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The implications of Borders Check Delay Post-Brexit on Irish Cheese Export and Supply Chain: a Case Study

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Smart Sustainable Solution for Business Processes (3S Research Group)

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- Collaborating with national and international Industrial partners;
- Providing accurate, quality and innovative solutions for business problems;
- Working closely with clients using proactive planning and modelling techniques;
- and Capturing innovation opportunities that support businesses in the emerging markets.

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Key Findings

- A delay of up to 231% in delivery times of cheese products will occur if border checks are applied at western UK ports. This delay will significantly affect the value of Irish cheese on the UK market, particularly the products with limited shelf-life.[1]
- Cheese delivery times could increase by around 34% and 109% respectively, using direct routes to mainland Europe via Cherbourg and Rotterdam/ Zeebrugge, compared to delivery times via the UK land-bridge.[2] Products with short lifespans cannot afford such delays. However, exporters of longer shelf-life products (e.g. hard and semi-hard cheese) may prefer these routes. The direct route provides companies with more control over transportation times, and consistent delivery performance.
- Dublin-Holyhead is a strategically vital route for cheese exports. It has high sailing frequencies and a short sailing time to and from Ireland. It has been suggested that Holyhead Port does not have enough space for adequate checking facilities and the infrastructure to carry out border controls. If so, the trade flow between Ireland and the UK, and then to the EU26 via the UK land-bridge, would suffer significant disruption. In this scenario, the delivery times for cheese products would increase by 36% and 21% to the UK and EU26 markets respectively.[3]

Recommendations

- New markets for Irish cheese are necessary given the current trade uncertainty with the UK in terms of new tariffs, associated red tape and other controls.
- The Irish cheese supply chain should be redesigned to reduce its reliance on UK operations and to change the just-in-time nature of consumer demand and products delivery.
- Sending products to distant markets such as Japan, China, South Korea and the Middle East would require changes in the current transportation strategies. Alternatives to the traditional Ro/Ro transportation modes, such as containerisation, must be arranged.
- Cheese exporters should invest in refrigerated storage facilities and refrigerated trucks (reefers), as these can be used as storage facilities on wheels. This strategy will create an essential buffer against trade uncertainty with the UK.
- Cheese exporters need to hire capable personnel to manage export declarations and other certificates to minimise the administrative burdens. This will help avoid delays at ports.

[1] For more information about the model outcomes, please refer to Section 5 in the Case Study
[2] For more information about this scenario. Please refer to Figure 3, Section 5
[3] Figure 5, Section 5 illustrates the model outcomes in the case of this scenario

- Establishing a consistent direct shipping service to Europe is vital. This will provide companies with more control over product delivery time and, in turn, maximise the quality of their products.
- If there is inadequate space for checking infrastructure at Holyhead Port, there will be significant disruption to the Cheese exports to UK markets. Special arrangements must be made to facilitate the traffic through alternative short-sea maritime routes such as Rosslare-Pembroke and Rosslare-Fishguard.

1. Introduction

In 2018 the Irish agri-foods sector contributed nearly €15 billion to the economy.[4] It is Ireland's most important indigenous industry, employing 8% of the total workforce.[5] The sector exports to over 180 countries and the UK remains its largest trading partner, with 41% of all exports. Dairy produce is the main product category exported, adding up to 34% of the sector's total global trade. Cheese produce accounts for over €800 million exports per year alone.

Cheese is Ireland's largest dairy export by volume. The Irish cheese manufacturing industry is mostly limited to four key players: Carbery, Dairygold, Glanbia, and Kerry. In 2018, these companies produced around 269,752 tonnes of cheese. The main category of cheese in Ireland is cheddar, which makes up approximately 90% of the total output or 242,776 tonnes. About 93% of the cheddar produced in Ireland is exported each year – around 225,782 tonnes. Approximately 57% of all cheddar shipped from Ireland is sold in the UK market – around 128,695 tonnes.[6]

Due to the importance of the UK market to exporters of cheese, cheese products in general are seen as extremely vulnerable to Brexit. If the 'cliff-edge' scenario occurs, this will result in WTO tariff and non-tariff barriers. If tariffs are to be applied to Irish cheddar exports, this would cost the producers around €161,899,848 per annum, should 2016 export volumes be maintained (Ibec case study).[7] In addition to the cost implications, the consequences of non-tariff barriers, concerning trade flow and accessibility to the UK market, cannot be ignored. Any applications for checking points at Irish or UK ports is expected to significantly affect truck waiting times at checkpoints, and in turn the shelf-life of cheese products.

2. Cheese supply-chain design

The design of the Irish cheese supply chain is complex; therefore, it relies on the frictionless nature of borders between Ireland and the UK. All Irish cheese products are reliant on Ornua, an agri-food cooperative, which markets and sells dairy products on behalf of its members. It owns a huge packaging and slicing manufacturing facility in Leek, Staffordshire, in the UK. Most Irish and even some British cheese is processed and packaged there. On the other hand, a tiny percentage of cheese is imported from GB and Northern Ireland (NI) and Continental Europe, from markets such as France and Italy. Most of the imported cheese is speciality cheese.

Beyond the UK and EU26 markets, the Irish cheese sector currently expects to expand into new markets in the Far East, such as Japan, South Korea, China, Northern Africa and the Middle East. The Japanese and South Korean markets have developed a taste for cheddar cheese. The design of new supply chains in these markets is supported within the EU. In the last two years, three FTAs, with Japan, South Korea and Vietnam, have been signed. Free Trades with

[4] Department of Agriculture, Food and the Marine (DAFM), 2019, Annual Review and Outlook for Agricultural, Food and the Marine

[5] Department of Agriculture, Food and the Marine (DAFM), 2019, Fact Sheet on Irish Agriculture

[6] Bord Bia, 2019, Export Performance & Prospects

[7] Ibec, 2018, Cheddar Type Cheese – A Brexit Case Study.

