99.3	14.8	99.9	99.2	17.7
Germany	100.4	100.8	2.8	100.4	100.2	3.0
Italy	100.1	100.2	5.3	100.2	100.2	6.2
Netherlands	100.2	100.1	17.7	100.3	100.1	25.0
Rest of EU28	100.5	101.5	4.6	100.5	100.9	5.3
EU28	100.3	100.7	7.5	100.3	100.3	9.0
	Perfect competition			Imperfect competition		
Market prices	Baseline		Quota elim. vs.baseline	Baseline		Quota elim. vs.baseline
Raw Milk	**2020**	**2030**	**2030**	**2020**	**2030**	**2030**
Belgium	107.2	155.4	-78.0	105.7	133.8	-54.2
France	109.1	133.8	-39.4	107.6	125.6	-31.4
Germany	103.4	118.0	-24.6	102.5	111.6	-18.5
Italy	107.1	129.4	-43.7	105.6	120.1	-34.1
Netherlands	103.7	121.0	-31.3	103.3	115.8	-24.3
Rest of EU28	108.8	139.9	-45.1	107.0	127.5	-32.8
EU28	107.1	131.9	-39.1	105.7	122.4	-29.4
Dairy	**2020**	**2030**	**2030**	**2020**	**2030**	**2030**
Belgium	102.8	112.3	-13.3	102.1	110.1	-13.7
France	103.8	114.2	-14.1	103.3	112.0	-14.5
Germany	101.8	109.7	-9.2	101.4	107.8	-9.1
Italy	103.2	111.5	-9.8	102.5	109.5	-9.8
Netherlands	102.5	111.8	-13.8	102.0	109.5	-15.2
Rest of EU28	102.3	111.0	-9.9	101.9	109.4	-9.7
EU28	102.6	111.5	-10.9	102.1	109.6	-10.9

Table 2: Change in EU dairy trade volumes (2013=100)

	Perfect competition			Imperfect competition		
	Baseline		Quota elim. vs.baseline	Baseline		Quota elim. vs.baseline
	2020	**2030**	**2030**	**2020**	**2030**	**2030**
Intra-EU trade	100.6	101.3	6.9	100.9	101.8	6.8
Extra-EU imports	126.8	160.7	-38.1	125.5	157.6	-43.3
Extra-EU exports	103.0	106.1	30.4	101.7	103.5	43.5
Destinations of Extra-EU exports:						
	2020	**2030**	**2030**	**2020**	**2030**	**2030**
Switzerland	90.2	79.5	35.0	86.2	78.9	57.8
United States	80.4	60.9	32.5	68.6	48.1	51.1
Mexico	92.7	83.1	44.9	93.5	87.8	51.3
Argentina	72.5	38.2	19.8	54.9	20.8	19.9
Russia	91.1	87.0	25.6	91.0	88.2	30.1
China	92.1	78.0	33.3	92.5	81.4	38.4
Japan	97.2	84.1	31.1	98.3	88.0	33.9
Australia	90.3	80.5	40.7	85.9	81.8	70.6
New Zealand	91.1	81.5	32.5	84.9	79.4	57.0
Oth. dairy exporters	90.1	75.0	39.1	84.7	71.8	71.8
Oth. dairy importers	114.7	123.1	36.5	115.3	126.3	43.8

Table 3: Regional Dairy trade balances (€ millions, 2007 prices)

	Perfect competition			Imperfect competition		
	Baseline		Quota elim. vs.baseline	Baseline		Quota elim. vs.baseline
	2020	2030	2030	2020	2030	2030
EU28	8904	9111	3257	8726	9290	4038
Switzerland	322	524	-383	350	472	-435
United States	289	1289	-805	522	1673	-1451
Mexico	-1990	-2498	0	-1654	-2076	1
Argentina	854	1517	-211	974	1679	-183
Russia	-2906	-3445	4	-3273	-3877	6
China	-5105	-5597	8	-4950	-5423	-1
Japan	-1061	-1152	-1	-1089	-1184	0
Australia	1321	1681	-406	1398	1678	-530
New Zealand	7758	9088	-758	8103	9345	-596
Oth. dairy exporters	2478	3427	-746	2829	3768	-1041
Oth. dairy importers	-14037	-17591	10	-15267	-19124	11

Table 4: Change in output per firm in the dairy industry (2013=100)