Indonesia and Malaysia are also being investigated by the EU, with possibilities to extend Irish cheese supply chains there in the future. In this context, Irish cheese stakeholders are working to adapt their cheese supply chains with regard to transportation modes, storage strategies and contracting to serve these new markets. Brexit is seen as an opportunity for the cheese companies to change their market typology and address their over-reliance on the UK market.

3. *Brexit implications for cheese supply chains*

Irish maritime transport consists of a strategic route-to-market infrastructure, connecting the Republic of Ireland to most of its international markets. More than 90% of Ireland's global trade volumes move through its ports.[8] Apart from their close trade relationship, Ireland has historically relied on the UK road and ports network, known as the UK land-bridge, as its primary route-to-market to mainland Europe. The UK land-bridge is favoured by cheese supply chains as it offers a border-free route with high-frequency short-sea crossings and faster transit times than alternative direct routes to mainland Europe.

The uncertainty which Brexit brings has called the efficiency of the land-bridge into question. Depending on which FTA is reached between the UK and the EU, which specific EU rules and procedures will be used remains uncertain. The most complex of these are in regard to Sanitary and Phytosanitary Standards (SPS) controls on products of animal origin. It is envisaged that, in tandem with the throughput rates at ports, along with overall transit times from Irish cheese manufacturing sites, getting cheese products to their final destination in the UK market will take much longer. Any increase in delivery times would severely affect the shelf-life of short-life-cycle cheese produce (i.e. soft cheese). According to the Food Safety Authority of Ireland (FSAI), the shelf-life of some soft cheeses can be less than one week. There is a high risk of supporting the growth of harmful L monocytogenes if shelf-life decreases or storage conditions deteriorate.[9] Even a 24hr delay at a port can decrease shelf-life by 20% and increase the risk of harmful pathogen growth.

Therefore, this case study aims to analyse and quantify the potential disruptions involved in both transportation time and shelf-life for each of the following post-Brexit scenarios:

1) Introduction of new non-tariff barriers at Irish and UK ports

2) Use of direct shipping services to Continental Europe as an alternative to the UK land-bridge

3) Deficit of checking infrastructure at UK ports

4. *Methodology*

The methodology of the study is designed based on different data sources and modelling activities. This includes interviews with professionals and experts from the sector, simulation model development, and scenario mapping and analysis. A series of interviews were conducted with Irish-based cheese exporters along with two directors of the dairy industry trade association (Ibec). These interviews aimed to gain better understanding of the Irish

[8] IMDO, 2019, Irish Maritime Transport Economist, Volume 16.
[9] Food Safety Authority of Ireland (SAFI), 2019, Validation of Product Shelf-life.

cheese sector and its trade determinants. A review of key statistics related to cheese trade figures was conducted in parallel, to frame the broader context of the Irish cheese trade. Relevant Irish and EU statistics, particularly CSO, Eurostat, CLAL[10] databases and OECD statistics, were used. A presentation of the case study was presented and distributed to both the interviewees and the involved state agencies (i.e. the Revenue, DAFM and DTTAS) for review and further comments. Telephone conversations were also conducted with industrial stakeholders from the Irish cheese sector to fill in gaps identified in the available information. (For more information about the research methodology please refer to Chapter 3.)

5. *Scenario mapping and results analysis*

In this case study, a number of potential scenarios are presented to quantify the extent of Brexit impact on the Cheese export sector in Ireland. Information from literature, expert opinions and trade trends of the cheese sector were collected to define the scenarios settings and related assumptions.

- *Scenario 1: Introducing non-tariff barriers*

Brexit could lead to the reintroduction of border controls, customs and rules of origin between the UK and the EU27 (i.e. non-tariff barriers). The UK announced on 12 June 2020 that all border controls for inbound goods from the EU27 into the UK will be introduced at the end of the transition period. However, the new border checks will be rolled out in three stages, to give businesses affected by Covid-19 more time to prepare. From July 2021, all inbound trucks will have to make the required declarations at UK ports. An increase in physical checks and the taking of samples for all SPS commodities (including cheese products) is expected. Besides, all security and safety checks will be applied.[11]

Different levels of checks were investigated to understand the effects of these arrangements on the Irish cheese supply chain, including: 1) No border checks (As-Is situation), 2) Limited Check delay, 3) Moderate Check delay, and 4) High Check delay. To mimic these scenarios, it is assumed that a certain proportion of inbound trucks will be subjected to documentary and physical examinations as well as transit checks at UK ports, as illustrated in Table 1. In the four scenarios, it was assumed that transit checks would be subjected to all trucks (including the trucks that carry cheese) using the UK land-bridge to Continental Europe.

[10] CLAL is an Italian dairy economic consulting firm that analyses the European market.
[11] GOV.UK, 2020, Border planning by the end of the transition period, https://www.gov.uk/government/news/government-accelerates-border-planning-for-the-end-of-the-transition-period.

Table 1: Scenario mapping of border checks delay scenarios

Scenario Levels	Scenario Mapping using Simulation Model
No border checks (As-Is situation)	• No checks are applied on inbound trucks at UK ports, including cheese trucks.
Limited Check Delay	• No customs interventions to most export products to the UK. 90% of inbound vehicles are directed to the green route at UK ports. Non-physical checks are assumed to be applied before the arrival of trucks at the ports. • Few agri-food trucks are selected for SPS checks at UK ports (i.e. 10% of trucks, including cheese trucks). This minimal level of intervention is envisaged if the EU and UK reach an agreement that minimises the regulatory divergence. The duration of SPS checks is assumed to be one hour per truck in this scenario. • Documentary checks for non-Agri food trucks and documentary and sealed identity checks for agri-food trucks (including cheese) at UK ports are assumed to take 20 minutes. The scenario assumes that drivers and operators are highly familiar with the new border check procedures, and also assumes minimum administrative errors (correct declarations and certificates).
Moderate Check Delay	• More custom interventions for exports to the UK market are assumed. 80% of outbound vehicles are directed to the green route. More documentary checks are assumed to take place on the arrival of trucks at UK ports. • More agri-food trucks are selected for SPS checks at UK ports (i.e. 20% of trucks, including cheese trucks). This level of intervention is assumed if the EU and the UK fail to reach an agreement which minimises regulatory divergence. SPS check time is assumed to increase to 90 minutes per truck. • Documentary checks for non-Agri food trucks and documentary and sealed identity checks for agri-food trucks (including cheese) are assumed to take 30 minutes per truck. The scenario assumes that drivers and operators are moderately familiar with the new border control procedures, with more administrative errors (correct declarations and certificates) compared to the Limited-Check-Delay scenario.
High Check Delay	• High custom interventions are assumed in this scenario at UK ports (i.e. 70% of incoming vehicles are directed to the green route). • More agri-food trucks are selected for SPS checks at UK ports (i.e. 30% of trucks, including cheese trucks). This scenario presents the worst-case if no trade agreement is achieved. Large regulatory divergence is expected which could cause longer check delays. SPS check delay is assumed to increase to 135 minutes per truck. • Documentary checks for non-Agri food trucks and documentary and sealed identity checks for agri-food trucks are assumed to take 45 minutes per truck. The scenario assumes that drivers and operators are not familiar with the new border control procedures or the transit check technologies; a high level of administrative errors (correct declarations and certificates) is assumed occurred compared to the Moderate-Check-Delay scenario.

As illustrated in Chapter 3, Table 3-8, it is assumed that the capacity of check facilities at Holyhead Port will be limited to 2 revenue sheds, 13 SPS inspection bays, and 2 sealed check booths. This assumption is based on the concerns raised by both shipping lines and business communities in regard to the limited space at Holyhead. There is concern that Holyhead will be unable to accommodate the many check facilities required to carry out checks on the

immense volume of trade which flows through the port.[12] Non-tariff-barrier scenarios are evaluated using several measurement metrics, including average truck transportation time, remaining product shelf-life, and average waiting time of trucks at checkpoints. Please refer to Table 3-7, Chapter 3 for more information about measurement indicators.

The model outcomes revealed that the traffic for trucks carrying cheese from Ireland to the UK will not be significantly affected by the introduction of non-tariff barriers under *the Low-Check-Delay and Moderate-Check-Delay* scenarios, Figure 1. There is around a 7% and 14% increase in the average transportation time under both scenarios compared to the As-Is scenario. On the other hand, a big rise in average transportation time is observed in the *High-Check-Delay* scenario. The transportation time increased by 207% compared to the *Limited-Check scenario*.

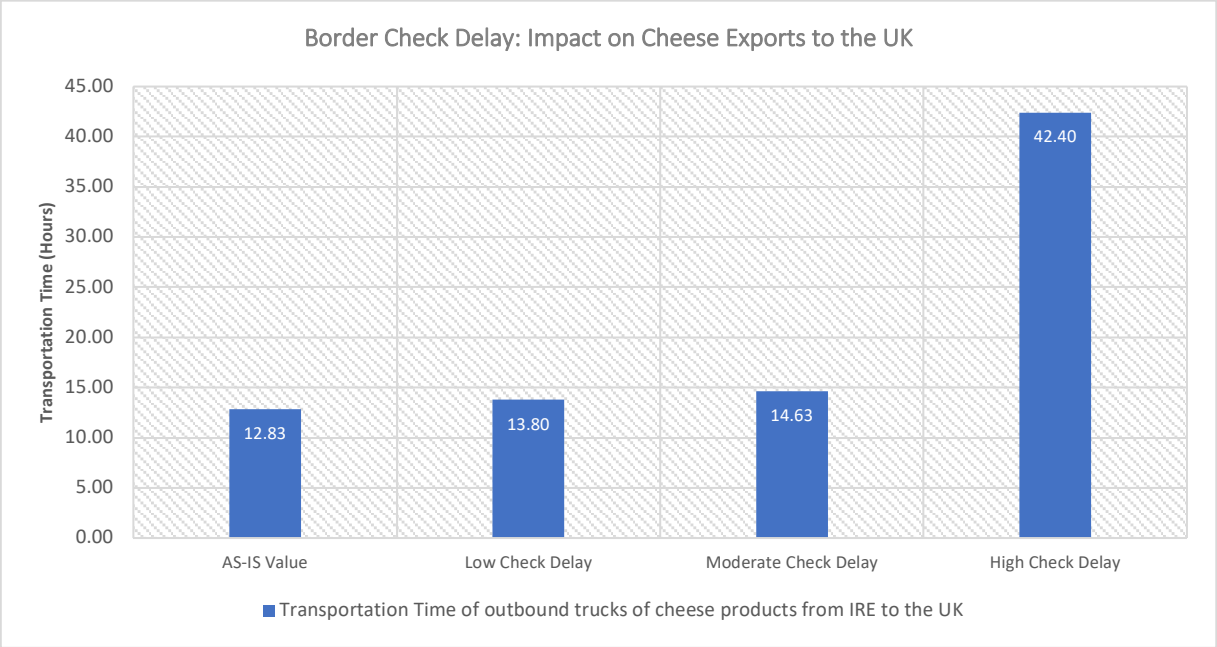

Figure 1: Impact of introducing new border checks on Irish exports at UK ports

Table 2 shows that the reason for the increase in transportation time is the long waiting times for trucks at Holyhead Port. The Dublin-Holyhead route is the most popular route among hauliers and logistics companies. The short shipping times between Dublin and Holyhead, along with the high sailing frequencies, facilitate the flow of high traffic volumes compared to other routes between Ireland and the UK. However, the limited space at the port constrains the development of adequate checks infrastructure. This in turn would affect whether the port can adequately fulfil the border check requirements for the high volume of trade between Dublin and Holyhead. Stena Line, the largest ferry operator in the Irish Sea, has made its concerns known regarding the readiness of this port and other UK ports in general. It believes that Holyhead Port, for instance, as the UK's second-largest port, is currently not fit to carry out SPS or freight checks due to limited space and checks infrastructure. Similar concerns were raised by experts in the cheese sector, emphasising the potential disruption in cheese exports

[12] Lloyd's Loading List, 2019, Holyhead 'absolutely not' ready for a no-deal Brexit.

to the UK if this scenario is realised. It is expected that such a situation would cause longer transit times for cheese products into the UK market. This, in turn, affects the shelf-life and competitive advantage of those products. The delay under the High-Check Delay scenario caused a reduction in the remaining shelf-life of cheese products of 94%, Figure2. This is under the assumption that the average cheese shelf-life is 30 days; the shelf-life of cheese products ranges from six months for hard cheese and less than a week for some soft cheese.