Output per firm	Baseline		Quota abolition		Abolition vs. baseline
	2020	**2030**	**2020**	**2030**	**2030**
Belgium	102.2	92.4	113.0	105.7	13.3
France	98.8	91.2	110.2	107.2	16.0
Germany	101.3	98.8	110.3	108.8	10.0
Italy	102.7	100.3	110.2	111.0	10.7
Netherlands	101.0	95.3	116.7	113.6	18.4
Rest of EU28	99.8	93.9	104.3	104.0	10.1
EU28	100.3	95.0	108.0	106.8	11.8

Table 5: Changes in dairy industry firms and EU firms operating by non-EU routes (2013=100)

Number of firms	Baseline		Quota abolition		Abolition vs. baseline
	2020	**2030**	**2020**	**2030**	**2030**
Belgium	97.2	105.1	98.4	115.9	10.9
France	101.1	108.0	101.9	109.7	1.7
Germany	99.1	101.3	98.1	94.3	-7.0
Italy	97.6	99.9	94.7	95.4	-4.5
Netherlands	99.3	104.8	106.8	111.4	6.6
Rest of EU28	100.7	107.0	95.9	102.2	-4.8
EU28	100.0	105.3	97.9	102.5	-2.9
EU28 firms operating by bilateral route	**Baseline**		**Quota abolition**		**Abolition vs. baseline**
	2020	**2030**	**2020**	**2030**	**2030**
Switzerland	92.3	92.1	108.0	114.5	22.4
United States	82.2	71.9	99.1	97.6	25.7
Mexico	96.6	98.9	108.5	117.7	18.8
Argentina	73.3	46.8	92.7	61.9	15.0
Russia	95.3	99.0	99.7	107.7	8.7
China	96.2	95.0	105.3	108.7	13.7
Japan	98.8	97.9	106.3	108.7	10.8
Australia	92.4	94.8	108.0	122.2	27.5
New Zealand	91.7	93.3	105.9	115.7	22.4
Other dairy exporters	91.8	88.8	109.4	118.7	29.9
Other dairy importers	107.5	118.8	114.5	130.4	11.5

Table 6: Changes in 'home' market and 'foreign' market productivity thresholds (2013=100)

Home market firm productivity threshold	Baseline		Quota abolition		Abolition vs. baseline
	2020	**2030**	**2020**	**2030**	**2030**
Belgium	100.3	99.7	100.6	99.6	-0.1
France	100.1	99.8	100.6	100.4	0.6
Germany	100.4	100.5	100.6	100.5	0.0
Italy	100.4	100.4	100.5	100.6	0.2
Netherlands	100.1	100.0	100.8	100.7	0.7
Rest of EU28	100.1	100.1	100.1	100.1	0.1
EU28	100.2	100.1	100.4	100.3	0.2
EU28 average firm productivity threshold	**Baseline**		**Quota abolition**		**Abolition vs. baseline**
	2020	**2030**	**2020**	**2030**	**2030**
Switzerland	102.3	103.5	98.0	97.1	-6.4
United States	105.5	110.8	100.0	101.5	-9.4
Mexico	101.1	102.0	98.1	97.1	-4.9
Argentina	108.8	124.2	102.3	114.8	-9.4
Russia	101.5	102.0	99.8	99.0	-3.0
China	101.3	103.0	98.9	99.0	-4.0
Japan	100.4	102.0	98.6	98.8	-3.1
Australia	102.3	103.0	97.8	95.6	-7.4
New Zealand	102.5	103.4	98.5	97.1	-6.3
Other dairy exporters	102.5	104.9	97.4	96.3	-8.6
Other dairy importers	98.2	96.9	96.7	94.5	-2.5

Table 7: Decomposition of EU28 Equivalent Variation (EV) (imperfect competition) (€ millions, 2007 prices)

	Baseline			Quota abolition			Abol. vs. baseline
	2013-2020	2020-2030	2013-2030	2013-2020	2020-2030	2013-2030	2013-2030
Allocative	148064	137917	285981	148888	138426	287314	1333
Endowment	245506	341683	587189	245675	342019	587694	505
Technical change	3573	1203	4776	3732	1652	5384	608
Terms of trade	145365	-17561	127804	145034	-17470	127564	-240
Population	179642	212888	392529	179694	212958	392652	123
Variety	32	2932	2964	-1056	2195	1139	-1825
Scale	149	-2513	-2363	3379	-506	2873	5236
Fixed trading costs	288	-144	145	565	-61	504	359
EV	722043	676692	1398735	724781	679334	1404115	5380