Table 2: Average waiting time per truck at UK ports checkpoints

Scenario	Truck waiting time for cheese exports at checkpoints in UK ports (hours)				
	Heysham	Liverpool	Holyhead	Fishguard	Pembroke
As-Is scenario	0.00	0.00	0.00	0.00	0.00
Limited Check Delay	0.12	0.05	0.84	0.16	0.00
Moderate Check Delay	0.6	0.50	4.72	0.6	0.00
High Check Delay	1.15	0.77	166.15	1.8	0.27

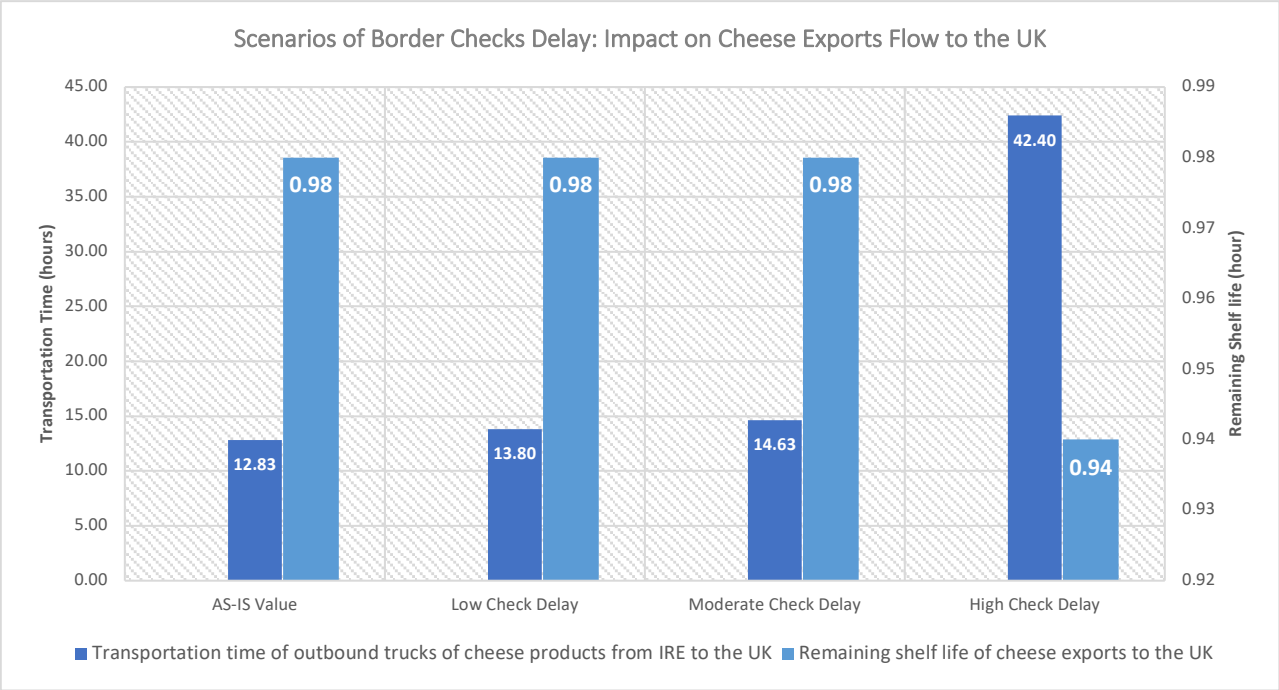

Figure 2: Remaining shelf-life of cheese products based on border check delay scenarios

Furthermore, business communities in the UK have warned that the British government is falling far short in training the targeted numbers of customs agents required following Brexit. These fears are shared by a logistics professional who works in the cheese sector. They believe that the UK does not have sufficient numbers of custom officials in place because of the delay in introducing upskill training courses for customs procedures.

The analysis concludes that special attention must be paid to the readiness of the checking infrastructure and resources capacity, which are both important factors in the efficiency of cheese supply chain after the transition period. Maintaining a smooth flow on the Dublin-

Holyhead route and preparing other routes between Ireland and the UK as alternatives to this route are described as substantial measures to mitigate the risk of long check delays. This effort would enable Irish exporters to maintain maximum cheese shelf-life and secure their competitive advantage and product values in the UK market.

- *Scenario 2: Land-bridge uncertainty – direct route feasibility*

The UK's strategies for dealing with Irish drivers and operators who use the UK land-bridge after the transition period are not clear, especially in terms of mutual recognition of documents, access to the UK road transport market, recognition of drivers' licences and operator permits, and fair treatment for Irish transport companies in the UK.[13] As a result, Irish haulage, logistics and supply-chain professionals expressed their concerns about the uncertainty surrounding the UK land-bridge. The analysis of this scenario aims to understand the effect of selecting either of the two maritime routes to Continental Europe – the UK land-bridge or the direct shipping service to Europe – on cheese exports to Europe and product shelf-life.

Four scenarios for the anticipated changes in demand for direct shipping services to Continental Europe will be examined. The As-Is scenario presents the current demand level on the UK land-bridge and direct shipping services to mainland Europe. The other three scenarios assume that demand from cheese exporters for direct shipping services to Europe will increase by 15%, 25% and 35% respectively. Four direct services between Ireland and mainland Europe are considered: Dublin-Cherbourg, Rosslare-Cherbourg, Dublin-Rotterdam and Dublin-Zeebrugge. The analysis assumes that a moderate transit check delay (15 minutes) will take place at the offices of transit in UK ports for all transit trucks between Ireland and the EU26 via the UK land-bridge. The assumption is based on expert opinion that the delays caused by the UK's transit checks may be minimised once the proposed transit check digital solutions[14] (i.e. Good Vehicle Movement Service (GVMS)) is implemented, and that the EU27 and the UK will agree on mutually recognising the documentation of drivers and operators. This will further facilitate movement via the land-bridge. Figure 3 compares the average transportation times of the trucks in transit to mainland Europe via the UK land-bridge versus the trucks directly shipped through Cherbourg, Rotterdam or Zeebrugge under the tested scenarios.

[13] FTAI Ireland, 2019, Brexit FTAI Position Paper.
[14] UK Government, 2020, The Border with the European Union: Importing and Exporting Goods.

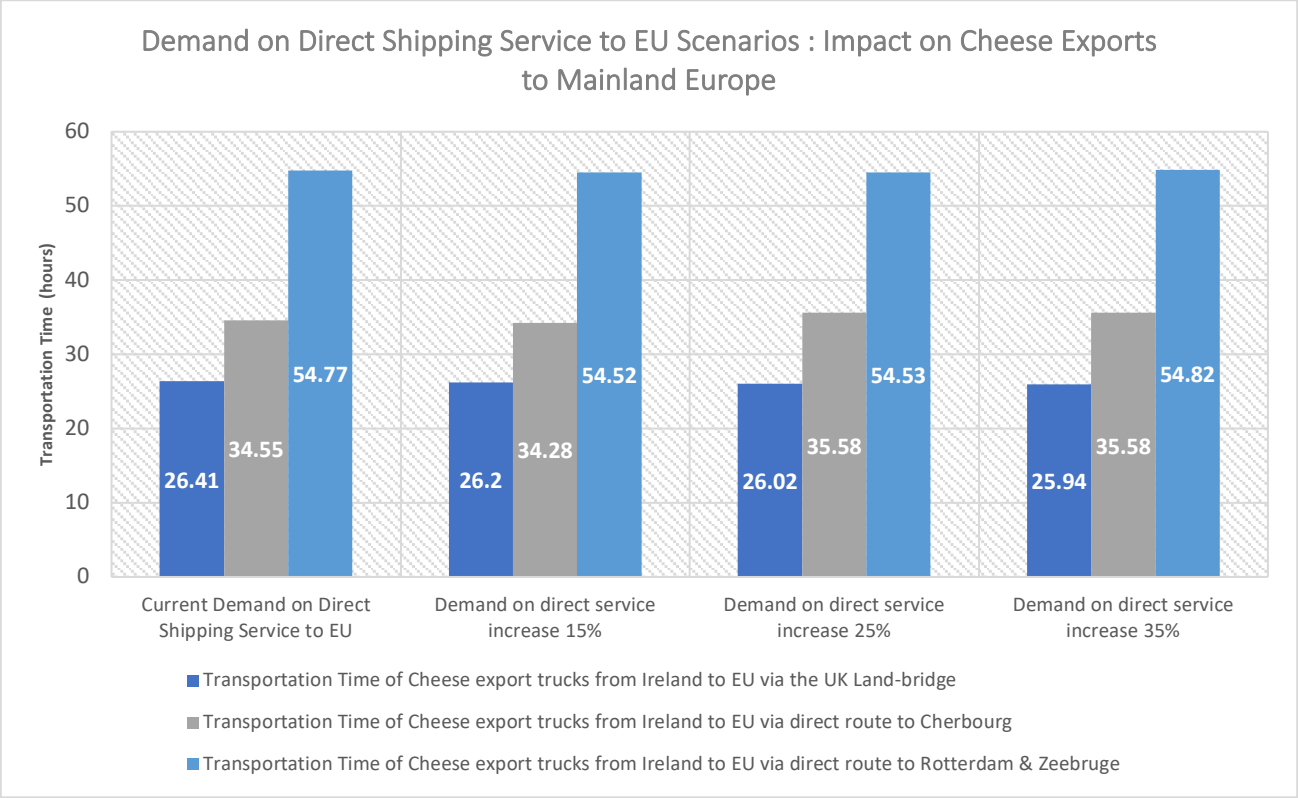

Figure 3: Truck flow via UK land-bridge vs direct route to Continental Europe

In all scenarios, despite running scenarios with a *moderate transit check delay* of 15 minutes per truck, selecting the UK land-bridge shortened truck transportation time by around 36% compared to using the shortest direct maritime route to Europe, the direct service to Cherbourg. This result supports the argument that outbound product flow will not be significantly affected by the introduction of new transit check with moderate check delay at UK ports. It is less likely that outbound traffic flow (including cheese exports) will experience bottlenecks at the offices of transit at western UK ports. The flow is distributed evenly across five ports (Heysham, Liverpool, Holyhead, Fishguard and Pembroke), which are assumed to have equivalent capacity for their offices of transit. Irish cheese exporters may consider this advantage and continue to exploit the east/west maritime corridor (i.e. maritime routes that link eastern Irish ports with western UK ports) and the UK land-bridge to enter the UK and EU26 markets. According to the model results, the corridor shows a reasonable transportation performance and provides Irish exporters with a competitive advantage in terms of product shelf-life and supply-chain efficiency, Figure 4.

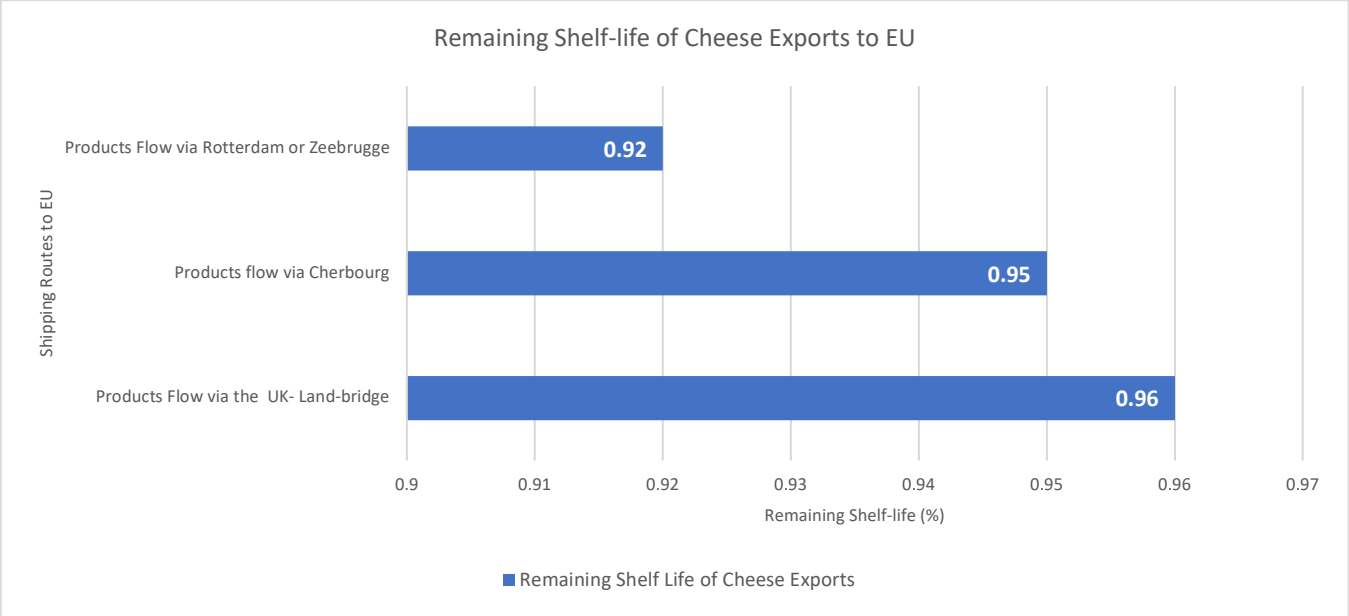

Figure 4: Remaining shelf-life of cheese products using different shipping services to Europe

However, this conclusion depends on the development of adequate checking capacity at western UK ports. The uncertainty regarding the preparedness of these ports to accommodate border transit checkpoints, along with the restrictions that would be imposed by the UK authorities after the transition period, increase the need for more consistent routes to Continental Europe. Although selecting the direct routes to the EU26 market could cause delays in product delivery, haulage and logistics companies will enjoy more certainty and better control over time by using these routes, particularly via Cherbourg, as an alternative to the UK land-bridge.

- *Scenario 3: Lack of checking infrastructure at western UK ports*

In the two previous scenarios, it was highlighted that, to maintain reasonable product shelf-life and decrease the transportation time between Ireland, the UK and Continental Europe, adequate checking space and infrastructure must be available at UK ports. As mentioned for the first scenario, Stena Line has expressed concerns about the adequacy of checking infrastructure at western UK ports, which may affect trade between Ireland and the UK. Stena Line owns three ports on the east/west maritime corridor. It is not yet clear what physical changes will be necessary to perform border checks.

The consequences of inadequate border checks infrastructure at the UK ports at the end of the transition period were tested in this scenario. After consultation with the experts and analysis, it was concluded that the absence of checks infrastructure at the UK ports could break the transportation link between Ireland and the UK in the future. This situation would have adverse implications for the cheese supply chain and its associated transportation network. The only exception to this scenario was Liverpool Port. This port is well equipped with check infrastructure as it is one of the main entry points to the UK for imports from outside the EU. The port enjoys large grounds, which means extensions to the infrastructure and development of new facilities are possible.

Therefore, four scenarios were suggested to investigate the situation if the UK ports are not prepared with adequate check facilities following the transition period. The maritime route between Irish ports (i.e. Dublin or Rosslare) and each of the UK ports (i.e. Heysham, Holyhead, Fishguard, and Pembroke) was suspended to show how unprepared these ports are. The traffic in each scenario will be diverted to the other ports, Figure 5.

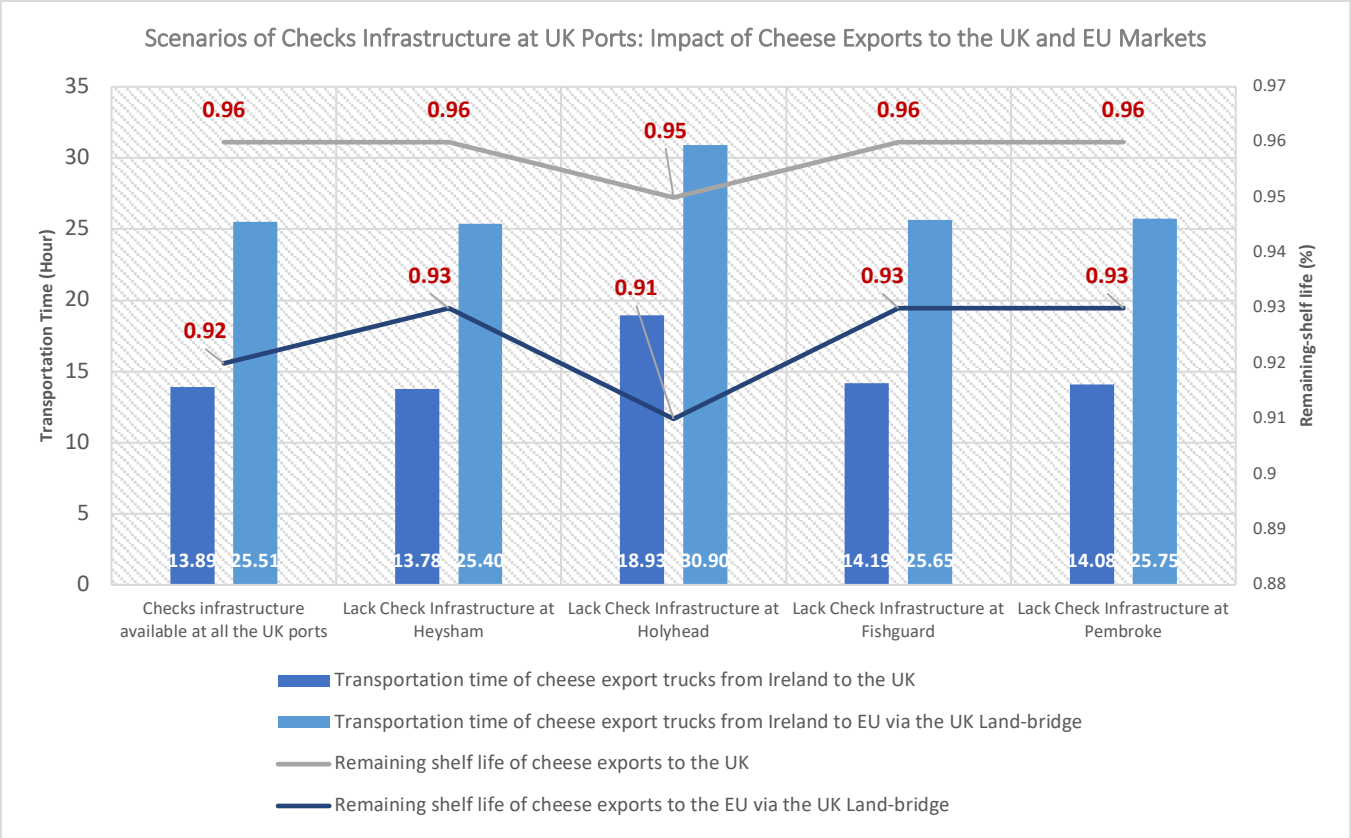

Figure 5: Checks infrastructure at UK ports: Impact on cheese exports

While insignificant implications were observed in the case of suspending the traffic through Dublin-Heysham, Rosslare-Fishguard and Rosslare-Pembroke, a considerable increase in transportation time arises when the Dublin-Holyhead route is suspended. Transportation time between Ireland and the UK increased by 35%, with a 21% increase in the journey time from Ireland to mainland Europe via the land-bridge. Diverting truck traffic from a short sea route (i.e. Dublin-Holyhead) to long sea routes (i.e. Dublin-Heysham or Dublin-Liverpool) added to the transportation time. Such outcomes would have consequences for the remaining shelf-life of cheese exported to both markets, in particular for shorter-shelf-life products. Exporters in this case revealed their plans to use Rosslare-Fishguard and Rosslare-Pembroke as alternative short-sea routes to Dublin-Holyhead to avoid the delay. However, the limited sailing frequency of the shipping services from Rosslare to the UK ports raises concerns about the feasibility of this strategy. The results show the strategic importance of the Dublin-Holyhead maritime route to the traffic along the east/west maritime corridor for the efficiency of the cheese supply chain.

6. *Industry response*

The overall analysis of the case study shows five main issues that concern industry:

1) Application of tariff barriers on cheese products traded with the UK

2) Introduction of non-tariff barriers and border checks at UK ports

3) Accessibility to Continental Europe via the UK land-bridge

4) Changes in shipping and transportation modes

5) Cost implications as a result of the delay at UK ports

The model results showed that, in the short to medium term, cheese shelf-life could be diminished if a high level of checks delay coupled with inadequate port preparations is experienced following the transition period. The final agreement between the EU and the UK will determine the nature and the scale of such an impact.

- *Expected trade barriers on cheese exports to the UK market*

Irish cheese exporters understand their over-reliance on the UK market. This reliance presents a risk given the high uncertainty that surrounds trade relations between Ireland and the UK following the end of the transition period. Therefore, market diversification is a top priority for Irish cheese producers, to provide alternative markets to the UK. For instance, by the year 2021, two large mozzarella factories are to be built in the south of Ireland, in Portlaoise and West Cork, by Glanbia and Carbery, as an effort to reduce reliance on the cheddar market in the UK. The combined output of these factories will be around 150,000 tonnes per annum, which will move Ireland from zero market share of mozzarella sales to one of the most prominent European players. Although Glanbia has a mozzarella site in Northern Ireland, using Northern Ireland milk, these sites will be the first of their kind in Ireland. In similar efforts, Irish producers also hope to tap the cheese market in Norway. Another cheese factory is to be built in East Cork by Dairygold, to produce a type of Norwegian cheese called Jarlsberg. This move is in response to the tastes and needs of the Norwegian market. However, this strategy of shifting the cheese market is not easy; it requires time to establish new supply-chain operations to comply with the required quality standards.

- *Non-tariff barriers effect*

Depending on which outcome is agreed upon, the application of EU rules and procedures, in regard to SPS controls on animals and animal products, remains uncertain. Therefore, throughput rates at ports and overall transit times from point of origin to final destination could be significantly higher. To date, this remains an unknown variable. Any border checks at Irish or UK ports are expected to influence accessibility to the UK market. The model results show that truck transportation time would dramatically increase – by around 2 days – if a high level of check delays is experienced at the UK ports, Figure 1. This delay is expected to increase if there is a lack of checking infrastructure or check facilities. To mitigate this risk, discussions between the EU27 and the UK must take place. The importance of minimising interventions

and delays to Irish agri-food exports (including cheese) at UK ports must be emphasised. A similar agreement to what the EU has with New Zealand, Switzerland and Canada would be suitable. This is emphasised by the outcomes of the model, where reducing the percentage of trucks selected for SPS checks substantially reduces the waiting and transportation time of trucks.

Finally, two-thirds of Irish cheese is exported to the food preparation and sandwich sector in the UK, which means only one-third goes to consumer shelves. The cheese supply chain is based on just-in-time dynamics where suppliers cannot afford to lose days of product shelf-life at distribution centres (this represents between 20% and 25% of product value). In the *High-Check-Delay* scenario, the remaining shelf-life of cheese products lost 6% compared to the *Low-Check-Delay* scenarios. Therefore, using refrigerated warehouses to build a buffer against the uncertainty and expected delays at the UK ports could be a solution to this challenge. However, the lack of refrigerated warehouse and the investment required to build and operate these facilities exclude this as a short-term or viable solution. Therefore, it is essential for the cheese industry to maintain transportation times and to maintain as few delays as possible. If a company loses a day or more trying to cross the Irish Sea to the UK market, this will have a severe impact on the product's value.

- *Land-bridge uncertainty and alternative maritime routes*

From the point of view of the cheese sectors, the land-bridge is the most significant maritime route to Continental Europe, given the just-in-time nature of consumer demand and the importance of shelf-life to the value of the product. By using the land-bridge, exporters have more control over delivery time and the safety of truck contents, while guaranteeing fast delivery to their clients, Figure 3.

However, the land-bridge's advantage will diminish if transit checks cause longer delays. Professionals from the sector have clearly stated that, if the advantage the land-bridge currently offers is lost, a direct route service to Continental Europe will be the only viable option, even if such routes take longer. Irish cheese supply chains have been engineered to provide customers with high-quality products on supermarket shelves, with the maximum lifespan left in the product. The model results showed that a 35% increase, approximately, in transportation times can be expected if direct maritime services to Europe (i.e. Dublin-Cherbourg or Rosslare-Cherbourg) are used compared with the land-bridge. The increase in transportation time via direct routes to mainland Europe could be accepted if better control over shipping times and consistent delivery time for the products is granted. The land-bridge cannot ensure consistency of product delivery if transit check delays are uncertain.

Commercial shipping operators have responded to the shift in business strategies towards direct shipping services to Europe as alternatives to the land-bridge route. CLdN, for instance, has increased its service capacity by 20% by adding the newly built ship MV Laureline to its direct Ro/Ro shipping services between Dublin and Rotterdam and Zeebrugge. The new ship

brought the total number of trips between Dublin and Continental Europe to seven a week.[15] Assessment by the Department of Transport, Tourism and Sport (DTTAS), along with the Irish Maritime Development Office (IMDO), is that shipping lines will quickly respond to any demand increasing for direct shipping services to Continental Europe post-transition and will provide sufficient capacity to satisfy demand.[16] It is hard to envisage the decision each company will make as it may be case by case, but, strategically speaking, options are being set in place.

- *Changes in shipping modes*

To maximise cheese shelf-life, different transportation strategies were discussed and analysed by the sector professionals and trade associations. For the short to medium term, using the Ro/Ro transportation mode is seen as the only current option for the Irish cheese industry. This option is found viable under the condition that special refrigerated trucks are employed to maintain cheese shelf-life. For chilled products, Ireland relies on quick turnaround time to its export markets because of the just-in-time nature of the supply chain. Because of the EU driving hours regulations, any delay for Ro/Ro trucks at borders has a significant effect on driver hours, and in turn how far a driver can drive. Such disruption could increase the overall cost of the products to consumers and producers and affect the competitiveness of certain businesses.

Using refrigerated containers (i.e. containerisation) to ship cheese products to Europe is discussed as an alternative transportation solution to avoid the risks of Ro/Ro transportation. Cheese products could be loaded into containers at Cork Port and then shipped to Rotterdam, and from there to the rest of Europe. However, this alternative need more advanced controls linked with the Enterprise Resource Planning (ERP) systems of individual companies to achieve effective planning and operations. It is described as a long-term mitigation strategy for Brexit risk. The sector looks at containerisation as a vital strategy to serve long-distance new markets. As mentioned, the EU has signed FTA agreements with big blocks in the Far East such as Japan, South Korea and China, and FTAs with the Middle East and North Africa are possible in the future. These agreements will facilitate the trade between the EU and those markets. In this context, Irish cheese companies are considering refrigerated containers as a replacement for roll-on roll-off transportation settings in order to facilitate the flow of Irish cheese exports to these markets.

- *Cost implications as a result of the expected delays*

There is also a worry that, if WTO rules come into effect following the transition period, significant additional cost would be incurred by cheese exporters, as tariffs and quotas on Irish dairy products is estimated to increase by 35.5%. In this case, the competitive advantage for Irish cheese would be greatly reduced compared to other cheese producers to the UK market, such as New Zealand. According to cheese exporters, the UK's number one objective in this

[15] Dublin Port, 2019, New Brexit buster sister ship "MV Laureline" expands Dublin port's direct route cargo sailings to Europe.

[16] Government of Ireland, 2019, Preparing for the withdrawal of the UK from the EU: Contingency action plan.

regard would be to avoid an ‘empty shelf’ situation. There would be no loyalty to cheese producers, regardless of who is the supplier or the design of the supply chain.

Aside from apparent costs such as those associated with customs declarations, there is the issue of the products themselves. Dairy products such as cheese and butter must be refrigerated even for short distances and hence must be transported in specialised containers and trucks. They thus cost more to transport. As shipping amounts to around 4% of the overall cost for companies, this could be a significant increase. There is also the issue of refrigerated warehouses availability, in relation to the shelf-life of cheese products. In the event of a day lost, for example, the costs have yet to be calculated precisely. A direct effect on driver cost, truck fuel, maintenance costs, waiting and parking costs, and other operational costs, would be expected. It is believed, however, that a high cost to the producer will result.